To view this meeting, the livestream link is: https://vimeo.com/event/729428

To make a public comment, the call in number is (US) 1-605-412-4100

The PIN is 247 505 437#

Board of Education
April 18, 2023

BOE Conference Room
6:30 p.m.-Executive Session
Council Chambers
7:30 p.m.-Public Session

As citizens of our community, we will conduct ourselves in accordance with Newtown's Core Character Attributes as displayed in our character tree. We will be responsible for our actions and show respect for each other. We will interact peacefully, productively, and politely. We will be trustworthy and honest and show compassion toward others. Newtown's continued success is contingent upon our ability to persevere, to follow through with our commitments, and to stay focused on the greater good.

A G E N D A

Item 1 EXECUTIVE SESSION
- Discussion of Confidential Attorney/Client Privileged Material in Regards to Board Policy

Item 2 PLEDGE OF ALLEGIANCE

Item 3 CONSENT AGENDA
- Donation to Newtown High School
- Correspondence Report

Item 4 **PUBLIC PARTICIPATION

Item 5 REPORTS
- Chair Report
- Superintendent's Report
- Committee Reports
- Student Representative Reports
- Action on Financial Report and Transfers Month Ending March 31, 2023
- Grants and Funding Updates

Item 6 PRESENTATIONS
- First Read of Integrated Physical and Earth Science Curriculum

Item 7 OLD BUSINESS
- Strategic Plan Update
- Second Read and Possible Action on Policy 5114 Suspension and Expulsion/Due Process
- Second Read and Possible Action on Chemistry (CPA Honors) Curriculum
- Second Read and Possible Action on Multivariable Calculus Curriculum

Item 8 NEW BUSINESS
- Action on Minutes of April 4, 2023

Item 9 **PUBLIC PARTICIPATION

Item 10 ADJOURNMENT

***The Board encourages the public to share thoughts and concerns at two points during Regular Meetings. During the first Public Participation, the Board welcomes commentary regarding items on the agenda. During the second Public Participation, commentary may also include issues for the Board to consider in the future. After being recognized, please state your name and address for the record. We request that speakers be respectful and limit comments to three minutes. The Board of Education does not discuss personnel items or student matters in public nor does it engage in dialogue during either public comment period. If you desire more information or responses to specific questions, please email the Board.*

April 3, 2023

TO: Chris Melillo

FROM: Kim Longobucco

Please accept the donation of $2,023 from Mr. and Mrs. Beylouni. This is a very generous gift to the Newtown High School Senior Class of 2023. Newtown High senior students will certainly benefit from this donation.

Thank you.

David Beylouni
Melissa Beylouni
15 Equestrian Road
Newtown, CT 06470

NEWTOWN BOARD OF EDUCATION
MONTHLY FINANCIAL REPORT
MARCH 31, 2023

SUMMARY

The ninth financial report for the year continues to provide year to date expenditures, encumbrances and information for anticipated obligations. Many of the accounts within our major objects have been forecasted as "full budget spend" in order to more accurately project an estimated year-end balance. These balances are monitored closely and adjusted each month in order to capture any changes and fluctuations that occur throughout the year.

During the month of March, the district spent approximately $6.1M for all operations. About $4.0M was spent on salaries with the remaining balance of $2.1M on all other objects. All expenditures appear to be within normal limits at this time.

The change over the last month's year-end projection has resulted in an increase of $87,519 now showing a total projected balance of $578,833.

TRANSFERS

We are requesting a transfer of $33,000 from the surplus in transportation to cover the network wiring that is needed at the Hawley school. The replacement of this wire is essential in order to provide continuous and uninterrupted network coverage. Also, because the school is currently undergoing HVAC renovations, we have open access to the ceilings making this the perfect time to install the new wiring.

MAJOR MOVERS

SALARY OBJECT

The overall salary object currently displays a positive position of $508,130, increasing slightly by $53,156 over the prior month.

This area of our budget continues to drive the projected year-end balance. At this time, we are anticipating that many of our unfilled positions that follow the student year; such as, paraprofessionals and behavioral therapists will most likely remain open. We have also made some adjustments for teachers on leave, homebound tutors, as well as some of our open positions found in the non-certified group. These adjustments have all contributed to the increase in balance.

OTHER PURCHASED SERVICES – the overall position of this object is displaying a negative balance of -$481,831, having incurred additional costs of $74,177 over the prior month.

- **Contracted services** - this account has incurred additional expenditures of $89,211. The majority of this is coming from additional costs for contracted behavioral therapists. Over the prior month, we have incurred an additional $60,000 in encumbrances for these services and this continues to be an area of concern as we have been unsuccessful in filling our vacant positions. We are hopeful to fill some of our open positions before year-end and if that happens, we can lower this encumbrance.

SUPPLIES – the overall balance here is in a positive position, increasing over the prior month by $87,000 and showing a balance of $401,000.

- **Electric** – this account now shows a positive balance of $387,000. Due to the increase in the Eversource energy supply rate, we continue to experience additional credits as this rate has not yet been lowered. We anticipate that this balance may increase before year-end and we will be keeping a close eye on this account.

- **Fuel for Vehicles –** I am please to announce that we have received a check from the federal government for the use of alternative transportation fuel (propane for our buses) in the amount of $76,627.55. This program runs on a calendar year and the credit was for the 2022 year. We also anticipate to receive the remaining balance from the 2021 year in the amount of $40,445.75. If you recall, this was mentioned a few months back when we received a portion of this credit. The federal government inadvertently applied this amount to our payroll taxes. However, after going back-and-forth with them over the past few months, we have finally received an acknowledgement from them and they will be sending us the balance.

  Please note that the credit for $76,627.55 has not been included in this report; however, it will be included in the fuel balance next month. The 2021 credit will be given to the Town and will not be applied to our balance since it is from the prior year.

ALL OTHER OBJECTS
All other objects are currently in good standing and we will continue our account analysis throughout the year.

REVENUE
The board of education received $4,101.63 in tuition.

Tanja Vadas
Director of Business
April 11, 2023

NEWTOWN BOARD OF EDUCATION
2022-23 BUDGET SUMMARY REPORT
FOR THE MONTH ENDING MARCH 31, 2023

OBJECT CODE	EXPENSE CATEGORY	EXPENDED 2021 - 2022	2022 - 2023 APPROVED BUDGET	YTD TRANSFERS 2022 - 2023	CURRENT BUDGET	YTD EXPENDITURE	ENCUMBER	BALANCE	ANTICIPATED OBLIGATIONS	PROJECTED BALANCE	% EXP
	GENERAL FUND BUDGET										
100	**SALARIES**	$ 51,681,024	$ 53,701,233	$ (12,875)	$ 53,688,358	$ 34,343,142	$ 18,044,811	$ 1,300,405	$ 792,275	**$ 508,130**	99.05%
200	**EMPLOYEE BENEFITS**	$ 11,744,808	$ 11,955,016	$ 249	$ 11,955,265	$ 9,055,018	$ 2,180,845	$ 719,403	$ 726,452	**$ (7,049)**	100.06%
300	**PROFESSIONAL SERVICES**	$ 543,087	$ 687,141	$ (14,000)	$ 673,141	$ 373,765	$ 48,325	$ 251,051	$ 247,622	**$ 3,428**	99.49%
400	**PURCHASED PROPERTY SERV.**	$ 2,093,569	$ 1,814,663	$ -	$ 1,814,663	$ 1,154,950	$ 379,204	$ 280,509	$ 225,355	**$ 55,154**	96.96%
500	**OTHER PURCHASED SERVICES**	$ 9,327,010	$ 10,095,326	$ 26,626	$ 10,121,952	$ 7,454,009	$ 2,868,384	$ (200,441)	$ 281,390	**$ (481,831)**	104.76%
600	**SUPPLIES**	$ 3,474,903	$ 3,365,464	$ -	$ 3,365,464	$ 2,339,096	$ 160,333	$ 866,035	$ 465,035	**$ 401,000**	88.08%
700	**PROPERTY**	$ 536,285	$ 339,710	$ -	$ 339,710	$ 140,020	$ 10,374	$ 189,316	$ 189,316	**$ -**	100.00%
800	**MISCELLANEOUS**	$ 59,271	$ 76,086	$ -	$ 76,086	$ 71,034	$ 1,819	$ 3,233	$ 3,233	**$ -**	100.00%
910	**SPECIAL ED CONTINGENCY**	$ -	$ 100,000	$ -	$ 100,000	$ -	$ -	$ 100,000	$ -	**$ 100,000**	0.00%
	TOTAL GENERAL FUND BUDGET	$ 79,459,957	$ 82,134,639	$ -	$ 82,134,639	$ 54,931,033	$ 23,694,095	$ 3,509,511	$ 2,930,678	**$ 578,833**	99.30%
900	**TRANSFER NON-LAPSING** *(unaudited)*	$ 237,879				$ (6,119,190)					
	GRAND TOTAL	$ 79,697,836	$ 82,134,639	$ -	$ 82,134,639	$ 48,811,843	$ 23,694,095	$ 3,509,511	$ 2,930,678	$ 578,833	91.85%

NEWTOWN BOARD OF EDUCATION
2022-23 BUDGET SUMMARY REPORT
FOR THE MONTH ENDING MARCH 31, 2023

OBJECT CODE	EXPENSE CATEGORY	EXPENDED 2021 - 2022	2022 - 2023 APPROVED BUDGET	YTD TRANSFERS 2022 - 2023	CURRENT BUDGET	YTD EXPENDITURE	ENCUMBER	BALANCE	ANTICIPATED OBLIGATIONS	PROJECTED BALANCE	% EXP
100	**SALARIES**										
	Administrative Salaries	$ 4,245,732	$ 4,312,038	$ (121,271)	$ 4,190,767	$ 3,044,749	$ 1,146,632	$ (614)	$ 7,185	$ (7,798)	100.19%
	Teachers & Specialists Salaries	$ 32,745,539	$ 33,817,522	$ 149,271	$ 33,966,793	$ 20,926,881	$ 12,986,906	$ 53,006	$ 72,223	$ (19,217)	100.06%
	Early Retirement	$ 81,000	$ 81,000	$ -	$ 81,000	$ 89,000	$ -	$ (8,000)	$ -	$ (8,000)	109.88%
	Continuing Ed./Summer School	$ 96,279	$ 97,846	$ 1,161	$ 99,007	$ 84,833	$ 13,680	$ 494	$ 494	$ -	100.00%
	Homebound & Tutors Salaries	$ 104,026	$ 189,413	$ 45,185	$ 234,598	$ 115,245	$ 41,840	$ 77,512	$ 47,512	$ 30,000	87.21%
	Certified Substitutes	$ 677,354	$ 742,610	$ -	$ 742,610	$ 556,510	$ 114,705	$ 71,395	$ 118,045	$ (46,650)	106.28%
	Coaching/Activities	$ 659,048	$ 737,184	$ -	$ 737,184	$ 392,433	$ 4,000	$ 340,751	$ 320,751	$ 20,000	97.29%
	Staff & Program Development	$ 188,833	$ 155,128	$ -	$ 155,128	$ 50,899	$ 19,401	$ 84,827	$ 81,178	$ 3,649	97.65%
	CERTIFIED SALARIES	$ 38,797,811	$ 40,132,741	$ 74,346	$ 40,207,087	$ 25,260,550	$ 14,327,165	$ 619,372	$ 647,388	$ (28,016)	100.07%
	Supervisors & Technology Salaries	$ 1,010,203	$ 1,103,470	$ 4,960	$ 1,108,430	$ 747,875	$ 236,814	$ 123,741	$ 12,023	$ 111,718	89.92%
	Clerical & Secretarial Salaries	$ 2,305,020	$ 2,361,178	$ 200	$ 2,361,378	$ 1,639,916	$ 678,425	$ 43,037	$ 1,050	$ 41,987	98.22%
	Educational Assistants	$ 2,751,027	$ 2,965,151	$ 47,602	$ 3,012,753	$ 2,018,428	$ 867,117	$ 127,208	$ 8,000	$ 119,208	96.04%
	Nurses & Medical Advisors	$ 939,312	$ 902,273	$ 31,615	$ 933,888	$ 552,579	$ 335,264	$ 46,045	$ 14,226	$ 31,820	96.59%
	Custodial & Maint. Salaries	$ 3,218,689	$ 3,395,484	$ (45,604)	$ 3,349,880	$ 2,322,487	$ 932,374	$ 95,019	$ 18,742	$ 76,278	97.72%
	Non-Certied Adj & Bus Drivers Salaries	$ -	$ 155,981	$ (155,981)	$ -	$ -	$ -	$ -	$ -	$ -	#DIV/0!
	Career/Job Salaries	$ 122,065	$ 171,116	$ 4,257	$ 175,373	$ 108,964	$ 75,791	$ (9,381)	$ (11,181)	$ 1,800	98.97%
	Special Education Svcs Salaries	$ 1,348,349	$ 1,456,181	$ 20,937	$ 1,477,118	$ 943,395	$ 416,145	$ 117,579	$ 2,552	$ 115,027	92.21%
	Security Salaries & Attendance	$ 684,773	$ 679,888	$ 293	$ 680,181	$ 459,300	$ 174,264	$ 46,617	$ 2,902	$ 43,716	93.57%
	Extra Work - Non-Cert.	$ 119,364	$ 109,770	$ 4,500	$ 114,270	$ 77,554	$ 1,453	$ 35,262	$ 34,528	$ 735	99.36%
	Custodial & Maint. Overtime	$ 356,554	$ 236,000	$ -	$ 236,000	$ 186,352	$ -	$ 49,648	$ 55,790	$ (6,142)	102.60%
	Civic Activities/Park & Rec.	$ 27,857	$ 32,000	$ -	$ 32,000	$ 25,743	$ -	$ 6,257	$ 6,257	$ -	100.00%
	NON-CERTIFIED SALARIES	$ 12,883,213	$ 13,568,492	$ (87,221)	$ 13,481,271	$ 9,082,592	$ 3,717,646	$ 681,033	$ 144,886	$ 536,146	96.02%
	SUBTOTAL SALARIES	**$ 51,681,024**	**$ 53,701,233**	**$ (12,875)**	**$ 53,688,358**	**$ 34,343,142**	**$ 18,044,811**	**$ 1,300,405**	**$ 792,275**	**$ 508,130**	99.05%
200	**EMPLOYEE BENEFITS**										
	Medical & Dental Expenses	$ 8,538,506	$ 8,790,863	$ (12,125)	$ 8,778,738	$ 6,604,387	$ 2,160,595	$ 13,756	$ 10,979	$ 2,777	99.97%
	Life Insurance	$ 88,568	$ 87,000	$ -	$ 87,000	$ 67,067	$ -	$ 19,933	$ 19,933	$ -	100.00%
	FICA & Medicare	$ 1,624,911	$ 1,706,549	$ -	$ 1,706,549	$ 1,110,006	$ -	$ 596,543	$ 596,543	$ -	100.00%
	Pensions	$ 954,029	$ 852,347	$ 25,000	$ 877,347	$ 824,044	$ 250	$ 53,053	$ 69,997	$ (16,944)	101.93%
	Unemployment & Employee Assist.	$ 102,469	$ 81,600	$ -	$ 81,600	$ 25,600	$ 20,000	$ 36,000	$ 29,000	$ 7,000	91.42%
	Workers Compensation	$ 436,325	$ 436,657	$ (12,626)	$ 424,031	$ 423,914	$ -	$ 117	$ -	$ 117	99.97%
	SUBTOTAL EMPLOYEE BENEFITS	**$ 11,744,808**	**$ 11,955,016**	**$ 249**	**$ 11,955,265**	**$ 9,055,018**	**$ 2,180,845**	**$ 719,403**	**$ 726,452**	**$ (7,049)**	100.06%

NEWTOWN BOARD OF EDUCATION
2022-23 BUDGET SUMMARY REPORT
FOR THE MONTH ENDING MARCH 31, 2023

OBJECT CODE	EXPENSE CATEGORY	EXPENDED 2021 - 2022	2022 - 2023 APPROVED BUDGET	YTD TRANSFERS 2022 - 2023	CURRENT BUDGET	YTD EXPENDITURE	ENCUMBER	BALANCE	ANTICIPATED OBLIGATIONS	PROJECTED BALANCE	% EXP
300	**PROFESSIONAL SERVICES**										
	Professional Services	$ 404,089	$ 493,643	$ -	$ 493,643	$ 302,934	$ 33,900	$ 156,809	$ 176,981	$ (20,172)	104.09%
	Professional Educational Serv.	$ 138,998	$ 193,498	$ (14,000)	$ 179,498	$ 70,831	$ 14,425	$ 94,242	$ 70,642	$ 23,600	86.85%
	SUBTOTAL PROFESSIONAL SERV.	**$ 543,087**	**$ 687,141**	**$ (14,000)**	**$ 673,141**	**$ 373,765**	**$ 48,325**	**$ 251,051**	**$ 247,622**	**$ 3,428**	99.49%
400	**PURCHASED PROPERTY SERV.**										
	Buildings & Grounds Contracted Svc.	$ 672,697	$ 683,600	$ -	$ 683,600	$ 482,391	$ 161,250	$ 39,960	$ 27,140	$ 12,820	98.12%
	Utility Services - Water & Sewer	$ 160,597	$ 144,770	$ -	$ 144,770	$ 84,425	$ -	$ 60,345	$ 38,845	$ 21,500	85.15%
	Building, Site & Emergency Repairs	$ 710,231	$ 450,000	$ -	$ 450,000	$ 283,192	$ 120,469	$ 46,340	$ 46,340	$ -	100.00%
	Equipment Repairs	$ 289,596	$ 269,051	$ -	$ 269,051	$ 142,707	$ 45,346	$ 80,998	$ 72,598	$ 8,400	96.88%
	Rentals - Building & Equipment	$ 260,448	$ 267,242	$ -	$ 267,242	$ 162,236	$ 52,139	$ 52,867	$ 40,432	$ 12,434	95.35%
	Building & Site Improvements	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
	SUBTOTAL PUR. PROPERTY SERV.	**$ 2,093,569**	**$ 1,814,663**	**$ -**	**$ 1,814,663**	**$ 1,154,950**	**$ 379,204**	**$ 280,509**	**$ 225,355**	**$ 55,154**	96.96%
500	**OTHER PURCHASED SERVICES**										
	Contracted Services	$ 1,019,495	$ 886,545	$ 153,754	$ 1,040,299	$ 837,936	$ 227,168	$ (24,806)	$ 90,588	$ (115,394)	111.09%
	Transportation Services	$ 4,229,179	$ 4,919,428	$ (139,754)	$ 4,779,674	$ 3,132,416	$ 1,034,779	$ 612,479	$ 461,479	$ 151,000	96.84%
	Insurance - Property & Liability	$ 425,660	$ 422,766	$ 12,626	$ 435,392	$ 406,079	$ 37,210	$ (7,897)	$ -	$ (7,897)	101.81%
	Communications	$ 189,488	$ 152,524	$ -	$ 152,524	$ 117,539	$ 44,101	$ (9,116)	$ (1,061)	$ (8,055)	105.28%
	Printing Services	$ 19,859	$ 24,789	$ -	$ 24,789	$ 13,404	$ 4,620	$ 6,765	$ 2,531	$ 4,234	82.92%
	Tuition - Out of District	$ 3,252,787	$ 3,450,187	$ -	$ 3,450,187	$ 2,777,923	$ 1,504,049	$ (831,784)	$ (309,762)	$ (522,022)	115.13%
	Student Travel & Staff Mileage	$ 190,540	$ 239,087	$ -	$ 239,087	$ 168,711	$ 16,457	$ 53,919	$ 37,616	$ 16,303	93.18%
	SUBTOTAL OTHER PURCHASED SERV.	$ 9,327,010	$ 10,095,326	$ 26,626	$ 10,121,952	$ 7,454,009	$ 2,868,384	$ (200,441)	$ 281,390	$ (481,831)	104.76%
600	**SUPPLIES**										
	Instructional & Library Supplies	$ 799,649	$ 854,242	$ -	$ 854,242	$ 673,690	$ 113,724	$ 66,828	$ 66,828	$ -	100.00%
	Software, Medical & Office Supplies	$ 217,455	$ 194,940	$ -	$ 194,940	$ 161,800	$ 8,800	$ 24,340	$ 24,340	$ -	100.00%
	Plant Supplies	$ 423,279	$ 366,100	$ -	$ 366,100	$ 306,219	$ 19,609	$ 40,272	$ 35,272	$ 5,000	98.63%
	Electric	$ 995,294	$ 1,022,812	$ (93,500)	$ 929,312	$ 527,690	$ -	$ 401,622	$ 14,622	$ 387,000	58.36%
	Propane & Natural Gas	$ 415,377	$ 424,980	$ 40,000	$ 464,980	$ 334,917	$ -	$ 130,063	$ 149,063	$ (19,000)	104.09%
	Fuel Oil	$ 88,194	$ 63,000	$ 53,500	$ 116,500	$ 62,780	$ -	$ 53,720	$ 38,720	$ 15,000	87.12%
	Fuel for Vehicles & Equip.	$ 191,173	$ 216,258	$ -	$ 216,258	$ 145,304	$ -	$ 70,954	$ 57,954	$ 13,000	93.99%
	Textbooks	$ 344,482	$ 223,132	$ -	$ 223,132	$ 126,697	$ 18,199	$ 78,236	$ 78,236	$ -	100.00%
	SUBTOTAL SUPPLIES	$ 3,474,903	$ 3,365,464	$ -	$ 3,365,464	$ 2,339,096	$ 160,333	$ 866,035	$ 465,035	$ 401,000	88.08%

NEWTOWN BOARD OF EDUCATION
2022-23 BUDGET SUMMARY REPORT
FOR THE MONTH ENDING MARCH 31, 2023

OBJECT CODE	EXPENSE CATEGORY	EXPENDED 2021 - 2022	2022 - 2023 APPROVED BUDGET	YTD TRANSFERS 2022 - 2023	CURRENT BUDGET	YTD EXPENDITURE	ENCUMBER	BALANCE	ANTICIPATED OBLIGATIONS	PROJECTED BALANCE	% EXP
700	**PROPERTY**										
	Technology Equipment	$ 278,825	$ 156,024	$ -	$ 156,024	$ 95,692	$ -	$ 60,332	$ 60,332	$ -	100.00%
	Other Equipment	$ 257,460	$ 183,686	$ -	$ 183,686	$ 44,328	$ 10,374	$ 128,983	$ 128,983	$ -	100.00%
	SUBTOTAL PROPERTY	$ 536,285	$ 339,710	$ -	$ 339,710	$ 140,020	$ 10,374	$ 189,316	$ 189,316	$ -	100.00%
800	**MISCELLANEOUS**										
	Memberships	$ 59,271	$ 76,086	$ -	$ 76,086	$ 71,034	$ 1,819	$ 3,233	$ 3,233	$ -	100.00%
	SUBTOTAL MISCELLANEOUS	**$ 59,271**	**$ 76,086**	**$ -**	**$ 76,086**	**$ 71,034**	**$ 1,819**	**$ 3,233**	**$ 3,233**	**$ -**	100.00%
910	**SPECIAL ED CONTINGENCY**	**$ -**	**$ 100,000**	**$ -**	**$ 100,000**	**$ -**	**$ -**	**$ 100,000**	**$ -**	$ 100,000	0.00%
	TOTAL LOCAL BUDGET	**$ 79,459,957**	**$ 82,134,639**	**$ -**	**$ 82,134,639**	**$ 54,931,033**	**$ 23,694,095**	**$ 3,509,511**	**$ 2,930,678**	**$ 578,833**	99.30%
900	Transfer to Non-Lapsing	$ 237,741									
	GRAND TOTAL	**$ 79,697,698**	**$ 82,134,639**	**$ -**	**$ 82,134,639**	**$ 54,931,033**	**$ 23,694,095**	**$ 3,509,511**	**$ 2,930,678**	**$ 578,833**	**99.30%**

SPECIAL REVENUES

	EXCESS COST GRANT REVENUE	EXPENDED 2021-2022	APPROVED BUDGET	STATE PROJECTED 1-Jan	PROJECTED 1-Mar	ESTIMATED Total	VARIANCE to Budget	FEB DEPOSIT	MAY DEPOSIT	% TO BUDGET
51266	*Special Education Svcs Salaries ECG*	*$ (7,170)*		*$ (7,843)*	*$ (7,421)*	***$ (7,421)***	$ 7,421	$ (5,673)	$ (1,748)	#DIV/0!
54116	*Transportation Services - ECG*	*$ (333,218)*	$ (320,028)	*$ (469,245)*	*$ (468,874)*	***$ (468,874)***	$ 148,846	$ (358,435)	$ (110,439)	146.51%
54160	*Tuition - Out of District ECG*	*$ (1,193,144)*	$ (1,300,484)	*$ (1,348,899)*	*$ (1,315,145)*	***$ (1,315,145)***	$ 14,661	$ (1,005,383)	$ (309,762)	101.13%
	Total	*$ (1,533,532)*	$ (1,620,512)	*$ (1,825,987)*	*$ (1,791,440)*	***$ (1,791,440)***	$ 170,928	$ (1,369,491)	$ (421,949)	110.55%
								Total*	**$ (1,791,440)**	
								*75% of Jan Proj		
	SDE MAGNET TRASNPORTATION GRANT	*$ (9,100)*	*$ (13,000)*	*$ (13,000)*		***$ (13,000)***	$ -			100.00%

OTHER REVENUES

BOARD OF EDUCATION FEES & CHARGES - SERVICES	APPROVED BUDGET	ANTICIPATED	RECEIVED	BALANCE	% RECEIVED
LOCAL TUITION	$32,430	$32,430	$34,616	($2,186)	106.74%
HIGH SCHOOL FEES FOR PARKING PERMITS	$30,000	$30,000		$30,000	0.00%
MISCELLANEOUS FEES	$6,000	$6,000	$15,768	($9,768)	262.81%
TOTAL SCHOOL GENERATED FEES	$68,430		$50,384	$18,046	73.63%

	OTHER GRANTS	TOTAL BUDGET	21-22 EXPENSED	YTD EXPENSE	ENCUMBER	BALANCE	% EXPENSED
214	ESSER II	$625,532	$573,735	$16,243	$25,000	$10,554	98.31%
218	ESSER III (estimated $809k for 21-22 use)	$1,253,726	$709,840	$278,988	$233,314	$31,584	97.48%

2022 - 2023
NEWTOWN BOARD OF EDUCATION
DETAIL OF TRANSFERS RECOMMENDED
MARCH 31, 2023

	FROM			TO		
OBJECT CODE	AMOUNT		OBJECT CODE	AMOUNT		
500	$33,000	TRANSPORTATION $33,000 001920870000 - 54110 TRANSPORTATION - LOCAL	500	$33,000	CONTRACTED SERVICES $33,000 001800800000 - 54000 TECHNOLOGY CONTRACTED SERVICES	

2022 - 2023
NEWTOWN BOARD OF EDUCATION
TRANSFERS RECOMMENDED
MARCH 31, 2023

AMOUNT	FROM CODE	FROM DESCRIPTION	TO CODE	TO DESCRIPTION	REASON
ADMINISTRATIVE					
$33,000	500	TRANSPORTATION	500	CONTRACTED SERVICES	TO COVER COSTS FOR HAWLEY NETWORK WIRING
$33,000	**TOTAL TRASNFERS REQUESTED**				

NEWTOWN BOARD OF EDUCATION
GIFT FUND EXPENDITURES

3/23/2023

BUDGET UNIT	Account	BUDGET UNIT Title	Account Title	Available	Encumbrances	Balance
DIST DONATIONS						
400000000000	50110	DIST DONATIONS GENERAL	FUND BALANCE/REVENUE	$5,014.04	$0.00	$5,014.04
400000220000	50110	DIST DONATIONS MUSIC	FUND BALANCE/REVENUE	$1,105.00	$0.00	$1,105.00
400000360000	50110	DIST DONATIONS BOOKS	FUND BALANCE/REVENUE	$494.68	$0.00	$494.68
400009820000	50110	DIST DONATIONS CULTURE	FUND BALANCE/REVENUE	$1,052.00	$0.00	$1,052.00
400009900000	50110	DIST DONATIONS CHILDREN	FUND BALANCE/REVENUE	$3,195.00	$0.00	$3,195.00
400009910000	50110	DIST DONATIONS BUTTERFLY BUSHES	FUND BALANCE/REVENUE	$60.00	$0.00	$60.00
400009940000	50110	DIST DONATIONS RECOVERY	FUND BALANCE/REVENUE	$7,023.93	$0.00	$7,023.93
				$17,944.65	$0.00	$17,944.65
HAW DONATIONS						
410100000000	50110	HAW DONATIONS GENERAL	FUND BALANCE/REVENUE	$169.40	$0.00	$169.40
410100380000	50110	HAW DONATIONS CLASSROOM	FUND BALANCE/REVENUE	$85.87	$0.00	$85.87
410100380000	56900	HAW DONATIONS CLASSROOM	TEXTBOOKS	$1,250.00	$0.00	$1,250.00
410100980000	50110	HAW DONATIONS PTA	FUND BALANCE/REVENUE	$9,709.72	$0.00	$9,709.72
				$11,214.99	$0.00	$11,214.99
S.H. DONATIONS						
420200000000	50110	S.H. DONATIONS GENERAL	FUND BALANCE/REVENUE	$1,016.37	$0.00	$1,016.37
420200220000	50110	S.H. DONATIONS MUSIC	FUND BALANCE/REVENUE	$1,629.45	$0.00	$1,629.45
420200240000	50110	S.H. DONATIONS P.E.	FUND BALANCE/REVENUE	$6.57	$0.00	$6.57
420200380000	50110	S.H. DONATIONS CLASSROOM	FUND BALANCE/REVENUE	$735.69	$0.00	$735.69
420200380000	56900	S.H. DONATIONS CLASSROOM	TEXTBOOKS	$1,250.00	$0.00	$1,250.00
420200400000	50110	S.H. DONATIONS COUNSELING	FUND BALANCE/REVENUE	$339.61	$0.00	$339.61
				$4,977.69	$0.00	$4,977.69
M.G. DONATIONS						
430300000000	50110	M.G. DONATIONS GENERAL	FUND BALANCE/REVENUE	$1,493.18	$0.00	$1,493.18
430300290000	55100	M.G. DONATIONS STEM	INSTRUCTIONAL SUPPLIES	$750.00	$0.00	$750.00
430300380000	56900	M.G. DONATIONS CLASSROOM	TEXTBOOKS	$1,250.00	$0.00	$1,250.00
430300850000	50110	M.G. DONATIONS TECH	FUND BALANCE/REVENUE	$1,441.10	$0.00	$1,441.10
430300980000	50110	M.G. DONATIONS PTA	FUND BALANCE/REVENUE	$606.72	$0.00	$606.72
				$5,541.00	$0.00	$5,541.00
HOM. DONATIONS						
440400000000	50110	HOM. DONATIONS GENERAL	FUND BALANCE/REVENUE	$104.74	$0.00	$104.74
440400240000	50110	HOM. DONATIONS P.E.	FUND BALANCE/REVENUE	$7.62	$0.00	$7.62
440400380000	56900	HOM. DONATIONS CLASSROOM	TEXTBOOKS	$1,250.00	$0.00	$1,250.00
				$1,362.36	$0.00	$1,362.36
RIS. DONATIONS						
445450000000	50110	RIS. DONATIONS GENERAL	FUND BALANCE/REVENUE	$4,294.67	$0.00	$4,294.67
445450000000	55100	RIS. DONATIONS GENERAL	INSTRUCTIONAL SUPPLIES	$0.00	$4,300.00	($4,300.00)
445450380000	53505	RIS. DONATIONS WATER STATION	B & G IMPROVE - RIS	$3,800.00	$0.00	$3,800.00
445450380000	56900	RIS. DONATIONS CLASSROOM	TEXTBOOKS	$1,250.00	$1,015.00	$235.00
				$9,344.67	$5,315.00	$4,029.67
M.S. DONATIONS						
				$0.00	$0.00	$0.00
H.S. DONATIONS						
460600000000	50110	H.S. DONATIONS GENERAL	FUND BALANCE/REVENUE	$1,533.78	$0.00	$1,533.78
460600280000	50110	H.S. DONATIONS SCIENCE	FUND BALANCE/REVENUE	$124.52	$0.00	$124.52
				$1,658.30	$0.00	$1,658.30

NEWTOWN BOARD OF EDUCATION
GIFT FUND EXPENDITURES

3/23/2023

BUDGET UNIT	Account	BUDGET UNIT Title	Account Title	Available	Encumbrances	Balance
SPED DONATIONS						
475750700000	50110	SPED DONATIONS GENERAL PK	FUND BALANCE/REVENUE	$546.09	$0.00	$546.09
				$546.09	$0.00	$546.09
HEALTH DONATIONS						
477770430000	50110	HEALTH DONATIONS S.H.	FUND BALANCE/REVENUE	$83.37	$0.00	$83.37
				$83.37	$0.00	$83.37
OTHER DONATIONS						
480809800000	50110	OTHER DONATIONS PARENT TR	FUND BALANCE/REVENUE	$60.58	$0.00	$60.58
480809810000	50110	OTHER DONATIONS GRAUSTEIN	FUND BALANCE/REVENUE	$175.18	$0.00	$175.18
				$235.76	$0.00	$235.76
SECURITY DONATIONS						
485850880000	50110	SECURITY DONATIONS GENERA	FUND BALANCE/REVENUE	$810.65	$0.00	$810.65
				$810.65	$0.00	$810.65
CONT ED DONATIONS						
494949480000	50110	CONT ED DONATIONS - S.P. SMART	FUND BALANCE/REVENUE	$80.00	$0.00	$80.00
				$80.00	$0.00	$80.00
				$53,799.53	$5,315.00	$48,484.53

Grants and Support Impacting the 2023-24 School Year

Funder	Need to be Addressed	Award Value	Date Awarded/Expected
Entitlement Grants (Awarded Annually)			
CSDE IDEA 611/619	Providing academic support and services to individuals with disabilities	Anticipated increase to $944,000	Anticipated October 2023
CSDE Title I	Assistance for children from low-income families	Anticipated $170,000	Anticipated October 2023
CSDE Title II	Supporting Effective Instruction	Anticipated $62,000	Anticipated October 2023
CSDE Title III	Instruction for ELL to improve language efficiency and academic achievement	Anticipated $5,800	Anticipated January 2024
CSDE Title IV	Social and Emotional Learning and other needs - primarily at Middle Gate School	Anticipated $12,000	Anticipated November 2023
CSDE Perkins Entitlement	Career and Technical Education learning opportunities	Anticipated $41,000	Anticipated November 2023
Competitive Grants			
VOCA Grant/CT Office of Victims Services	12/14 Recovery Support (NHS Social Worker and District Family Assistance Coordinator)	$71,815 anticipated; 2nd year of 2 years; final year of funding	Expected June 2023
CT DOA	Hawley HVAC Funds up to 50% of project, after federal funding is backed out	Potential $2.9 M	DECLINED
NRWIB/CYEP	Summer work experience opportunities	Anticipated $31,455	Anticipated June 2023 MOVED (NYFS)
NRWIB/CYEP	Year-round work experience opportunities	Anticipated ~ $25,000	Anticipated June 2023 MOVED (NYFS)
CSDE Perkins Supplemental Enhancement	Career and Technical Education learning opportunities	Potential ~ $40,000	Potential June 2023
NoVo Foundation Grant	Teen Talk	Potential ~ $80,000 for 2023/24 and/or 2024/25	Potential June 2023
CT DES MMSSCG	Radio Upgrade and Hawley Wiring	Potential $69,993.84 (up to 35% of project)	Potential Spring/Summer 2023
DOJ COPS	Radio Upgrade	Potential $120,410 (up to 75% of project)	Potential October 2023

CT DOPH	School Based Mental health Center Expansion - NMS	$37,340	DECLINED
CT DOA	High School HVAC Funds up to 50% of project	Potential $600K ?	Spring, 2024
CT DOA	Middle School HVAC Design Funds up to 50% of project	Potential $225K ?	Spring, 2024
Other Support / Income Sources			
Child Health and Development Institute (CHDI)	Trauma/Mental Health Support and Student Support	TBD based on historical data. Est. $10,000	Due Summer 2023
Anonymous donor	Backpack program for students who are food insecure	Est. value $20,000 - $26,000	Ongoing Support
Town of Newtown ARPA Funding	Project Adventure and Middlegate playground upgrades	$127,000	AWARDED 3/2023 $127,000
Borough ARPA Funding	Teen Talk Counselor - NMS	$40,000	Potential 5/15/23
Caraluzzi's	Backpack Program Contribution	$500	February 2023

Grants and Support Impacting the 2022-23 School Year to Date

Funder	**Need To Be Addressed**	**Award Value 22/23**	**Date/Total Awarded**
Entitlement Grants			
CSDE - CTSeds	CT Seds Implementation and Training	$21,000	AWARDED 3/2023 $21,000
CSDE IDEA 611/619	Providing academic support and services to individuals with disabilities	$943,414	October 2022 $943,414
CSDE IDEA 611/619 Carry Over	Providing academic support and services to individuals with disabilities	$15,137	July 2021 $911,772
CSDE Title I 2022-2023	Assistance for children from low-income families	$169,594	October 2022 $169,594
CSDE Title II 2022-2023	Supporting Effective Instruction	$62,415	October 2022 $62,415
CSDE Title III 2022-2023 (Consortium)	Instruction for ELL to improve language efficiency and academic achievement	$5,753	January 2023 $5,753

CSDE Title IV Student Support and Academic Enrichment 2022-2023	Social and Emotional Learning and other needs - primarily at Middle Gate School	$11,670	December 2022 $11,670
CSDE Title IV Student Support and Academic Enrichment 2021-2022 (Carry Over)	Social and Emotional Learning and other needs at Middle Gate School	$3,300	February 2022 $11,260
CSDE Perkins Entitlement	Career and Technical Education learning opportunities	$40,851	November 2022 $40,851
Esser II, including State set aside (Final Year)	Covid Recovery	$51,797	January 2021 (Set aside May 2021) $625,532
Esser III (ARP) (Year 3 of 4)	Covid Recovery	$518,085	July 2020 $1.2M
CSDE ARP IDEA 619 (Final Year)	Covid Recovery	$15,271	December 2021 $18,502
CSDE ARP IDEA 611 (Final Year)	Covid Recovery	$182,727	December 2021 $195,092
CSDE SPED Recovery Activities/Sp. Population $25K Recovery / Dyslexia (Final Year)	Covid Recovery	$108,838	December 2021 $124,500
Competitive Grants			
NoVo Foundation Grant - No Cost Extension of existing grant	K-12 Social and Emotional Learning and 12/14 Recovery Support	$367,014	June 2017 $750,000
VOCA Grant/CT Office of Victims Services	12/14 Recovery Support (NHS Social Worker and District Family Assistance Coordinator)	$88,797; 1st year of 2 years	June 2022 $88,797 (YR1 amount)
CSDE Perkins Supplemental Enhancement	Career and Technical Education learning opportunities	$48,734	June 2022 (Spend by September 2022)
NRWIB/CYEP	Summer-work experience opportunities	$31,455	June 2022
NRWIB/CYEP	Year-round work experience opportunities	$25,000	March 2023 AWARDED $26,000
NEF (Teacher Submission)	NHS Greenery - Irrigation Upgrade Phase I	$2,500	December 2022 AWARDED $2,500

USDA	NHS Greenery - Irrigation Upgrade Phase II Requires 25% match, met through NEF award and in-kind	Potential $10,213	Potential Spring 2023 $10,213
AFT Reclaim Our Future (Teacher Submission)	NHS Greenery – upgrades for greenhouse	Potential $21,814	Potential Spring 2023 $21,814 AWARDED $22,000
Other Support / Income Sources			
Child Health and Development Institute (CHDI) CBITS Payment	Trauma/Mental Health Support and Student Support	TBD based on historical data. Est. $10,000	Due Summer 2023 $10,000
Anonymous donor	Backpack program for students who are food insecure	Est. value $26,000	Ongoing Support $26,000

2022/2023 Pending Grants

Funder	**Need To Be Addressed**	**Value**	**Date of Submission**
Competitive			
PURA Pegpetia	Technology/Communications	Anticipated ~$28K	Feb. 2023
CSDE Perkins Supplemental Enhancement	Career and Technical Education	Potential ~$40K	Expected Spring 2023

Newtown Public Schools

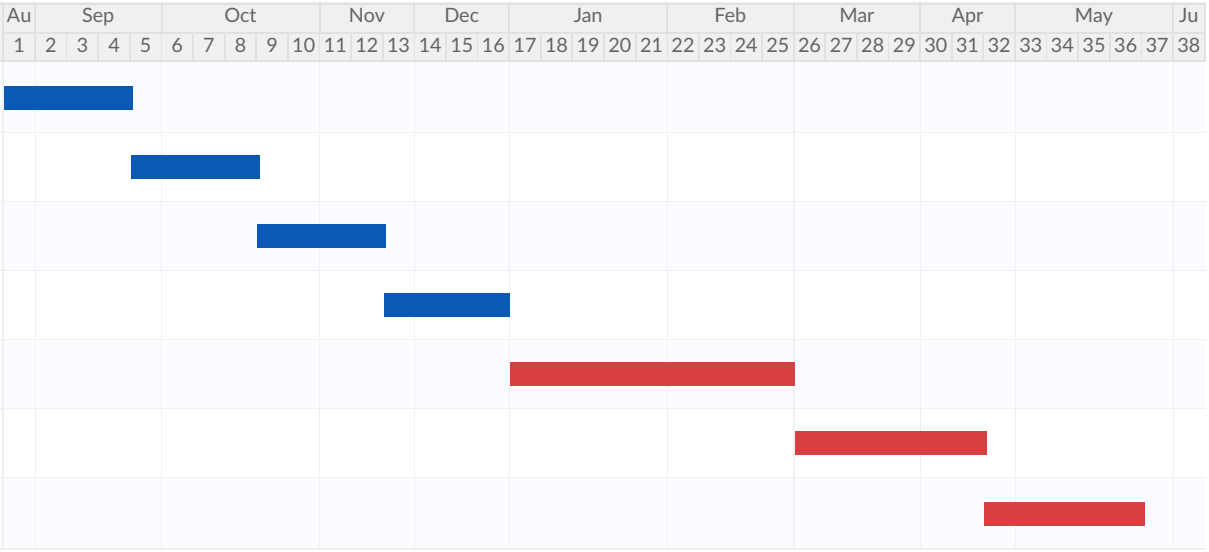
Atlas

Integrated Physical and Earth Science

8 Curriculum Developers | Last Updated: Thursday, Jan 5, 2023 by Georgina, Fawn

Unit Calendar by Year

Unit	Lessons
Lab skills and density	0
01a Big Bang and The...	0
01b Formation and Life cycle of...	0
02 Motion of the solar system	0
03 Formation and History of the...	0
04 Climate Change (Historical an...	0
05 Energy Resources	0



7 Units found

Previous Year

Lab skills and density

8 Curriculum Developers

Concept-Based Unit Development Graphic Organizer (Download)

[Unit Web Template (Optional)]

Concepts / Conceptual Lens

Please attach your completed Unit Web Template here

Lens: Gathering Information
Concepts: **scientific inquiry, evaluation, design**, **numeracy**, **calculation, analysis, data, evidence**, **measurement, observation**, **scientific ideas**, **experimentation, objectivity**

G

Generalizations / Enduring Understandings

1. Scientific inquiry inspires critical evaluation and communication of scientific ideas to generate further experimentation, product design, and solutions to problems.

2. Scientific numeracy provides the foundation for the ability to calculate, analyze, and interpret scientific data and ideas.

3. Reliable evidence that supports scientific ideas must be valid, replicable, and objective.

4. Precise measurement and close, accurate observations create the evidence scientists need.

Guiding Questions

Please identify the type of question: (F) Factual, (C) Conceptual, (P) Provocative [Debatable]

1a. What is the scientific method? (F)
1b. What are the steps of the scientific method? (F)
1c. How does the scientific method attempt to remain totally objective? (C)
1d. What is the nature of science? (C)
1e. Is the scientific method important to modern society? (P)

2a.Which type of graph is appropriate for a particular set of data? (F)
2b. How are simple mathematical relationships applied to scientific problems? (C)
2c. How does one determine the type of graph based on the data? (C)
2d. How do scientists use data to show relationships between variables, draw conclusions and make inferences? (C)
2e. How can mathematical operations be used to analyze and interpret data and present relationships between variables in appropriate terms? (C)
2f. Is mathematics essential to the study of science? (P)

3a. What is data? (F)
3b. How do scientists assess the reliability of the data that was generated in the investigation? (C)
3c. Why is evidence a necessity for explaining scientific ideas? (C)
3d. Does all science need evidence? (P)
3e. Can the public trust scientific studies? (P)

4a.What is mass, volume, and density? (F)
4b. How does one measure in science? (F)
4c. How do scientists choose the appropriate equipment and techniques to make observations and gather data?(F)
4d. What is the relationship between mass, volume, and density? (C)
4e. Why do scientists use certain equipment and techniques to make observations and gather data? (C)
4f. Why is it important for scientists to use data and observations as evidence? (C)
4g. Should the United States switch to the metric system? (P)

Standard(s)

Connecticut Core Standards / Content Standards

NGSS: Science and Engineering Practices

NGSS: 9-12

Practice 1. Asking questions (for science) and defining problems (for engineering)

Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.

- Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information.
- Evaluate a question to determine if it is testable and relevant.
- Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.

Practice 3. Planning and carrying out investigations

Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

- Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts.
- Select appropriate tools to collect, record, analyze, and evaluate data.

Practice 5. Using mathematics and computational thinking

Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Apply techniques of algebra and functions to represent and solve scientific and engineering problems.

Practice 6. Constructing explanations (for science) and designing solutions (for engineering)

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables.

Connections to the Nature of Science: Most Closely Associated with Practices

Scientific Investigations Use a Variety of Methods

- Scientific investigations use a variety of methods, tools, and techniques to revise and produce new knowledge.

Scientific Knowledge is Based on Empirical Evidence

- Science knowledge is based on empirical evidence.

Critical Content & Skills

*What students must **KNOW and be able to DO***

Students must KNOW:

Physical Properties
Mass
Length
Volume
Density
D=M/V
Area
Meter
Liter
Gram
Metric system
Customary system
Scientific notation
Scientific method
Variables
Hypothesis
Experiment
Data
Results
Conclusion
Error analysis
Validity
Testable
Measurable
Objective
Observation
Claim
Evidence
Reasoning
Beaker
Graduated Cylinder
Meter Stick
Ruler
Balance
Pie chart
Line graph
Bar graph
Scatter plot
Trend
Precision vs. Accuracy
Percent Error
Qualitative vs. Quantitative data

Students will be able to DO:

Asking questions and defining problems
Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information.
Evaluate a question to determine if it is testable and relevant.
Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.

Planning and carrying out investigations
Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts.
Select appropriate tools to collect, record, analyze, and evaluate data.

Mathematical and computational thinking
Apply techniques of algebra and functions to represent and solve scientific and engineering problems.

Constructing explanations and designing solutions
Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables.

Core Learning Activities

1. Density of Aluminum Lab Practical or Density Cube Lab: Students measure mass and volume of varied aluminum shapes then calculate the density of each shape within a small percent error to make conclusions about how shape/size affects density of objects made from the same material.

2. Density of Water: Students measure the mass of different volumes of water to determine basic properties of density.

3. Density of Fluids: Students measure the density of various fluids, then layer them in a graduated cylinder according to their density and suspend small solids in each layer to determine relative density.

4. Scientific Method Comic: Students create a comic strip that shows a character using the scientific method to solve an experimental problem to show their understanding of the steps of the scientific method.

5. Measuring activity: Students measure basic properties such as mass, volume, length, area, temperature, etc. using appropriate lab equipment to practice getting accurate measurements.

6. Questioning using Snapple bottle activity: Students see an engaging demonstration (Balloon in a Snapple Bottle) to generate scientific questions then evaluate them according to criteria for scientific questions (testable, measurable, objective).

7. The Obscertainer: Using little black containers, students predict, observe, and hypothesize about the unseen shapes contained within. This is an exercise in using different senses to make observations and collect data.

8. Converting metric units worksheets: Students engage in a math workshop to convert metric units into different scales or to convert between metric and standard units. Also known as "dimensional analysis".

- Density practical - aluminum - short version.doc
- density of water - graph m&V.doc
- Density Cube Lab.doc
- ob-scertainer activity.pdf
- questioning activity with snapple-water balloon.docx
- Conversions and dimensional analysis.docx
- lab safety worksheet.pdf

Assessments

Density of Aluminum Lab Practical
Summative: Lab Assignment
Uses aluminum rectangular prism, cylinder, can, foil to reinforce writing procedures, making data tables, and calculating density
Density practical - aluminum - short version.doc

Scientific Method Comic
Summative: Other Visual Assessments
Create comic illustrating the scientific method
comic sci method - K.doc

Density of Fluids
Summative: Lab Assignment
Measures and calculates the density of several fluids and small objects then predicts which fluids the objects would float in
density of fluids.doc

Measuring Activity
Formative: Lab Assignment
Practice measuring using various tools and then converting metric units
measuring activity.pdf

Measuring and Lab skills test
Summative: Written Test
HIES quest 1 - 2014.doc

Resources

Professional & Student

Glencoe Physical Science with Earth Science text, Unit 1, chapters 1 and 2 pages 4-36 Text book resources for relevant math skills are found on page 16. Also on multiple pages throughout the chapter in the form of practice problems.

Student Learning Expectation & 21st Century Skills

Information Literacy
Critical Thinking
Spoken Communication
Written Performance

- Problem Solving

Students will engage in lab scenarios to practice commonly used lab skills that will be carried through the year. Students will be required to design and conduct a procedure and will learn and practice the scientific method. This unit will lay the groundwork for all following units that require lab skills.

Interdisciplinary Connections

Math: This unit has a strong focus on Math integration. Using the metric system to measure in base 10's is a practiced skill and will be used in data collection and calculations. Math is also integrated through the use of graphs to interpret data which is a skill that will be used throughout the course and during lab experiences.

English: Creation of the comic strip requires clear use of language and communication to express understanding of the scientific method.

01a Big Bang and The electromagnetic Spectrum

8 Curriculum Developers

Concept-Based Unit Development Graphic Organizer (Download)

[Unit Web Template (Optional)]

Concepts / Conceptual Lens

Please attach your completed Unit Web Template here

Lens: **Scale, Proportion, and Quantity**
Universe, models, observation, indirect and direct observation, limitations, ,measurement theory, technology, mathematical representations, wave, evidence, relationships ,matter, phenomenon

01A Earth in the Universe Unit plan

G

Generalizations / Enduring Understandings

1. Indirect observation allows for studying objects that are too distant at scale for the limits of direct observation.

2. Models use scale and proportion to communicate relationships between different parts of the model.

3. Observational evidence and measurements support theories about distant objects or past events, such as The Big Bang Theory.

4. Wave behaviors and their mathematical representations explain many phenomena such as the expansion of the Universe.

5. Technological devices use wave behavior and interactions with matter to transmit and capture information.

6. Technology produces, transmits, and captures signals for storing and interpreting information used as evidence to support theories.

Guiding Questions

Please identify the type of question: (F) Factual, (C) Conceptual, (P) Provocative [Debatable]

1a. How is the universe 's size discovered? (F)
1b. How did stars and galaxies form? (F)
1c. How long would it take to get to the closest star? (F)
1d. How big is the Milky Way Galaxy? (F)
1e. How did the stars and galaxies form? (C)
1f. How does one gather evidence about objects incapable of being directly observe? (C)
1g. Did anything come (exist) before the Big Bang? (P)

2a. How old is the universe?(F)
2b. Where is Earth located within the Milky Way Galaxy? (F)
2c. How big is the universe? (C)
2d. How is the age of the Universe determined? (C)
2e. Why are there so many different models of the Universe? (C)
2f. Can anyone travel to the edge of the universe? (C)
2g. Is there one center to the Universe? (P)

3a. What is the Big Bang Theory? (F)
3b. How fast is the Universe expanding? (F)
3c.What do redshift and blueshift reveal about the expansion of the Universe? (F)
3d. What does the Cosmic Background Radiation reveal about the formation of the universe? (C)
3e. What is causing the Universe to expand at its current rate? (C)
3f. Why have scientists theorized about the existence of dark matter and energy even though they cannot be readily observed? (C)
3g. How do redshift/blue shift to describe motion in the Universe? (C)
3h. Does the multiverse exist? (P)
3i. What did the universe come from? (P)
3j.What is beyond the edge of the universe? (P)

4a. What is the light limit? (F)
4b. What travels fastest in the known Universe? (F)
4c. What does it sound like in space? (F)
4d.What is the speed of light? (F)
4e. Why does the frequency of a wave apparently change when it is moving towards/away from the observer? (C)
4 f. When one looks into space can one see objects in the present, past, or future? (C)
4g. How does change in velocity affect the flow of time? (C)
4h. Can humans travel at the speed of light? (C)

5a. What at the benefits and drawbacks of using electromagnetic waves in technology? (F)
5c. What kinds of technological devices use waves to collect or transmit information? (F)
5d. What practical applications do technological devices have to collect or store information? (F)
5e. How can the human body be affected by the use of devices that use waves? (C)
5f. Why is a lead apron necessary at the dentist's office? (C)

6a. Which technological devices collect the information scientists use as evidence for astronomical theories? (F)
6b. What types of evidence are collected with wave technology to support astronomical theories?
6c.How does information gathered by telescopes help determine the origin of the universe? (C)
6d. Is the telescope the most important invention contributing to scientific knowledge? (P)

Standard(s)

Connecticut Core Standards / Content Standards

NGSS: Science and Engineering Practices

NGSS: 9-12

Practice 2. Developing and using models

Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

- Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism or system in order to select or revise a model that best fits the evidence or design criteria.
- Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.

NGSS: Disciplinary Core Ideas

NGSS: 9-12

ESS1: Earth's Place in the Universe

ESS1.A: The Universe and Its Stars

- The Big Bang theory is supported by observations of distant galaxiesreceding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe.(HSESS1-2)

PS4: Waves and Their Applications in Technologies for Information Transfer

PS4.A: Wave Properties

- The wavelength and frequency of a wave are related to one another by thespeed of travel of the wave, which depends on the type of wave and the medium through which it is passing. (HS-PS4-1)
- Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sentover long distances as a series of wave pulses. (HS-PS4-2),(HSPS4-5)

PS4.B: Electromagnetic Radiation

- Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features.(HS-PS4-3)
- Atoms of each element emit and absorb characteristic frequencies of light.These characteristics allow identification of the presence of an element, even in microscopic quantities. (secondary to HS-ESS1-2)

PS4.C: Information Technologies and Instrumentation

- Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them.(HS-PS4-5)

Critical Content & Skills

*What students must **KNOW and be able to DO***

Students must KNOW:

Universe
Observable Universe
Galaxy
Milky way galaxy
Star
Lightyear
Big Bang theory
Theory
Cosmic background radiation
Hubble's law
Matter
Expansion
Space
Time
Telescope
Detector
Hubble space telescope
Refraction
Reflection
Doppler effect
Red/Blueshift
EM radiation
Gamma, x-ray, ultraviolet, visible, infrared, micro, radio waves
Spectroscopy
Wave
Speed of light
Wavelength
Frequency
Speed = wavelength x frequency
Amplitude
Transverse waves
Longitudinal waves
Sound
Light
Medium
Vacuum

Students must be able to DO:

Constructing Explanations and Designing Solutions

Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.
Apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion.

Using Mathematics and Computational Thinking

Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations.

Obtaining, Evaluating, and Communicating Information

Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

Engaging in Argument from Evidence

Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.

Developing and using models

Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism or system in order to select or revise a model that best fits the evidence or design criteria.
Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.

Core Learning Activities

1. **Scale and Proportion:** Students explore their place in the Universe by gaining an understanding of the full scale of the Universe. Videos, models, and analogies are presented to students to give them a sense of how large or small they are in relation to other objects in the Universe.
-How big is the Universe? Scale of the Universe video
Crash Course Video - Distances
Students draw a model of the universe (pre-model takes place before students do any major new learning and a post-model summative assessment will happen after students have completed the content about the expansion of the Universe and the Big Bang Theory)

2. **Expansion of the Universe:** Students will take notes on the concepts and supporting evidence of the Big Bang Theory. Students will then engage in models and activities that simulate and help explain how scientists know the Universe is expanding.
The Beginning of Everything -Big Bang: video explaining the general concept of the Big Bang Theory and some further implications as well as the limitations of current scientific knowledge.
Balloon expansion activity: Students use a balloon as a model of the expanding Universe by measuring the changes in spacing between marks made on the balloon.
Visualizing expansion of space: Paper based activity that shows how the space between galaxy clusters changes over time.
Graph Hubble's constant
Questions from Hubble Graphing activity
Theory, law, hypothesis lesson: Students are presented with the scientific language of "theory, law, and hypothesis" and that each means something specific and different in the scientific community.

- TedEd video

3. **Wave properties.**
Cymatics-science vs. music video.: Music video to explore properties of waves such as frequency, movement, shape, etc. used as an introductory phenomenon.
Slinky lab: Hands on lab where students measure the wavelength and frequency of slinky waves.
Math workshop on speed = wavelength x frequency calculations

4. **Doppler effect.**
Doppler sound (car horn): Introductory video to the show real world experience of the Doppler Effect
Red shift/Blue shift activity (CSI galaxies): Students calculate how fast a galaxy is moving based on the change in wavelength of the galaxy's light.

5. **Telescopes and detectors.**
Pictures of celestial objects in different portions of the EM spectrum.
Building/Using telescopes
Telescope research project

6. **EM Radiation**
Demos of different types of technologies that utilize EM radiation such as radios, remote controllers, UV lights, toaster, etc.
Build a Scale model of the EM spectrum

Assessments

Slinky Lab
Formative: Lab Assignment
See attachments below for link to handout.

Big Bang Balloon Lab
Formative: Lab Assignment
See attachments below for link to handout.

Waves Test
Summative: Written Test
Waves, EM, and Doppler test.pdf

Model of Universe
Summative: Group Project
Model (drawing) of the universe.docx.pdf

Copy of Waves, EM, and Doppler test.pdf

Big Bang Balloon Lab.pdf

Slinky Lab.pdf

Resources

Professional & Student

Phet simulation that shows electromagnetic waves in relationship to electron movement. https://phet.colorado.edu/en/simulation/legacy/radio-waves

Crash Course Astronomy: Telescopes video used to introduce telescope technology and EM waves technology. https://www.youtube.com/watch?v=mYhy7eaazIk&list=PL8dPuuaLjXtPAJr1ysd5yGIyiSFuh0mIL&index=6

Resource website for EM spectrum and radiation basics.
https://science.hq.nasa.gov/kids/imagers/ems/waves3.html

Phet simulation of transverse waves. Very simple and basic introduction to wave properties. https://phet.colorado.edu/sims...

Student Learning Expectation & 21st Century Skills

Information Literacy
Critical Thinking
Spoken Communication
Written Performance

Interdisciplinary Connections

Math: Mathematical models of scale and proportion are useful in conceptualizing the true vastness of the Universe. Wave forms, like those created by electromagnetic radiation, can be described by classical math formulae such as sine and cosine waves.

Technology: Technological advancements have aided our observations of the Universe.

01b Formation and Life cycle of Stars

8 Curriculum Developers

Concept-Based Unit Development Graphic Organizer (Download)

Unit Web Template (Optional)

Concepts / Conceptual Lens

Please attach your completed Unit Web Template here

Lens: Energy and Matter
Concepts: **energy, matter, conservation, model, pattern, transformation, sequence, data, cycle, prediction, radiation, fusion, nuclear processes, structure, life cycle, transport, energy output, wave**

01B Earth in the Universe

G

Generalizations / Enduring Understandings

1. A wave model or a particle model describes electromagnetic radiation, and for some situations one model is more useful than the other.

2. The Sun, a typical main sequence star, has a structure and life cycle pattern representative of all stars in the galaxy.

3. Nuclear fusion in the Sun's core transforms and releases energy that transports to Earth through radiation.

4. The life cycle of a star produces all natural elements on the periodic table through nuclear fusion while conserving matter and transforming energy.

5. All stars follow a sequence of stages as they produce new elements through nuclear processes and will end their "life" depending on their starting mass.

6. Scientists study the historical data of sunspot activity and use these patterns to help predict the Sun's cycle and its energy output.

Guiding Questions

Please identify the type of question: (F) Factual, (C) Conceptual, (P) Provocative [Debatable]

1a. Do all electromagnetic waves travel at the same speed? (F)
1b.Does energy move the medium it travels through?(F)
1c. Do all types of waves behave the same? (F)
1d. Can all types of waves travel through empty space? (F)
1e. How is wavelength related to energy and frequency? (C)
1f. Why do some electromagnetic waves have more energy? (C)
1g. Is there a cosmic speed limit? (P)

2a. How do scientists know details about the sun and stars? (F).
2b. Will the sun devour the Earth as it goes through its life cycle? (F)
2c. What is a star? (F)
2d. What type of star is most abundant in the Universe? (F)
2e. Are all stars the same? (F)
2f. Why does all life on Earth depend on the sun? (C)

3a. How does the sun generate energy? (F)
3b. Why do stars twinkle? (C)
3c. Why are there no green stars? (C)
3d. How are elements created inside a star? (C)

4a. Where do the elements that make up the Earth come from? (F)
4b.What element do all main sequence stars fuse together? (F)
4c.How can a star produce elements in its core through its life cycle? (C)
4d. How do elements reveal detailed information about astronomical bodies? (C)

5a. What is going to happen to the sun when it "dies"? (F)
5b. How long do stars live? (F)
5c. How are stars born? (F)
5d. How do stars die? (F)
5e. Why do some stars become black holes? (C)
5f. How big can stars get? (C)
5g. Will Earth be devoured by a black hole? (P)

6a. What are sunspots? (F)
6b. Are sunspots predictable? (F)
6c.How does energy output correlate to the number of sunspots present? (C)
6d. How do scientists know that the Sun goes through cycles? (C)
6e. What caused the Little Ice Age? (P)

Standard(s)

Connecticut Core Standards / Content Standards

NGSS: Science Performance Expectations (2017)

NGSS: HS Physical Sciences

HS.Energy

Performance Expectations

- HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).

HS.Waves and Electromagnetic Radiation

Performance Expectations

- HS-PS4-3. Evaluate the claims, evidence, and reasoning behind behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.

NGSS: HS Earth & Space Science

HS.Space Systems

Performance Expectations

- HS-ESS1-1. Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy in the form of radiation.
- HS-ESS1-3. Communicate scientific ideas about the way stars, over their life cycle, produce elements.

NGSS: Disciplinary Core Ideas

NGSS: 9-12

ESS1: Earth's Place in the Universe

ESS1.A: The Universe and Its Stars

- The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years. (HS-ESS1-1)
- The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. (HS-ESS1-2),(HS-ESS1-3)
- Other than the hydrogen and helium formed at the time of the BigBang, nuclear fusion within stars produces all atomic nuclei lighterthan and including iron, and the process releases electromagneticenergy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. (HS-ESS1- 2),(HS-ESS1-3)

PS3: Energy

PS3.D: Energy in Chemical Processes and Everyday Life

- Nuclear Fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation. (secondary to HS-ESS1-1)

PS4: Waves and Their Applications in Technologies for Information Transfer

PS4.B: Electromagnetic Radiation

- Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features.(HS-PS4-3)
- Atoms of each element emit and absorb characteristic frequencies of light.These characteristics allow identification of the presence of an element, even in microscopic quantities. (secondary to HS-ESS1-2)

Critical Content & Skills

*What students must **KNOW and be able to DO***

Students must KNOW:

Star
Sun
First generation star
Second generation star
Energy
Light
Spectrum
Waves
Photon
Absorption
Radiation
Gravity
Nuclear fusion
H-R diagram
Main sequence
Giant
Supergiant
White dwarf
Neutron star
Black hole
Supernova
Nebula
Planetary nebula
Solar mass
Corona
Chromosphere
Photosphere
Radiative zone
Convection zone
Solar wind
Sunspot
Prominence
Solar flares
Element
Proton
Neutron
Electron
Electron energy level (orbital)
Hydrogen
Helium

Students must be able to DO:

Developing and Using Models

Develop a model based on evidence to illustrate the relationships between systems or between components of a system.
Use a model to provide mechanistic accounts of phenomena. (HS-ESS2-4)

Obtaining, Evaluating, and Communicating Information

Communicate scientific ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

Engaging in Argument from Evidence

Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.

Core Learning Activities

1. Spectroscopy lab (see attachments below) using spectroscopes and emission tubes and the solar/continuous spectrum

2. Layers of the Sun: Sun-ion; students research properties of each layer of the sun and construct a simple flipbook to keep as a resource.

3.Modeling Nuclear Fusion in Stars: Students construct a diagram of nuclear fusion by combining atomic particles to make new elements and show the release of energy.
Nuclear fusion activity template

4. Life cycle of a star card sort instructions: Students explore and reinforce the life cycle of a star by matching images with descriptions.
Life cycle of a star card sort cards

5. Graphing sunspot cycles : Students graph the amount of sun spots over several years to show a clear pattern that scientists call the "solar cycle"

6. HR-Diagram Graphing Activity: Students plot many stars on the HR-Diagram based on their temperature. They will then group the stars based on the scatter plot into their commonly named star categories (red giants, white dwarves, main sequence, etc.) This is a critical activity because the content has been known to show up on the NGSS state-level test.

- Sun-onion instructions.pdf
- Modeling Nuclear Fusion in stars.pdf
- nuclear fusion activity template.pdf
- Life cycle of a star card sort instructions.pdf
- Life Cycle of Stars Card Sort cardspdf.pdf
- Graphing Sunspot Cycles.pdf
- HR Diagram Graphing Activity (1).docx.pdf

Assessments

Spectroscopy Lab
Formative: Lab Assignment
spectroscopy lab.docx

Modeling Nuclear Fusion
Formative: Lab Assignment
See attachments under Core Learning activities.

Star Stations
Summative: Group Project
Multiple day assessment activity
Folder containing Star Station material

Resources

Professional & Student

Phet simulation: Models of a hydrogen atom. Can be used to introduce atomic structure as it relates to fusion in stars. https://phet.colorado.edu/en/simulation/legacy/hydrogen-atom
Lesson-Level Phenomenon: video of a star being eaten by a black hole
Crash Course Astronomy - Stars
Crash Course Astronomy- Sun
Crash Course Astronomy- Black Holes
Video about elements used during nuclear fusion activity.
https://cptv.pbslearningmedia....

Student Learning Expectation & 21st Century Skills

Information Literacy
Critical Thinking
Spoken Communication
Written Performance

Interdisciplinary Connections

Math: Scale and proportions can aid in the understanding of immense sizes, distances, and lengths of time associated with the scale of the Universe.' Complex understanding of astronomy would not be possible without mathematical relationships that explain patterns and sizes observed in space. Astronomy would be reduced to the types of simple observations made by ancient humans.

02 Motion of the solar system

8 Curriculum Developers

Concept-Based Unit Development Graphic Organizer (Download)

[Unit Web Template (Optional)]

Concepts / Conceptual Lens

Please attach your completed Unit Web Template here

Lens: Patterns
Concepts: **motion**, **scale**, **systems, patterns**, **astronomical events**, **predictability**, **laws**, **observation**, **gravity**, **distance**, **mass**, **models**, **properties**, **cause and effect**, **evidence**, **scientific principles**, **change, space**

02 Earth in the Solar System

G

Generalizations / Enduring Understandings

1. Patterns in star systems observed at different scales provide evidence for cause and effect explanations of observed astronomical events.

2. Laws of orbital motion describe the patterns of movement of objects in the Solar System and can predict astronomical events with accuracy.

3. Gravity from the objects in motion in space changes based on the mass of the objects and distance between objects.

4. Scientific models capture important aspects of scientific principles, but they cannot accurately depict all properties simultaneously.

Guiding Questions

Please identify the type of question: (F) Factual, (C) Conceptual, (P) Provocative [Debatable]

1a.How have humans used astronomical observations throughout history? (F)
1b.What is a meteor shower? (F)
1c. Do all comets return like Halley's comet? (F)
1d.Why do planets orbit a star? (C)
1e. How have humans perceived/interpreted astronomical observations throughout history? (C)
1f. Why do meteor showers happen at the same time every year? (C)
1g.Do astronomical events have meaning? (P)

2a.How do the planets travel around the sun? (F)
2b.What factors affect an object's orbit? (F)
2c.What does eccentricity measure? (F)
2d. How does the acceleration of an object change throughout its orbit around an ellipse? (F)
2e What are Kepler's Laws of Planetary Motion? (F)
2f. What is Newton's Law of Universal gravitation? (F)
2g. How does high eccentricity affect a comet's orbit? (C)
2h. How do scientists predict future comet appearances and solar eclipses? (C)
2i.Are far-future predictions of astronomical events accurate? (P)

3a. What is gravity? (F)
3b.What is the shape of the asteroid belt? (F)
3c. What is the effect of gravity on different masses? (C)
3d. Does the effect of gravity extend out from a mass forever? (C)
3e. How does Jupiter affect the shape and orbit of the asteroid belt? (C)
3f. How are Kepler's and Newton's Laws related? (C)
3g. How can laws of planetary motion help with understanding motion in the Universe? (C)

4a. How is scale used to make models more accurate? (F)
4b. How big would an accurate model of the solar system have to be? (F)
4c. Why do scientific models have limits? (C)
4d. What does an accurate model of the Solar System look like? (C)
4e. Why is it difficult to produce a model of the solar system that shows both accurate sizes and distances? (C)
4f. Are all posters of the Solar System wrong? (P)

Standard(s)

Connecticut Core Standards / Content Standards

NGSS: Science Performance Expectations (2017)

NGSS: HS Physical Sciences

HS.Forces and Interactions

Performance Expectations

- HS-PS2-1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.
- HS-PS2-2. Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.
- HS-PS2-4. Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.

NGSS: HS Earth & Space Science

HS.Space Systems

Performance Expectations

- HS-ESS1-4. Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.

NGSS: Disciplinary Core Ideas

NGSS: 9-12

ESS1: Earth's Place in the Universe

ESS1.B: Earth and theSolar System

- Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. (HS-ESS1-4)

PS2: Motion and Stability: Forces and Interactions

PS2.A: Forces and Motion

- Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1)
- If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objectsoutside the system. (HS-PS2-2),(HS-PS2-3)

PS2.B: Types of Interactions

- Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects.(HS-PS2-4)
- Forces at a distance are explained by fields (gravitational,electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. (HS-PS2-4),(HS-PS2-5)

Critical Content & Skills

*What students must **KNOW and be able to DO***

Student must KNOW:

Solar system
Dwarf planet
Moon
Kuiper belt
Oort cloud
Comet
Asteroid/meteor/meteorite
Kepler
Kepler's Laws
Ellipse
Foci (focus point)
Eccentricity
Orbit/Revolution
Rotation
Perihelion
Aphelion
Orbital period
Newton
Gravity
Mass
Acceleration
Force
F=ma
Newton's law of universal gravitation
Distance
Gravitational field
Center of mass
Centripetal
Collision

Students must be able to DO:

Using Mathematical and Computational Thinking

Use mathematical or computational representations of phenomena to describe explanations.

Analyzing and Interpreting Data

Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.

Constructing Explanations and Designing Solutions

Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects.

Core Learning Activities

1. See-Think-Wonder Protocol: The class discusses a variety of astronomical phenomena such as planetary transits, eclipses, meteor showers, and comet sightings to explore the idea that astronomical phenomena are highly predictable due to laws of motion.

2. Drawing of a model of the solar system: Used as a pre-model to assess students' learning about scale and proportion and motion in the solar system.

3. Kepler's 1st law; Drawing elliptical orbits and identifying the effect of changing aspects of the ellipse.

4. Kepler's 2nd law; Computer simulation activity exploring the orbits of inner solar system objects and the effect on speed of objects through the course of their orbit to achieve equal area over equal time.

5. Kepler's 3rd law; Rubber stopper lab Students swing rubber stoppers around on a string to measure how distance affects orbital period.

6. Gravity Well (Lycra-balls): a simple demonstration that can show orbital motion as described by Kepler's Laws as well as integrate topics about gravity and space-time.

7. Gravity and Motion worksheet: Reading and Math workshop practicing and exploring the effects of the law of universal gravitation in different scenarios.

Copy of Kepler's 1st law activity
Copy of Kepler's 2nd Law activity
Copy of keplers 3rd law activity
Gravity - (lycra-balls) Investigation_Guide.pdf
Copy of Model Rubric.pdf
Gravity and Motion Worksheet.pdf
see_think_wonder_template.pdf

Assessments

Gravity Well Activity
Formative: Lab Assignment
See attachments under Core Learning Activities.

Kepler's 3rd Law Activity
Formative: Lab Assignment
See attachments under Core Learning Activities.

Kepler's 2nd Law Simulation
Formative: Lab Assignment
See attachments under Core Learning Activities.

Kepler's 1st Law Activity (Ellipses)
Formative: Lab Assignment
See attachments under Core Learning Activities.

Kepler's Laws Quiz
Summative: Written Test
Kepler Quiz 2019.pdf

Solar System Model
Summative: Group Project
See attachments under Core Learning Activities for rubric.

Resources

Professional & Student

Text book: Glencoe Physical Science with Earth Science. 2006. (Chapters 3,4,7,8)
PhET orbital simulations can be used as introduction or exploration of orbital motion and Kepler's laws.
https://phet.colorado.edu/sims/html/gravity-and-orbits/latest/gravity-and-orbits_en.html
https://phet.colorado.edu/en/simulation/legacy/my-solar-system
https://phet.colorado.edu/en/simulation/gravity-force-lab
Video
Crash Course Astronomy: Gravity
https://www.youtube.com/watch?...

Student Learning Expectation & 21st Century Skills

Information Literacy
Critical Thinking
Spoken Communication
Written Performance

Interdisciplinary Connections

Math: Mathematical/computational skills will be used when analyzing data related to elliptical orbits. Mathematical/computational models will be used to predict motion of orbiting objects in the solar system. Without Mathematical connections astronomy would not have the complex modern understanding of space. Humans would be confined to the simple observations of heavenly bodies that ancient humans were.

Social Studies: Historical references to scientists and navigators who used similar techniques to initially gather information about heavenly bodies and their impact on the progress of science. Many of the famous scientists in this chapter made their contributions to science in the 1400-1600's which is known as a period of scientific renaissance.

03 Formation and History of the Earth

8 Curriculum Developers

Concept-Based Unit Development Graphic Organizer (Download)

[Unit Web Template (Optional)]

Concepts / Conceptual Lens

Please attach your completed Unit Web Template here

Lens: Stability and Change
Concepts: **evidence, processes, quantifications, models, change, formation, properties, materials, tectonics, geologic event, geologic history, record, time, scale, preservation, synthesis, cause, human comprehension**

03 Formation and History of Earth

G

Generalizations / Enduring Understandings

1. Different scales of time require quantifying and modeling change and rates of change to facilitate human comprehension.

2. Rocks preserve evidence of geologic events that occurred in the past and processes that are happening today.

3. Because active geologic processes have destroyed most of the very early rock record on Earth, other objects in the solar system that have changed little over billions of years provide critical information about Earth's formation and geologic history.

4. Properties of Earth materials drive internal processes which cause immense changes on the surface.

5. Surface processes and Earth materials provide evidence of how plate tectonics works and that it is still happening today.

6. Because the rock record preserves geologic events, absolute dating can be synthesized with relative dating to make a more complete record of Earth's history.

Guiding Questions

Please identify the type of question: (F) Factual, (C) Conceptual, (P) Provocative [Debatable]

1a. What is the geologic time scale?(F)
1b. What is the evidence scientists use to construct Earth's history? (F)
1c. What types of phenomena are considered major geologic events? (F)
1d. How do scientists construct a timeline of Earth's 4.6 billion year old history?(C)
1e. How do humans fit into Earth's history?(P)

2a. What are the major events in Earth's history?(F)
2b. What information do rocks provide? (F)
2c. What is the evidence for continental drift?(F)
2d. How old are rocks? (C)
2e. How does the rock record give evidence for plate tectonics?(C)
2f. How do scientists support the idea that Pangea existed? (C)
2g. What is the evidence for the formation of Earth?(C)

3a. What does Earth have in common with the other terrestrial planets in the solar system?(F)
3b. How do scientists know about conditions of early Earth?(F)
3c. How can evidence from space be used to support theories about early Earth?(C)
3d. How was the Earth formed?(C)

4a. Why is Earth organized in distinct layers?(F)
4b. What is the magnetosphere? (F)
4c. What causes plate tectonics? (F)
4d. What is convection?(F)
4e. What causes the Earth's magnetosphere?(F)
4f. How can movement of interior layers affect surface processes?(C)
4g. What is the significance of Earth having layers?(C)
4h. Why was the magnetosphere so important for the development of life on Earth? (C)
4i. How is the surface of the crust affected by the movement of the plates?(C)
4j. What would Earth be like if it did not have layers?(P)

5a. What is the theory of plate tectonics?(F)
5b. What geologic surface processes are a result of tectonic movements? (F)
5c. How fast do tectonic plates separate? (F)
5d. How can rock hand samples be evidence of large plates moving?(C)
5e. How can fossils tell scientists what latitudes continents used to be in? (C)
5f. How do we know plate tectonics are happening today if it's too slow to see? (C)
5g. Is understanding plate tectonics an essential part of telling Earth's whole history? (P)

6a. What is relative dating of rocks?(F)
6b. What techniques are used to estimate a relative age on a rock layer or geologic event?
6c. How are dating techniques used to estimate a relative age on a rock layer or geologic event?(F)
6d. How does absolute dating of rocks work?(F)
6e. What is stratigraphy? (F)
6f. How do scientists know the age of rocks?(C)
6g. Can scientists rely on the estimated ages of rocks?(P)

Standard(s)

Connecticut Core Standards / Content Standards

NGSS: Disciplinary Core Ideas

NGSS: 9-12

ESS1: Earth's Place in the Universe

ESS1.C: The History of Planet Earth

- Although active geologic processes, such as plate tectonics anderosion, have destroyed or altered most of the very early rock recordon Earth, other objects in the solar system, such as lunar rocks,asteroids, and meteorites, have changed little over billions of years.Studying these objects can provide information about Earth'sformation and early history. (HS-ESS1-6)

ESS2: Earth's Systems

ESS2.A: Earth Materials and Systems

- Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. (HSESS2-1),(HS-ESS2-2)
- Evidence from deep probes and seismic waves, reconstructions of historical changes in Earth's surface and its magnetic field, and an understanding of physical and chemical processes lead to a model of Earth with a hot but solid inner core, a liquid outer core, a solid mantle and crust. Motions of the mantle and its plates occur primarily through thermal convection, which involves the cycling of matter due to the outward flow of energy from Earth's interior and gravitational movement of denser materials toward the interior. (HSESS2-3)

ESS2.B: Plate Tectonics and Large-Scale SystemInteractions

- The radioactive decay of unstable isotopes continually generates new energy within Earth's crust and mantle, providing the primary source of the heat that drives mantle convection. Plate tectonics can beviewed as the surface expression of mantle convection. (HS-ESS2-3)
- Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history. (ESS2.B Grade 8 GBE) (HS-ESS2-1) (secondary to HS-ESS1-5)

PS1: Matter and Its Interactions

PS1.C: Nuclear Processes

- Spontaneous radioactive decays follow a characteristicexponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials. (secondary to HS-ESS1-5),(secondary to HS-ESS1-6)

PS4: Waves and Their Applications in Technologies for Information Transfer

PS4.A: Wave Properties

- Geologists use seismic waves and their reflection at interfaces betweenlayers to probe structures deep in the planet. (secondary to HS-ESS2-3)

Critical Content & Skills

*What students must **KNOW and be able to DO***

Students must KNOW:

Late Heavy Bombardment
Accretion
Meteorites
Craters
Volcanoes
Crust
Mantle
Outer Core
Inner Core
Felsic
Mafic
Continental Crust
Oceanic Crust
Direct Evidence
Indirect Evidence
Convection Currents
Thermal Expansion
Radioactive Decay
Rocks
Igneous
Metamorphic
Sedimentary
Minerals
Continental Drift
Plate Tectonics
Convergent Boundary
Divergent Boundary
Transform Boundary
Subduction
Deep Ocean Trench
Mid-Ocean Ridge
Mountain Building
Relative Dating
Law of Superposition
Law of Original Horizontality
Law of Cross-Cutting Relationships
Extrusion
Intrusion
Fault
Unconformity
Erosion
Fossils
Trace Fossils
Index Fossils
Fossil Correlation
Absolute Dating
Half Life Decay
Parent Isotope
Daughter Isotope
Radioactivity
Radiometric Dating

Students will be able to DO:

Engaging in Argument from Evidence
Evaluate evidence behind currently accepted explanations or solutions to determine the merits of arguments.

Constructing Explanations and Designing Solutions
Apply scientific reasoning to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion.

Developing and Using Models
Develop a model based on evidence to illustrate the relationships between systems or between components of a system.

Planning and Carrying Out Investigations
Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.

Core Learning Activities

1. Head-line Prompt (Unit Phenomenon): Strange teacher talks to rocks, rocks talk back! Students respond to the opening headline then engage in a stations activity. Investigation stations of local CT rocks of various types that tell stories about CT's geologic history including plate tectonics and fossil organisms.

2. Evidence of Earth's Formation Stations: Students will engage in "evidence stations" of interplanetary rock evidence that suggests that similar processes found on the terrestrial planets can help to explain the origin of our own planet.
Density of Earth materials lab: Students measure the density of rock and mineral samples then categorize them into groups based on their density and physical properties like crystal size, color, luster, etc.

3. Continental vs. Oceanic Crust lab: Students observe rocks and minerals to determine the component parts of the rocks based on visible properties.

4. Plate Tectonics (Slip, slide, collide) WebQuest: Students use computers to use an interactive website to gain general knowledge about plate boundaries and plate tectonics in place of traditional lecture-style notes based on their previous background knowledge of this topic from middle school.

5. Geologic History Project: Students create a piece of media such as a brochure or a website pretending they are taking a vacation to a geologic time period. This is a research project to introduce students to Geologic history.

5. Fossil Correlation Lab: Students construct a fictional fossil timeline based on the appearance and disappearance of fossil species in samples and make conclusions about extinction and relative dating.

6. Fossil Exploration Lab: Students observe and identify different fossils by using a field guide and the fossil's morphology.

- density of earth materials activity (densities given - KB version).docx
- Coninental vs. Oceanic crust lab
- Plate Tectonics webquest.pdf
- Copy of 06 Fossil Correlation Activity
- Do Now_ Headline Prompt.pdf
- fossil exploration lab.pdf

Assessments

Density of Earth Materials Lab
Formative: Lab Assignment
See attachments in Core Learning Activities.

Plate tectonics test/quiz
Summative: Written Test
Copy of Inside earth and plate tectonics quiz.pdf

Geologic time website project
Formative: Personal Project
https://sites.google.com/newtown.k12.ct.us/ipes-earth-history-project/home
geologic time project packet.pdf

Relative dating Quiz
Summative: Written Test
relative dating quiz.pdf

Resources

Professional & Student

Dynamic Earth Interactive website can be used with the webquest assignments and as a general learning and studying tool. https://www.learner.org/series...

Video to be used with Continental vs. Oceanic Crust lab:
https://www.youtube.com/watch?v=DHWavJf4SLE

Student Learning Expectation & 21st Century Skills

Information Literacy
Critical Thinking
Spoken Communication
Written Performance

Interdisciplinary Connections

Math: Using exponential decay curves when calculating half-lives. The half-life decay rate of radioactive isotopes follows the mathematically predictable exponential decay curve so reliably that scientists are able to form an accurate story of Earth's history around absolute dates of specific rocks samples.

Social Studies: There are connections to students' understanding of historical context to the Carboniferous Era in geologic history as this is when all the coal deposits were formed that were later discovered and utilized starting during the industrial revolution. Human history is also put into context with geologic history. Students will be presented with the fact that Earth's history spans 4.6 billion years and recorded human history is such a small fraction of that.

04 Climate Change (Historical and Modern)

8 Curriculum Developers

Concept-Based Unit Development Graphic Organizer (Download)

[Unit Web Template (Optional)]

Concepts / Conceptual Lens

Please attach your completed Unit Web Template here

Lens: Cause and Effect
Concepts: **geologic time, cause and effect, extinction, climate change, empirical evidence, models, feedback loops, changes, ratios, correlation, claims, systems, pattern, climate, relationships**

04 Climate Change

G

Generalizations / Enduring Understandings

1. Geologic time periods and their mass extinctions show correlation with global climate change and provide models that suggest current repetition of this pattern.

2. Positive feedback loops in Earth systems cause global climate change.

3. Models of the Earth's changing climate throughout geologic time suggest another mass extinction is in progress.

4. Drastic changes in the ratios of carbon within earth systems can cause an increase in global temperature.

5. Empirical evidence permits differentiation between cause and correlation and allows scientists to make claims about specific cause and effect relationships.

Guiding Questions

Please identify the type of question: (F) Factual, (C) Conceptual, (P) Provocative [Debatable]

1a. What does the fossil record say about past climate changes? (F)
1b. What has caused the climate to cool and warm in the past? (F)
1c. What caused the mass extinctions in Earth's past? (C)
1d. Should society care about climate change? (P)

2a. What is an atmospheric feedback loop? (F)
2b. What is the difference between weather and climate? (F)
2c. How do scientists use models to predict changing climate? (C)
2d. How are feedback loops making the climate crisis worse? (C)
2e. What can citizens of all ages do to mitigate the effects of climate change? (C)
2f. Who is responsible for "fixing" climate change? (P)

3a. What do current climate models say about the extinction rate of current species? (F)
3b. What are the effects climate change has on the future of the Earth? (C)
3c. How can climate change cause mass extinctions? (C)
3d. Is the Earth currently experiencing the sixth mass extinction? (P)
3e. Is the sixth mass extinction unavoidable? (P)

4a. What are the gasses that have the biggest impact on global temperature? (F)
4b. What are the ways that matter flows through the carbon cycle? (F)
4c. How do greenhouse gasses warm the atmosphere? (C)
4d. How can human activities cause imbalance in the carbon cycle? (C)
4e. How are humans increasing global temperature? (C)
4f. Is global warming irreversible? (P)

5a. What is the Sun's effect on the Earth's climate system? (F)
5b. What effect do solar cycles have on climate and climate change? (C)
5c. What is the current evidence for global climate change? (C)
5d. How do increases of average global temperatures, rising sea levels, reduced glaciation, and the accelerated extinction of species serve as evidence for climate change? (C)
5e. Are human activities causing climate change? (P)
5f. Is published climate data trustworthy/reliable? (P)

Standard(s)

Connecticut Core Standards / Content Standards

NGSS: Science Performance Expectations (2017)

NGSS: HS Earth & Space Science

HS.Earth's Systems

Performance Expectations

- HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
- HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.
- HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.

HS.Weather and Climate

Performance Expectations

- HS-ESS2-4. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
- HS-ESS3-5. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.

HS.Human Sustainability

Performance Expectations

- HS-ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

NGSS: Disciplinary Core Ideas

NGSS: 9-12

ESS2: Earth's Systems

ESS2.A: Earth Materials and Systems

- Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. (HSESS2-1),(HS-ESS2-2)
- The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation,volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g.,volcanic ash clouds) to intermediate (ice ages) to very long-termtectonic cycles. (HS-ESS2-4)

ESS2.C: The Roles of Water in Earth's SurfaceProcesses

- The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy,transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks. (HSESS2-5)

ESS2.D: Weather and Climate

- The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection,absorption, storage, and redistribution among the atmosphere,ocean, and land systems, and this energy's re-radiation into space.(HS-ESS2-4)
- Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. (HSESS2-6),(HS-ESS2-7)
- Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-6),(HS-ESS2-4)
- Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhousegases added to the atmosphere each year and by the ways in whichthese gases are absorbed by the ocean and biosphere. (secondary to HSESS3-6)

ESS3: Earth and Human Activity

ESS3.D: Global Climate Change

- Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. (HS-ESS3-5)
- Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in responseto human activities. (HS-ESS3-6)

Critical Content & Skills

*What students must **KNOW and be able to DO***

Terms students need to KNOW:

Solar Radiation
Absorption
Reflection
Albedo
Climate
Weather
Earth System
Climate System
Carbon
Carbon Cycle
Carbon sink
Carbon source
Fossil fuels
Emissions
Carbon Dioxide
Atmosphere
Hydrosphere
Lithosphere
Biosphere
Feedback loops
Positive/Negative feedback
Greenhouse Effect
Greenhouse gases
Global warming
Glaciation
Ice age
Mass Extinction
Solar Cycles
Seasons
Precession
Carboniferous Era
The Great Dying

Skills students need to DO:

Using Mathematics and Computational Thinking
Use a computational representation of phenomena or design solutions to describe and/or support claims and/or explanations.

Developing and Using Models
Develop a model based on evidence to illustrate the relationships between systems or between components of a system.
Use a model to provide mechanistic accounts of phenomena.

Planning and Carrying Out Investigations
Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.

Analyzing and Interpreting Data
Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.
Analyze data using computational models in order to make valid and reliable scientific claims.

Core Learning Activities

1. Albedo Lab: Students perform an experiment to test variables around reflection and absorption of light/heat to make conclusions about the effect of sunlight on different surfaces on Earth.

2. Melting glaciers “gallery walk”: Students view a series of pictures that show well known glaciers and bodies of water and the striking differences in conditions decades ago and modern day. Students are asked to think critically, evaluate the validity of the pictures, and make inferences.

3. Energy and resource efficiency check list: Students reflect on how their daily practices has an overall environmental impact.

4. Carbon Cycle Game: Students engage in a life-size board game style simulation that has them travel through carbon sinks.

5. Human Impact and Climate Change Test (link to test available below under "Assessments")

- Albedo lab.pdf
- Energy_Resource Efficiency Survey.pdf
- Melting glacier gallery walk of climate change.pdf
- Carbon Cycle Game Handout.pdf

Assessments

Carbon Cycle Game
Formative: Group Project
See attachments under Core Learning Activities.

Albedo Lab
Formative: Lab Assignment
See attachments under Core Learning Activities.

Human Impact on Earth Quiz
Summative: Written Test
Human Impact on Earth Quiz.pdf

Resources

Professional & Student

Climate Change Notes Presentation
Albedo article(s)
Greenhouse Effect (Notes)
Carbon cycle (Notes)
Sun's effect on climate (NASA website that provides data and evidence for melting ice caps)

Student Learning Expectation & 21st Century Skills

Information Literacy
Critical Thinking
Spoken Communication
Written Performance

Interdisciplinary Connections

Data Analysis of climate data such as rising sea levels, carbon dioxide concentrations in the oceans, and extinctions of species per year can link to math application. All climate data is typically displayed in graphical form such as on scatter plots and show a trend which is usually accompanied with a best fit line or rolling average line which are concepts covered in math.

Historically, climate change events have happened on a minor or more regional scale within the limits of human history. These historic examples can be used to analyze the effects that climate change can have on the course of history and their social, political, and economical impacts. (Examples; the year without a summer and the little ice age)

05 Energy Resources

8 Curriculum Developers

Concept-Based Unit Development Graphic Organizer (Download)

Unit Web Template (Optional)

Concepts / Conceptual Lens

Please attach your completed Unit Web Template here

Lens: Influence of Science, Engineering, and Technology on Society and the Natural World
Concepts: energy, systems, resources, renewability, development, constraints, evaluation, impact, solutions, sustainability, transformation, technology, demand, electricity, magnetism

05 Electromagnetism, Energy transformations, and Energy Resources

G

Generalizations / Enduring Understandings

1. Technological solutions to energy demand often reduce impacts of human activities on natural systems and resources.

2. Renewable energy resources enjoy sustainability because they transform energy from the Sun into usable technological solutions.

3. Evaluating energy solutions demands accounting for a range of natural and human constraints.

4. Electricity and magnetism interact to transform energy used for the development of society and technology, such as those used for generating power for human demand.

Guiding Questions

Please identify the type of question: (F) Factual, (C) Conceptual, (P) Provocative [Debatable]

1a. What are the current technological advances in renewable energy? (F)
1b. What is the role of energy in the modern world? (C)
1c. How do resource usage and availability affect the environment? (C)
1d. Is it critical to develop and utilize low impact energy sources? (P)
1e. Should non-renewable energy sources be outlawed? (P)

2a. What is the difference between renewable and non renewable resources? (F)
2b. How does heat energy generate electricity? (F)
2c. What is sustainability? (C)
2d. How does all the energy on Earth originate from the Sun? (C)
2e. Is sustainable energy better than non-renewable energy? (P)

3a. What factors affect human demand on energy/power? (F)
3b. What are the advantages and disadvantages of the different energy resources? (C)
3c. How do people choose the best energy resource for a particular location? (C)
3d. Can all renewable and nonrenewable resources be utilized in locations all over the world? (P)
3e. Are all renewable and nonrenewable resources available to the whole world's population? (P)
3f. Which method of generating electricity is the best? (P)
3g. Should the amount of usable energy influence human decisions and behaviors? (P)

4a. What is energy (F)
4b. What does it mean for energy to be conserved? (F)
4c. How can energy be conserved in a system? (C)
4d. What energy transformations are used to generate electricity? (C)
4e. How are electricity and magnetism related? (C)
4f. How do the properties of magnets allow them to be useful to society? (C)
4g. Is energy technology essential for the development of a global society? (P)

Standard(s)

Connecticut Core Standards / Content Standards

NGSS: Science Performance Expectations (2017)

NGSS: HS Physical Sciences

HS.Forces and Interactions

Performance Expectations

- HS-PS2-5. Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.

HS.Energy

Performance Expectations

- HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
- HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.*
- HS-PS3-5. Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.

NGSS: HS Earth & Space Science

HS.Human Sustainability

Performance Expectations

- HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
- HS-ESS3-2. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.*
- HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*

NGSS: Disciplinary Core Ideas

NGSS: 9-12

ESS3: Earth and Human Activity

ESS3.A: Natural Resources

- Resource availability has guided the development of human society.(HS-ESS3-1)
- All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulationscan change the balance of these factors. (HS-ESS3-2)

ESS3.B: Natural Hazards

- Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations. (HS-ESS3-1)

ESS3.C: Human Impacts on Earth Systems

- Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. (HS-ESS3-4)

PS2: Motion and Stability: Forces and Interactions

PS2.B: Types of Interactions

- Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects.(HS-PS2-4)
- Forces at a distance are explained by fields (gravitational,electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. (HS-PS2-4),(HS-PS2-5)

PS3: Energy

PS3.A: Definitions of Energy

- Energy is a quantitative property of a system that depends on the motionand interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. (HSPS3-1),(HS-PS3-2)
- At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HSPS3-2) (HS-PS3-3)

PS3.B: Conservation of Energy and Energy Transfer

- Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. (HS-PS3-1)
- Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1),(HSPS3-4)
- Mathematical expressions, which quantify how the stored energy in asystem depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior. (HS-PS3-1)
- The availability of energy limits what can occur in any system. (HS-PS3-1)

PS3.C: Relationship Between Energy and Forces

- When two objects interacting through a field change relative position, theenergy stored in the field is changed. (HS-PS3-5)

PS3.D: Energy in Chemical Processes and Everyday Life

- Although energy cannot be destroyed, it can be converted to less usefulforms—for example, to thermal energy in the surrounding environment.(HS-PS3-3),(HS-PS3-4)

ETS1: Engineering Design

ETS1.A: Defining and Delimiting an Engineering Problem

- Criteria and constraints also include satisfying any requirements setby society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such away that one can tell if a given design meets them. (HS-ETS1-1)(secondary to HS-PS2-3) (secondary to HS-PS3-3)

ETS1.B: Developing Possible Solutions

- When evaluating solutions it is important to take into account arange of constraints including cost, safety, reliability and aestheticsand to consider social, cultural and environmental impacts.(secondary to HS-LS2-7) (secondary to HS-LS4-6) (secondary to HSESS3-2),(secondaryHS-ESS3-4) (HS-ETS1-3)

Critical Content & Skills

*What students must **KNOW and be able to DO***

Terms Students must KNOW:

Renewable
Non-Renewable
Photovoltaic
Solar Energy
Wind Energy
Hydroelectric Energy
Biomass
Nuclear Power
Geothermal Energy
Turbine
Generator
Power Plant
Transformer
Conservation of Energy
Energy Transformation
Potential Energy
Kinetic Energy
Mechanical Energy
Chemical Energy
Radiant Energy
Nuclear Energy
Thermal Energy
Electron
Electromagnetism
Electrical Field
Magnetic Field
Magnet
Electricity
Current
Amps
Volts
V=IR
Resistance
Battery

Students must be able to DO:

Developing and Using Models
Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.
Constructing Explanations and Designing Solutions
Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations.
Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.
Using Mathematics and Computational Thinking
Create a computational model or simulation of a phenomenon, designed device, process, or system.
Planning and Carrying Out Investigations
Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.
Engaging in Argument from Evidence
Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations).

Core Learning Activities

1. Modern Marvels: Renewable Energy movie to offer background knowledge about renewable energy resource to aid in poster project.

2. Energy Resource Research and Presentation: Students create a poster detailing pros and cons of a renewable resource and how it works to generate electricity.

3. Wind Turbine: Students design and build a wind turbine that produces small amounts of voltage.

4. Testing PV Cells: Students use small photovoltaic cells (Solar Cells) to test the effects of different variables such as angle and light intensity on voltage production.

5. Energy Transformation Stations: Students engage in hands-on activities to explore simple energy transformations.

6. Using Electromagnetism Presentation: Basic notes and discussion on how various forms of energy are converted to electricity.

7. Build an Electromagnet: Students construct a simple electromagnet and determine which variables can affect the strength of the magnet.

- design a wind turbine.docx
- Testing PV Cells.doc
- Modern Marvels: Renewable Energy
- UsingElectroMagnetism.ppt.pdf
- Energy Transformation Stations.pdf
- Energy Sources Research and Presentations Rubric.pdf
- build an electromagnet.pdf

Assessments

Build an Electromagnet
Formative: Lab Assignment
See attachments under Core Learning Activities.

Energy Sources Research and Presentation
Formative: Group Project
See attachments under Core Learning Activities.

Wind Turbine Build
Summative: Personal Project
See attachments under Core Learning Activities.

Resources

Professional & Student

Text Book; Glencoe *Physical Science with Earth Science*. 2006. Unit 4. Chapter 16, pages 484-409.

Videos:
Introductory video to electromagnets and their use, effects, and how to build one.
https://www.youtube.com/watch?...

Crash Course Physics: Magnetism, a more detailed look at magnetism
https://www.youtube.com/watch?...

Sick Science: basic instructions on how to make a simple electromagnet. Use this video as in-class instructions for electromagnet activity. https://www.youtube.com/watch?...

Student Learning Expectation & 21st Century Skills

Information Literacy
Critical Thinking
Spoken Communication
Written Performance

- Information Literacy
- Problem Solving

Interdisciplinary Connections

Social Studies integration; In studying energy resources and how society generates power/electricity students will have to consider constraints such as population density, economics, and cost efficiency to determine the energy resources that would be best suited for certain regions. These social aspects of constraints on the power grid will help students synthesize a more complex solution to the energy crisis question and to more deeply weigh the pros and cons of each available resource. Further study of the effect of electric technology on society and modern first world life will be connected to the electromagnet investigations. Electromagnets are at the core of all electronic technology that makes life in the first world possible and could be part of the solution for lifting poorer nations out of poverty.

Students

Suspension and Expulsion/Due Process

It is the goal of the Board of Education to ensure the safety and welfare of all students in attendance, and to maintain an atmosphere conducive to learning. In keeping with this goal, students are expected to comply with school rules and regulations, as well as Board policies. Students may be disciplined for conduct on school grounds or at any school-sponsored activity that endangers persons or property, is seriously disruptive of the educational process, or that violates a publicized policy of the Board. Students may be disciplined for conduct off school grounds if such conduct is seriously disruptive of the educational process and violates a publicized policy of the Board.

In working with students, emphasis shall be placed upon developing effective self-discipline as the most effective disciplinary approach.

A. Definitions

1. **"Exclusion"** shall be defined as any denial of public school privileges to a student for disciplinary purposes.

2. **"Removal"** shall be defined as an exclusion from a classroom for all or a part of single class period, provided such exclusion shall not extend beyond ninety (90) minutes.

3. **"In-School Suspension"** shall be defined as an exclusion from regular classroom activity for no more than ten consecutive school days, but not exclusion from school, provided such exclusion shall not extend beyond the end of the school year in which such in-school suspension was imposed. Such suspensions shall be served in the school attended by the student. (or: Such suspensions may be served in any school building under the jurisdiction of the Board of Education. The Board has determined that in-school suspensions shall be served at all Newtown Schools.

4. **"Suspension"** shall be defined as an exclusion from school privileges or from transportation services for no more than ten (10) consecutive school days, provided such exclusion shall not extend beyond the end of the school year in which such suspension was imposed. All suspensions shall be in-school suspensions unless the administration determines for any student in grades three through twelve, inclusive, that (1) the student being suspended poses such a danger to persons or property or such a disruption of the educational process that the student (grades three to twelve, inclusive) shall be excluded from school during the period of suspension, or (2) that an out-of-school suspension is appropriate based on evidence of previous disciplinary problems that have led to suspensions or expulsion of the student and efforts by the administration to address such disciplinary problems through means other than out-of-school suspension or expulsion, including positive support strategies.

Students

Suspension and Expulsion/Due Process

A. Definitions (continued)

A student in grades preschool to two, inclusive, may be given an out-of-school suspension if it is determined by the administration that such suspension is appropriate based on evidence that the student's conduct on school grounds is of a violent or sexual nature that endangers persons. In addition, a person's duty as a mandated reporter to report suspected child abuse or neglect is not limited by this provision.

5. **"Expulsion"** shall be defined as an exclusion from school privileges for any student in grades three to twelve, inclusive, for more than ten (10) consecutive school days and shall be deemed to include but not be limited to, exclusion from the school to which such student was assigned at the time such disciplinary action was taken, provided that assignment to a regular classroom program in a different school in the district shall not constitute a suspension or an expulsion. Such period of exclusion may extend to the school year following the school year in which the exclusion was imposed, up to one calendar year.

6. **"Emergency"** shall be defined as a situation under which the continued presence of the student in the school imposes such a danger to persons or property or such a disruption of the educational process that a hearing may be delayed until a time as soon after the exclusion of such student as possible.

7. **"Days"** is defined as days when school is in session.

8. **"School-sponsored activity"** is defined as any activity sponsored, recognized or authorized by the Board of Education and includes activities conducted on or off school property.

9. **"Possess"** means to have physical possession or otherwise to exercise dominion or control over tangible property.

10. **"Deadly weapon"** means any weapon, whether loaded or unloaded, from which a shot may be discharged, or a switchblade knife, gravity knife, billy, blackjack, bludgeon metal or brass knuckles, any BB gun, any blackjack, any metal or brass knuckles, any police baton or nightstick, any dirk knife or switch knife, any knife having an automatic spring release device by which a blade is released from the handle, having a blade of over one and one- half inches in length, any stiletto, any knife the edged portion of the blade of which is four inches or over in length, any martial arts weapon or electronic defense weapon, as defined in section 53a-3, or any other dangerous or deadly weapon or instrument.

Students

Suspension and Expulsion/Due Process

A. Definitions (continued)

11. **"Firearm"** means 1) any weapon (including a starter gun) which will or is designed to or readily be converted to expel a projectile by the action of an explosive; 2) the frame or receiver of any such weapon; 3) any firearm muffler or firearm silencer; or 4) any destructive device. For purposes of this definition "destructive device" means any explosive, incendiary, or poison gas, bomb, grenade, rocket having a propellant charge of more than 4 ounces, missile having an explosive or incendiary charge of more than ¼ ounce, mine, or device similar to any of the weapons described herein.

12. **"Vehicle"** means a **"motor vehicle"** as defined in Section 14-1 of the Connecticut General Statutes, snow mobile, any aircraft, or any vessel equipped for propulsion by mechanical means or sail.

13. **"Martial arts weapon"** means a nunchakum kama, kasari-fundo, octagon sai, tonfa or Chinese star.

14. **"Dangerous Drugs and Narcotics"** is defined as any controlled drug in accordance with Connecticut General Statutes §21a-240.

15. **"Dangerous Instrument"** is any instrument, article or substance that, under the circumstances in which it is used or attempted or threatened to be used, is capable of causing death or serious physical injury.

16. **"Alternate education"** means a school or program maintained and operated by the Board of Education that is offered to students in a nontraditional setting and addresses their social, emotional, behavioral and academic needs. Such program must conform to SBE guidelines and conform to C.G.S 10-15 & 16 (180 days/900 hours)

B. Removal from Class

1. All teachers are hereby authorized to remove a student from class when such student causes a serious disruption of the educational process within the classroom.

2. Such teacher shall send the student to the office and shall immediately inform the building Principal or his/her designee as to the name of the student and the reason for removal.

C. Exclusion from Co-Curricular and Extra-Curricular Activities

Participation in co-curricular and extra-curricular activities is a privilege and not an entitlement. Students involved in such programs are expected to follow all school rules and demonstrate good citizenship. Failure to do so may result in partial or complete exclusion from said activities and programs. Activities include, but are not limited to, athletic programs, musical or drama productions, clubs, field trips, and school trips out-of-state and abroad.

Students

Suspension and Expulsion/Due Process (continued)

D. Suspension and Expulsion

1. A student may be suspended (in-school) or suspended (out-of-school) or expelled (grade three to twelve, inclusive) for conduct on school property or at a school-sponsored activity that endangers persons or property, is violative of a publicized policy of the Board, or is seriously disruptive of the educational process, including but not limited to one or more of the following reasons:

    a. Conduct causing danger to the physical well-being of himself/herself or other people that is not reasonably necessary for self-defense;

    b. Intentionally causing or attempting to cause physical injury to another person that is not reasonably necessary for self-defense;

    c. Intentionally causing or attempting to cause damage or school property or material belonging to staff (private property);

    d. Stealing or attempting to steal private or school property or taking or attempting to take personal property or money from any other person;

    e. The use, either spoken or written on clothing, of obscene or profane language or gestures on school property or at a school-sponsored activity;

    f. Deliberate refusal to obey the directions or orders of a member of the school staff;

    g. Harassment and/or hazing/bullying on the basis of that person's race, religion, ethnic background, gender or sexual orientation;

    h. Open defiance of the authority of any teacher or person having authority over the student, including verbal abuse;

    i. Threatening in any manner, including orally, in writing, or via electronic communication, a member of the school including any teacher, a member of the school administration or any other employee, or a fellow student;

    j. Blackmailing a member of the school community, including any teacher, member of the school administration or any other employee or fellow student;

    k. Possession of a firearm, deadly weapon, dangerous instrument, or martial arts weapon, as defined in Section 53a-3, such as a pistol, knife, blackjack, etc.;

    l. Possession of any weapon or weapon facsimile, including but not limited to knife, pistol, pellet guns and/or air soft pistols;

    m. Possession, transmission, distribution, selling, use or consumption of alcoholic beverages, dangerous drugs or narcotics or intoxicant of any kind or any facsimile of a dangerous drug, narcotic or intoxicant of any kind;

Students

Suspension and Expulsion/Due Process

D. Suspension and Expulsion (continued)

n. Knowingly being in the presence of those who are in possession of using, transmitting, or being under the influence of any dangerous drug, narcotic, hallucinogenic drug, amphetamine, barbiturate, marijuana, alcoholic beverage, or intoxicant of any kind;

o. Participation in any unauthorized occupancy by any group of students or others of any part of any school, school premises or other building owned by any school district after having been ordered to leave said school premises or other facility by the Principal or other person then in charge of said school building or facility;

p. Participation in any walkout from a classroom or school building by any group of students and refusing to immediately return to said classroom or school building after having been directed to do so by the Principal or other person then in charge of said classroom or school building;

q. Intentional incitement which results in an unauthorized occupation of, or walkout from, any school building, school premises, facility or classroom by any group of students or other persons;

r. Repeated unauthorized absence from or tardiness to school;

s. Intentional and successful incitement of truancy by other students;

t. The use or copying of the academic work of another and the presenting of it as one's own without proper attribution;

u. Violation of school rules and practices or Board policy, regulation or agreement, including that dealing with conduct on school buses and the use of school district equipment;

v. Violation of any federal or state law which would indicate that the violator presents a danger to any person in the school community or to school property;

w. Lying, misleading or being deceitful to a school employee or person having authority over the student;

x. Unauthorized leaving of school or school-sponsored activities;

y. Unauthorized smoking.

Students

Suspension and Expulsion/Due Process (continued)

E. Suspension for Conduct Off School Grounds

1. Students are subject to suspension for conduct off school property and outside of school-sponsored activities in accordance with law, for conduct that violates a publicized policy of the Board and is seriously disruptive of the educational process, including but not limited to the following:

    a. Conduct leading to a violation of any federal or state law if that conduct is determined to pose a danger to the student himself/herself, other students, school employees or school property.

    b. Adjudication as a delinquent or a youthful offender as the result of a felony if the conduct leading to the adjudication is determined to pose a danger to the student himself/herself, other students, school employees or school property.

2. In making a determination as to whether conduct is "seriously disruptive of the educational process," the administration, Board of Education or impartial hearing board may consider, but such consideration shall not be limited to; (1) whether the incident occurred within close proximity of a school; (2) whether other students from the school were involved or whether there was any gang involvement; (3) whether the conduct involved violence, threats of violence or the unlawful use of a weapon as defined in Section 29-38 and whether any injuries occurred, and (4) whether the conduct involved the use of alcohol, narcotic drug, hallucinogenic drug, amphetamine, barbiturate or marijuana.

F. Mandatory Expulsion

It shall be the policy of the Board to expel a student, grades preschool, and kindergarten to twelve, inclusive, for one full calendar year if:

1. The student, on grounds or at a school-sponsored activity, was in possession of a firearm, as defined in 18 U.S.C. 921*, as amended from time to time, or deadly weapon, dangerous instrument or martial arts weapon, as defined in C.G.S. 53A-3; or the student, off school grounds, did possess such firearm in violation of C.G.S. 29-35 or did possess and use such a firearm, instrument or weapon in the commission of a crime; or the student, on or off school grounds offered for sale or distribution a controlled substance, as defined in subdivision (9) of C.G.S. 21a-240, whose manufacture, distribution, sale, prescription, dispensing, transporting or possessing with intent to sell or dispense, offering or administering is subject to criminal penalties under C.G.S. 21-277 and 21a-278.

    *A firearm; currently defined by 18 U.S.C. 921, is any weapon that can expel a projectile by an explosive action and includes explosive devices, incendiaries, poison gases, and firearm frames, receivers, mufflers or silencers.

Students

Suspension and Expulsion/Due Process

F. Mandatory Expulsion (continued)

2. Such a student shall be expelled for one calendar year if the Board of Education or impartial hearing board finds that the student did so possess or so possess and use, as appropriate, such a weapon or firearm, instrument or weapon or did so offer for sale or distribution such a controlled substance.

3. The Board may modify the period of a mandatory expulsion on a case-by-case basis.

4. A firearm, as defined by C.G.S. 53a-3 includes any sawed-off shotgun, machine gun, rifle, shotgun, pistol, revolver, or other weapon, whether loaded or unloaded from which a shot may be discharged, or a switchblade knife, a gravity knife, billy, black jack, bludgeon or metal knuckles.

5. A student enrolled in a preschool program provided by the Board of Education, state or local charter school or interdistrict magnet school shall not be expelled from such school except that a student shall be expelled for one calendar year from such preschool program pursuant to the mandatory expulsion requirement in compliance with the Gun-Free School Act, as described in this section.

G. Suspension Procedure

1. The administration of each school shall have the authority to invoke suspension for a period of up to ten days or to invoke in-school suspension for a period of up to ten school days of any student for one or more of the reasons stated in paragraph C, above, in accordance with the procedure outlined in this paragraph. Suspensions shall be in-school suspensions unless the administration determines that the student being suspended poses such a danger to persons or property or such a disruption of the educational process that the student shall be excluded from school during the period of suspension. The administration may also consider a student's previous disciplinary problems when deciding whether an out-of-school suspension is warranted, as long as the school previously attempted to address the problems by means other than an out-of-school suspension or an expulsion.

   The administration is expected to use the guidelines developed and promulgated by the Commissioner of Education to help determine whether a student should receive an in-school or out-of-school suspension.

Students

Suspension and Expulsion/Due Process

G. Suspension Procedure (continued)

The administration shall also have the authority to suspend a student from transportation services whose conduct while awaiting or receiving transportation violates the standards set forth in paragraph C, above. The administration shall have the authority to immediately suspend from school any student when an emergency exists as that term is defined in paragraph A, above.

If an emergency situation exists, the hearing outlined in paragraph G (3) shall be held as soon as possible after the exclusion of the student.

2. In the case of suspension, the administration shall notify the student's parents and the Superintendent of Schools not later than twenty-four (24) hours of the suspension as to the name of the student who has been suspended and the reason therefore. Any student who is suspended shall be given an opportunity to complete any class work including, but not limited to, examinations which such student missed during the period of his/her suspension.

3. Except in the case of an emergency, as defined in paragraph A, above, a student shall be afforded the opportunity to meet with the administration and to respond to the stated charges prior to the effectuation of any period of suspension or in-school suspension. If, at such a meeting the student denies the stated charges, he/she may at that time present his/her version of the incident(s) upon which the proposed suspension is based. The administration shall then determine whether or not suspension or in-school suspension is warranted. In determining the length of a suspension period, the administration may receive and consider evidence of past disciplinary problems which have led to removal from a classroom, in-school suspension, or expulsion.

4. No student shall be suspended more than ten times or a total of fifty (50) days in one school year, whichever results in fewer days of exclusion, unless a hearing as provided in paragraph H(5) is first granted.

5. No student shall be placed on in-school suspension more than fifteen times or a total of fifty (50) days in one school year, whichever results in fewer days of exclusion, unless a hearing as provided in paragraph H(5) is first granted.

Students

Suspension and Expulsion/Due Process (continued)

H. Expulsion Procedures

1. The Board of Education may, upon recommendation of the Superintendent of Schools, expel any student for one or more of the reasons stated in this policy if in the judgment of the Board of Education, such disciplinary action is in the best interest of the school system.

2. Upon receipt of a recommendation for expulsion from the Superintendent of Schools the Board shall, after giving written notice, at least five (5) business days before such hearing, to the student and his parents or guardian, if said student is less than 18 years of age, conduct a hearing prior to taking any action on the expulsion of said student, provided however, that in the event of an emergency as defined in this policy, the student may be expelled prior to the hearing but in such case even a hearing shall be held as soon after the expulsion as possible. The notice shall include information concerning the student's and his/her parent's/guardian's legal rights and concerning legal services that are provided free of charge or at a reduced rate that are available locally (CT Legal Service a source of such services) and how to access such services. An attorney or other advocate may represent any student subject to expulsion proceedings. The parent/guardian of the student has the right to have the expulsion hearing postponed for up to one week to allow time to obtain representation, except that if an emergency exists, such hearing shall be held as soon after the expulsion as possible.

3. ~~A quorum of the Board of Education will be present for an expulsion hearing. A student may be expelled if a majority of the Board members sitting in the expulsion hearing vote to expel.~~ Expulsion hearings conducted by the Board will be heard by any three or more Board members. A decision to expel a student must be supported by a majority of the Board members present, provided that no less than three (3) affirmative votes to expel are cast. If fewer than three Board members are available then the Board Chair, in consultation with the Superintendent, may appoint a hearing officer.

   Alternatively, the Board may appoint an impartial hearing board composed of one (1) or more persons to hear and decide expulsion matters, provided that no member of the Board may serve on such panel. The Board may include a time period for the appointment.

4. A special education student's handicapping conditions shall be considered before making a decision to expel. A Planning and Placement Team (PPT) meeting must be held to determine whether the behavior or student actions violative of Board of Education standards set forth in policy governing suspension and expulsion are the result of the student's handicapping condition.

5. The procedure for any hearing conducted under this paragraph shall at least include the right to:

Students

Suspension and Expulsion/Due Process

H. Expulsion Procedures (continued)

a. Notice prior to the date of the proposed hearing which shall include a statement of the time, place and nature of the hearing and a statement of the legal jurisdiction under which the hearing is to be held and a statement that students under sixteen years old who are expelled and students between sixteen and eighteen who have been expelled for the first time and who comply with conditions set by the Board of Education, must be offered an alternative educational opportunity;

b. A short and plain statement of the matters asserted, if such matters have not already been provided in a statement of reasons requested by the student;

c. The opportunity to be heard in the student's own defense;

d. The opportunity to present witnesses and evidence in the student's defense;

e. The opportunity to cross-examine adverse witnesses;

f. The opportunity to be represented by counsel at the parents'/student's own expense; and

g. Information concerning legal services provided free of charge or at a reduced rate that are available locally and how to access such services;

h. The opportunity to have the services of a translator, to be provided by the Board of Education whenever the student or his/her parent or legal guardian do not speak the English language;

i. The prompt notification of the decision of the Board of Education, which decision shall be in writing if adverse to the student concerned.

6. The record of the hearing held in any expulsion case shall include the following:

a. All evidence received and considered by the Board of Education;

b. Questions and offers of proof, objections and ruling on such objections;

c. The decision of the Board of Education rendered after such hearing; and

d. A copy of the initial letter of notice of proposed expulsion, a copy of any statement of reasons provided upon request, a statement of the notice of hearing and the official transcript, if any or if not transcribed, any recording or stenographic record of the hearing.

Students

Suspension and Expulsion/Due Process

H. Expulsion Procedures (continued)

7. Rules of evidence at expulsion hearings shall assure fairness, but shall not be controlled by the formal rules of evidence, and shall include the following:

   a. Any oral or documentary evidence may be received by the Board of Education but, as a matter of policy, irrelevant, immaterial or unduly repetitious evidence may be excluded. In addition, other evidence of past disciplinary problems which have led to removal from a classroom, in-school suspension, suspension, or expulsion may be received for considering the length of an expulsion and the nature of the alternative educational opportunity, if any, to be offered;

   b. The Board of Education shall give effect to the rules of privilege by law;

   c. In order to expedite a hearing, evidence may be received in written form, provided the interest of any party is not substantially prejudiced thereby;

   d. Documentary evidence may be received in the form of copies or excerpts;

   e. A party to an expulsion hearing may conduct cross-examination of witnesses where examination is required for a full and accurate disclosure of the facts;

   f. The Board of Education may take notice of judicially relevant facts in addition to facts within the Board's specialized knowledge provided, however, the parties shall be notified either before or during the hearing of the material noticed, including any staff memoranda or data, and an opportunity shall be afforded to any party to contest the material so noticed;

   g. A stenographic record or recording of any oral proceedings before the Board of Education at an expulsion hearing shall be made provided, however, that a transcript of such proceedings shall be furnished upon request of a party with the cost of such transcript to be paid by the requesting party. Findings of fact made by the Board after an expulsion hearing shall be based exclusively upon the evidence adduced at the hearing.

   h. Decisions shall be in writing if adverse to the student and shall include findings of fact and conclusions necessary for the decision. Findings of fact made by the Board after an expulsion hearing shall be based exclusively upon the evidence adduced at the hearing.

Students

Suspension and Expulsion/Due Process

H. Expulsion Procedures (continued)

8. For any student expelled for the first time and who has never been suspended, except for a student who has been expelled based on possession of a firearm or deadly weapon, the Board of Education may shorten the length of or waive the expulsion period if the student successfully completes a Board specified program and meets any other conditions required by the Board. Such a Board specified program shall not require the student or the parent/guardian of such student to pay for participation in the program.

I. Notification

1. All students and parents within the jurisdiction of the Board of Education shall be informed, annually, of Board Policy governing student conduct by the delivery to each said student of a written copy of said Board Policy.
2. The parents or guardian of any minor student either expelled or suspended shall be given notice of such disciplinary action no later than 24 hours of the time of the institution of the period of expulsion or suspension.
3. The notice of an expulsion hearing shall be given at least five (5) business days before such hearing to the student and his/her parents or guardians, if said student is less than 18 years of age shall include information concerning the parent's/guardian's and the student's legal rights and concerning legal services that are provided free of charge or at a reduced rate that are available and how to access such services. The notification shall include a statement that an attorney or other advocate may represent any student subject to expulsion proceedings. The parent/guardian of the student shall be notified of the right to have the expulsion hearing postponed for up to one week to allow time to obtain representation, except that if an emergency exists, such hearing shall be held as soon after the expulsion as possible.

J. Students with Disabilities

A special education student's IEP and/or 504 disability shall be considered before making a decision to suspend. A student with disabilities may be suspended for up to ten school days in a school year without the need for the district to provide any educational services. A disabled student may be additionally removed (suspended) for up to ten school days at a time for separate acts of misconduct as long as the removals do not constitute a pattern. During any subsequent suspension of ten days or less of a student with disabilities, the district shall provide services to the disabled student to the extent determined necessary to enable the student to appropriately advance in the general education curriculum and toward achieving his/her IEP goals. In cases involving removals for ten days or less, school personnel (school administration) in consultation with the child's special education teacher, shall make the service determination.

Students

Suspension and Expulsion/Due Process

J. Students with Disabilities (continued)

If the disabled student's suspensions beyond ten school days in a school year constitute a pattern because of factors such as the length of each removal, the total amount of time the child is removed and the proximity of the removals to one another, the IEP team (PPT) shall conduct a manifestation determination. Meetings of a student's IEP team (PPT) are required to develop a behavioral assessment plan or to review and modify as necessary one previously developed when the disabled student has been removed (suspended) from his/her current placement for more than ten school days in a school year and when commencing a removal (suspension) that constitutes a change in placement.

Whenever a student is suspended, notice of the suspension and the conduct for which the student was suspended shall be included on the student's cumulative educational record. Such notice shall be expunged from the record by the Board if the student graduates from high school.

Notwithstanding the foregoing, the following procedures shall apply to students who have been identified as having one or more disabilities under the IDEA and/or Section 504 of the Rehabilitation Act (a "student with disabilities"):

1. If a student with disabilities engages in conduct that would lead to a recommendation for expulsion, the district shall promptly convene an IEP team (PPT) meeting to determine whether the misconduct was caused by or had a direct and substantial relationship to the student's disability or if the conduct in question was the direct result of the District's failure to implement the IEP. A student may be suspended for up to ten days pending the IEP team (PPT) determination.

2. If the District, parent and relevant members of the IEP team (PPT) determine that the misconduct was not caused by the disability, the Superintendent may proceed with a recommendation for expulsion. During any period of expulsion, a student with disabilities under the IDEA shall receive an alternative educational plan consistent with the student's educational needs as determined by the IEP team (PPT) in light of such expulsion and the student's IEP. The services must continue to the extent determined necessary to enable the disabled student to appropriately advance in the general education curriculum and to advance toward achieving the goals of his/her IEP, and be provided a free appropriate public education.

Students

Suspension and Expulsion/Due Process

J. Students with Disabilities (continued)

3. If the District, parent and relevant members of the IEP team (PPT) determine that the misconduct was caused by or had a direct and substantial relationship to the disability, or the conduct in question was the direct result of the District's failure to implement the student's IEP, the Superintendent shall not proceed with the recommendation for expulsion. The IEP team (PPT) shall consider the student's misconduct and revise the IEP to prevent a recurrence of such misconduct and to provide for the safety of the other students and staff. A functional behavioral assessment shall be conducted, if not previously done, and a behavioral intervention plan implemented or revised, if in existence. The student shall be returned to the placement from which he/she was removed unless agreed otherwise by the District and parent.

4. Should a parent of a student with disabilities who is eligible for services under the IDEA (or the student himself/herself if eighteen years of age or older) file a request for a due process hearing to contest an expulsion under subparagraph (2) above or a proposed change in placement under subparagraph (3), unless the parents (or student if eighteen years of age or older) and the Board otherwise agree, the child shall stay in the interim alternate educational setting, if so placed by student authorities, pending decision in said due process hearing and any subsequent judicial review proceedings.

5. Notwithstanding the provisions of the preceding subparagraph (4), a student with disabilities may be assigned to an interim alternative educational setting for not more than forty-five (45) school days if the student brings a weapon to school or to a school function or knowingly possesses or uses illegal drugs or sells or solicits the sale of a controlled substance while at school or a school function, or has inflicted serious bodily injury upon another person while at school, on school premises, or at a school function. For purposes of this paragraph, "weapon" means a device instrument, material, or substance, animate or inanimate, that is used for, or is readily capable of, causing death or serious bodily injury, but excludes a pocket knife with a blade of less than 2 ½ inches in length. "Serious bodily injury" is defined as bodily injury which involves a substantial risk of death, extreme physical pain, protracted and obvious disfigurement or protracted loss or impairment of the function of a bodily member, organ or mental faculty. The interim alternative placement shall be determined by the IEP team (PPT). If a due process hearing is requested, the student shall remain in said interim alternative placement pending a decision in the due process hearing, unless the Board and the parents otherwise agree, or the Board obtains a court order.

Students

Suspension and Expulsion/Due Process

J. Students with Disabilities (continued)

6. In order for the district to unilaterally obtain a 45-day change in placement from a federal judge of Connecticut hearing officer, it must prove by substantial evidence that maintaining the current placement of the student is substantially likely to result in injury to the child or others. The school must also prove that it has made reasonable efforts to minimize the risk of harm the student presents in the current placement.

K. Alternative Educational Opportunity

The Board of Education recognizes its obligation to offer any student under the age of sixteen (16) who is expelled an alternative educational opportunity which shall be equivalent to alternative education, as defined, with an individualized learning plan, during the period of expulsion. Any parent or guardian of such student who does not choose to have his or her child enrolled in an alternative educational program shall not be subject to the provision of Section 10-184 of the Connecticut General Statutes. Any expelled student who is between the ages of sixteen (16) and eighteen (18) not previously expelled and who wishes to continue his or her education shall be offered such an alternative educational opportunity if he or she complies with conditions established by the Board of Education. Such alternative educational opportunity may include, but shall not be limited to, the assignment of a student (who is seventeen (17) years of age or older) to an adult education program or placement of such student in a regular classroom program of a school other than the one from which the student has been excluded. Any student participating in an adult education program during a period of expulsion shall not be required to withdraw from school under C.G.S. 10-184. In determining the nature of the alternative education opportunity to be offered under this Section, the Board of Education may receive and consider evidence of past disciplinary problems which have led to removal from a classroom, suspension, or expulsion.

The Board of Education is not obligated to provide such alternative educational opportunity to any student eighteen years of age or older. The Board of Education is also required to offer such alternative educational opportunity, as defined, to any student between the ages of sixteen and eighteen who is expelled because of conduct which endangers persons, and involved the following, on school grounds or at a school-sponsored event:

1. Possession of a firearm, deadly weapon, dangerous instrument or martial arts weapon, or

2. Offering an illegal drug for sale or distribution.

Students

Suspension and Expulsion/Due Process

K. Alternative Educational Opportunity (continued)

If the Board expels a student for the sale or distribution of a controlled substance, the Board shall refer the student to an appropriate state or local agency for rehabilitation, intervention or job training, or any combination thereof, and inform the agency of its action. If a student is expelled for possession of a firearm, deadly weapon, dangerous instruments (those that can be used to cause death or serious injury) or martial arts weapons the Board shall report the violation to the local police department.

This provision shall not apply to students requiring special education who are described in subdivision (1) of sub-section (e) of C.G.S. 10-76a. The alternative educational opportunity for any such student shall be established by the IEP team (PPT) in accordance with the procedures described above.

L. Other Considerations

1. If a student is expelled, notice of the expulsion and the conduct for which the student was expelled shall be included on the student's cumulative educational record. Such notice, except for the notice of an expulsion of a student in grades nine through twelve, inclusive, based on possession of a firearm or deadly weapon, shall be expunged from the cumulative educational record by the Board if the Board determines that the student's conduct and behavior in the years following such expulsion warrants an expungement or if the student graduates from high school.

2. If a student's expulsion is shortened or the expulsion period waived based upon the fact that the student was expelled for the first time, had never been suspended, and successfully completed a Board specified program and/or met other conditions required by the Board, the notice of expulsion shall be expunged from the cumulative educational record if the student graduates from high school or, if the Board so chooses, at the time the student completes the Board specified program and meets any other conditions required by the Board.

3. If a student in grades kindergarten to eight, is expelled based on possession of a firearm or deadly weapon, the Board may expunge from the students' cumulative education record the notice of the expulsion and the conduct for which the student was expelled if the Board determines that the conduct and behavior of the student in the years following such expulsion warrants an expungement.

Students

Suspension and Expulsion/Due Process

L. Other Considerations (continued)

4. The Board may adopt the decision of a student expulsion hearing conducted by another school district provided such Board of Education held a hearing pursuant to C.G.S.10-233d(a). Adoption of such a decision shall be limited to a determination of whether the conduct which was the basis for the expulsion would also warrant expulsion under the policies of this Board. The student shall be excluded from school pending such hearing. The excluded student shall be offered an alternative education opportunity in accordance with item K above.

5. Whenever a student against whom an expulsion hearing is pending withdraws from school and after notification of such hearing but before the hearing is completed and a decision rendered, (1) notice of the pending expulsion hearing shall be included on the student's cumulative educational record and (2) the Board shall complete the expulsion hearing and render a decision.

6. A student expelled for possession of a firearm, deadly weapon, dangerous instrument or martial arts weapon shall have the violation reported to the local police department.

7. The period of expulsion shall not extend beyond a period of one calendar year. A period of exclusion may extend into the next school year.

8. An expelled student may apply for early readmission to school. Such readmission shall be at the discretion of the Board of Education or their designee. Readmission decisions shall not be subject to appeal to Superior Court. The Board or their designee may condition such readmission on specified criteria.

9. Any student who commits an expellable offense and is subsequently committed to a juvenile detention center, The Connecticut Juvenile Training School or any other residential placement for such offense may be expelled by the local Board of Education. The period of expulsion shall run concurrently with the period of commitment to a juvenile detention center, the Connecticut Juvenile Training School or any other residential placement.

Readmission of Student from a Residential Placement

A District student who has committed an expellable offense who seeks to return to a District school, after participating in a diversionary program or having been detained in a juvenile detention center, the Connecticut Juvenile Training School or any other residential placement, for one year or more, in lieu of expulsion from the District, shall be permitted to return to the appropriate school setting within the District. Further, the District shall not expel the student for any additional time for the offense(s).

Students and parents shall be notified of this policy annually.

Students

Suspension and Expulsion/Due Process

Legal Reference: Connecticut General Statutes
4-176e through 4-180a. Contested Cases. Notice. Record, as amended
10-233a through 10-233f Suspension, removal and expulsion of students, as amended by PA 95-304, PA 96-244, PA 98-139, PA 07-66, PA 07-122, PA 08-160, PA 09-82, PA 09-6 (September Special Session), PA 10-111, PA 11-126, PA 14-229, PA 15-96 and PA 16-147.
53a-3 Definitions.
53a-217b Possession of Firearms and Deadly Weapons on School Grounds.
PA 94-221 An Act Concerning School Discipline and Safety.
PA 15-96 An Act Prohibiting Out-of-School Suspensions and Expulsions for Students in Preschool and Grades Kindergarten to Two.
GOALS 2000: Educate America Act, Pub. L. 103-227.
18 U.S.C. 921 Definitions.
Title III - Amendments to the Individuals with Disabilities Education Act. Sec. 314 (Local Control Over Violence)
Elementary and Secondary Act of 1965 as amended by the Gun Free Schools Act of 1994
P.L. 105-17 The Individuals with Disabilities Act, Amendments of 1997.
Kyle P. Packer PPA Jane Packer v. Thomaston Board of Education.
20 U.S.C. Section 7114, No Child Left Behind Act
P.L. 108-446 The Individuals with Disabilities Education Improvement Act of 2004

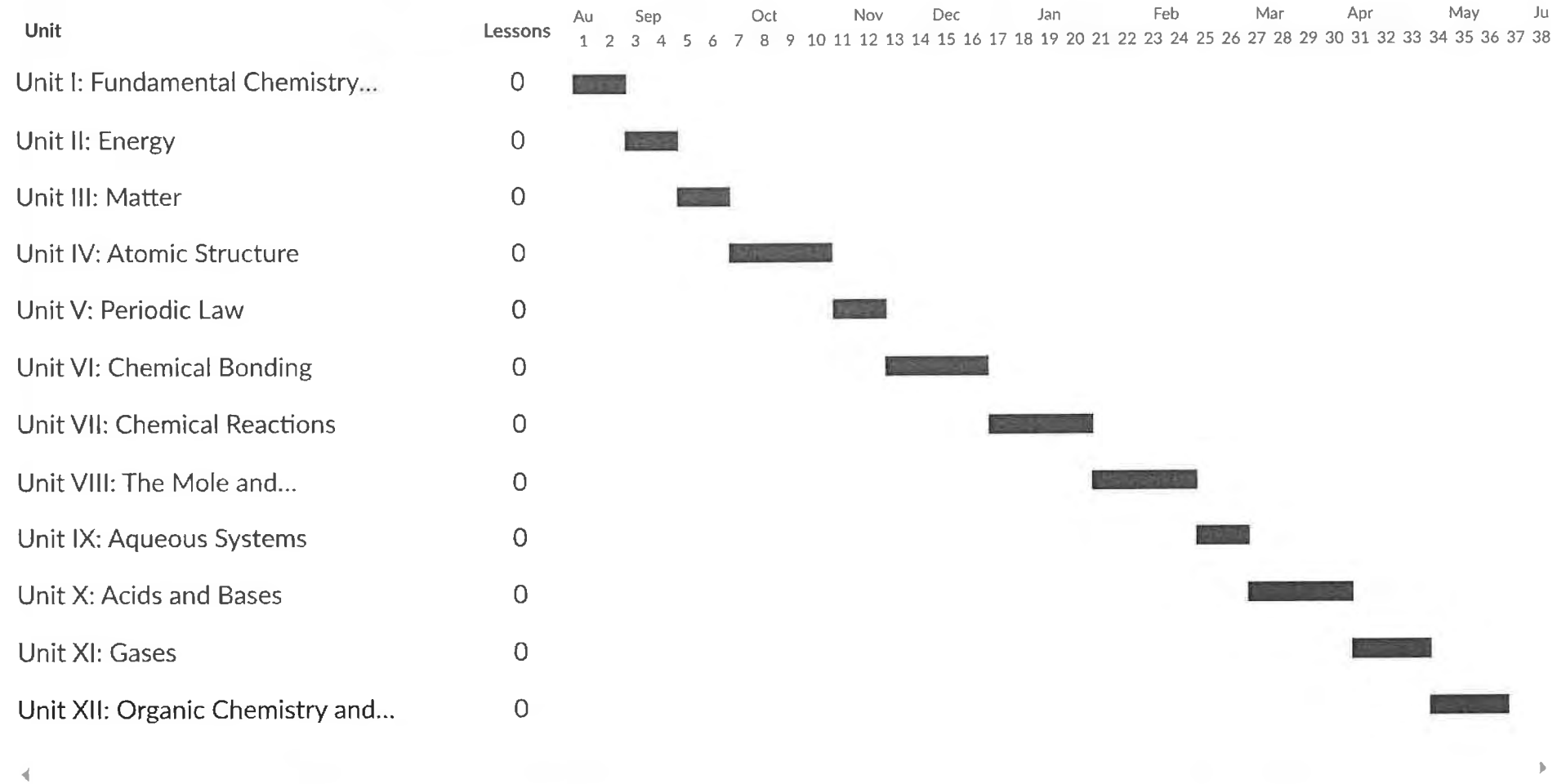
Newtown Public Schools

Atlas

Chemistry (CPA/Honors)

2 Curriculum Developers | Last Updated: Thursday, Feb 23, 2023 by Berechid, Bridget

Unit Calendar by Year



12 Units found

Unit Planner: Unit I: Fundamental Chemistry Skills Chemistry (CPA/Honors)

Friday, February 24, 2023 9:12AM

Newtown High School / 2022-2023 / Grade 11 / Science / Chemistry (CPA/Honors) / Week 1 - Week 2

Last Updated: Today by Christopher Carley

Unit I: Fundamental Chemistry Skills

Berechid, Bridget; Carley, Christopher

- Unit Planner
- Lesson Planner

Concept-Based Unit Development Graphic Organizer (Download)

Unit Web Template (Optional)

Concepts / Conceptual Lens

Please attach your completed Unit Web Template here

Lens:

Scientific Method

Concepts:

Safety

Inquiry

Hypothesis

Data

Objectivity

Qualitative Observations

Quantitative Observations

Equivalency

Conversions

Measurements

Precision

Accuracy

Significant figures

Error

G	Guiding Questions

Generalizations / Enduring Understandings	***Please identify the type of question: (F) Factual, (C) Conceptual, (P) Provocative [Debatable]***
1. Scientific inquiry investigates natural phenomena through the scientific method.	1a. What are phenomena? (F) 1b. What are the components of the scientific method? (F) 1c. Can all phenomena be investigated with the scientific method? (P)
2. Scientific inquiry supports or refutes scientific hypotheses. 3. Qualitative and quantitative data create an objective record of observations.	2a. How does one create a hypothesis? (C) 2b. Has an experiment failed if it does not support the hypothesis? (P)
4. Equivalencies convert measurements between related units. 5. Measurement tools provide different levels of precision in data collection.	3a. What is qualitative data? (F) 3b. What is quantitative data? (F) 3c. Is one type of data more important than the other? (P) 3d. How important is objectivity in scientific inquiry? (P)
6. Significant figures preserve the precision of measurements.	4a. What are the base units in the metric system? (F) 4b. Why are conversions necessary? (C) 4c. Are all equivalencies exactly equal? (C) 4d. Do all units have equivalencies with all other units? (C)
7. Percent error reports the accuracy of data.	5a. What is meant by the precision in data? (F) 5b. How do scientists determine which tool is most appropriate for a particular task? (P)
	6a. How are significant figures recorded? (F) 6b. How do significant figures relate to measurement tools? (C) 6c. Can measurements be perfectly precise? (P) 6d. Is there a benefit to properly recording the significant figures of a measurement? (C)
	7a. What is meant by the accuracy of data? (F) 7b. What is experimental data compared to when assessing accuracy? (F) 7c. Can data be accurate without precision? (P) 7d. Is there an acceptable maximum percent error in an experiment? (P)

Standard(s)

Connecticut Core Standards / Content Standards

NGSS: Science and Engineering Practices

NGSS: 9-12

Practice 1. Asking questions (for science) and defining problems (for engineering)

Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.

Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information.

Ask questions to determine relationships, including quantitative relationships, between independent and dependent variables.

Practice 3. Planning and carrying out investigations

Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.

Select appropriate tools to collect, record, analyze, and evaluate data.

Practice 4. Analyzing and interpreting data

Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.

Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.

Practice 5. Using mathematics and computational thinking

Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.

Apply techniques of algebra and functions to represent and solve scientific and engineering problems.

Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3, acre-feet, etc.).

Practice 6. Constructing explanations (for science) and designing solutions (for engineering)

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables.

Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.

Apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion.

Access the interactive version of the NGSS here

Critical Content & Skills

*What students must **KNOW and be able to DO***

- Understand proper design, execution, and reporting of an experiment through the scientific method
- Identify independent and dependent variables, constants, and the control in an experiment
- Distinguish between qualitative and quantitative observations
- Know the symbols and meanings of metric prefixes

- Use dimensional analysis to convert between metric and non-metric units
- Perform density calculations
- Convert between decimal form and scientific notation
- Identify and use laboratory equipment appropriately
- Utilize the correct technique to properly read instruments in order to take scientific measurements with correct significant figures
- Calculate percent error
- Assess whether data is accurate and/or precise
- Understand and apply basic laboratory safety rules

Core Learning Activities

- Math and Measurement Review
- Metric and Non-metric Conversions Practice
- Lab Safety Videos
- Lab Equipment Scavenger Hunt
- Reading Instruments Activity
- Bunsen Burner Lab
- Density Lab

Chemistry Math and Measurement Review .pdf
Metric System and Dimensional Analysis Practice 1 and 2.pdf
Dimensional Analysis Practice Set.pdf
Laboratory Equipment Graphic Organizer wo Names .pdf
Laboratory Equipment Conclusion .pdf
Laboratory Equipment Silent Scavenger Hunt.pdf
Reading Instruments Activity.pdf
Bunsen Burner Lab.pdf

Assessments

Measurements and Calculations Test
Summative: Written Test
Measurement and Calculations Review pdf
Density Lab
Formative: Lab Assignment
Students select two metal objects with different shapes and compositions and use two different methods to determine their volumes. They then calculate the density of each object and determine their percent error based on theoretical values.
Density Lab 2 Metals with Repeats .pdf

Resources

Professional & Student

Teacher Resources:

- Review of Introductory Science Skills
  - DiStasio,J., Chemistry, Frank Schaffer Publications,.
- Teacher's Edition of Text: T.Buthelezi, L. Dingrando, N. Hainen, C. Wistrom, Chemistry. McGraw Hill, Glencoe, 2008.
- K. Trivedi, General Chemistry 3.3: An Interactive Multimedia Course on DVD-ROM, 2006
- K. Packard, D. Jacobs, R. Marshall. Chemistry. Pearson AGS Globe, 2007.
- K. Packard, D. Jacobs, R. Marshall. Chemistry: Lab Manual. Pearson AGS Globe, 2007.
- K. Packard, D. Jacobs, R. Marshall. Chemistry: Student Workbook. Pearson AGS Globe, 2007.
- ChemWiki:The Dynamic Chemistry E-textbook
- Safety Videos
  - "The Ultimate Lab Safety Video"
  - "The Accident at Jefferson High"

	Student Resources: • Student Text: T.Buthelezi, L. Dingrando, N. Hainen, C. Wistrom, Chemistry. McGraw Hill, Glencoe, 2008. • K. Packard, D. Jacobs, R. Marshall. Chemistry. Pearson AGS Globe, 2007. • PHET Interactive Simulations • ChemWiki:The Dynamic Chemistry E-textbook • Metric System Conversions • Scientific Method • Significant Figures
Student Learning Expectation & 21st Century Skills Information Literacy Critical Thinking Spoken Communication Written Performance	Interdisciplinary Connections

Unit Planner: Unit II: Energy
Chemistry (CPA/Honors)

Friday, February 24, 2023 9:13AM

Newtown High School / 2022-2023 / Grade 11 / Science / Chemistry (CPA/Honors) / Week 3 - Week 4

Last Updated: Today by Christopher Carley

Unit II: Energy

Berechid, Bridget; Carley, Christopher

- Unit Planner
- Lesson Planner

Concept-Based Unit Development Graphic Organizer (Download)

Unit Web Template (Optional)

Concepts / Conceptual Lens

Please attach your completed Unit Web Template here

Lens:

Transformation

Concepts:

Energy
Motion

Potential energy

Kinetic energy

Electromagnetic radiation

Waves

Transmission

Chemical processes

Physical processes

Heat

Temperature

System

Surroundings

Exothermic process

Endothermic process

Thermodynamic favorability

G

Generalizations / Enduring Understandings	Guiding Questions ***Please identify the type of question: (F) Factual, (C) Conceptual, (P) Provocative [Debatable]***
1. Chemical and physical processes conserve and transform energy.	1a. What are the forms of energy? (F) 1b. What does it mean for energy to transform? (C) 1c. How is energy conserved when it changes forms? (C)
2. Matter stores potential energy.	2a. What is potential energy? (F) 2b. How do atoms and molecules store chemical potential energy? (F)
3. Moving objects utilize kinetic energy.	3a. What is kinetic energy? (F) 3b. How does the mass of a particle impact its kinetic energy? (F) 3c. How does the velocity of a particle impact its kinetic energy? (F) 3d. How do the kinetic energies of solids, liquids, and gases compare to each other? (C)
4. Electromagnetic radiation energy, such as light or heat, travels as waves.	4a. What are the types of electromagnetic radiation? (F) 4b. Is radiation able to move through any medium? (C)
5. Temperature measures the average kinetic energy of a system.	5a. What does temperature measure? (F) 5b. How are temperature and heat different? (C) 5c. Do all particles in a substance have equal kinetic energies? (C) 5d. How does the average kinetic energy of different objects at the same temperature compare? (C)
6. Exothermic processes release system energy into the surroundings, while endothermic processes absorb surrounding energy into the system.	6a. What is an exothermic process? (F) 6b. What is an endothermic process? (F) 6c. Is it thermodynamically favorable for a process to be exothermic or endothermic? (C) 6d. Will an endothermic process conducted at room temperature feel hot or cold? (C)

Standard(s)

Connecticut Core Standards / Content Standards

NGSS: Science Performance Expectations (2017)

NGSS: HS Physical Sciences

HS.Energy

Performance Expectations

HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when

the change in energy of the other component(s) and energy flows in and out of the system are known.

HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).

NGSS: Science and Engineering Practices

NGSS: 9-12

Practice 5. Using mathematics and computational thinking

Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.

Apply techniques of algebra and functions to represent and solve scientific and engineering problems.

Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3, acre-feet, etc.).

NGSS: Disciplinary Core Ideas

NGSS: 9-12

PS3: Energy

PS3.A: Definitions of Energy

Energy is a quantitative property of a system that depends on the motionand interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. (HSPS3-1),(HS-PS3-2)

At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HSPS3-2) (HS-PS3-3)

These relationships are better understood at the microscopic scale, atwhich all of the different manifestations of energy can be modeled as either motions of particles or energy stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. (HSPS3-2)

PS3.B: Conservation of Energy and Energy Transfer

Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. (HS-PS3-1)

Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1),(HSPS3-4)

Mathematical expressions, which quantify how the stored energy in asystem depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior. (HS-PS3-1)

Access the interactive version of the NGSS here

Critical Content & Skills

*What students must **KNOW and be able to DO***

- Distinguish between potential and kinetic energy.
- Understand that chemical and physical changes can be exothermic or endothermic.
- Construct and analyze potential energy diagrams to show that energy is released or absorbed during a

chemical reaction
- Understand that energy released or absorbed during a chemical reaction (heat of reaction) is equal to the difference between the potential energy of the products and the potential energy of the products.
- Convert between Celsius and Kelvin temperature scales.
- Distinguish between temperature and heat energy.
- Describe how temperature is a measurement of the average kinetic energy of the particles in a sample of material. Temperature is not a form of energy.
- Utilize the concepts of kinetic and potential energy to explain physical processes that include: fusion (melting), solidification (freezing), vaporization (boiling/evaporation), condensation, sublimation, and deposition.
- Calculate heat changes during pure phases or phase changes.
- Perform calorimetry calculations.
- Explain that entropy is a measurement of randomness or disorder of a system. A system with greater disorder has greater entropy.
- Understand that systems in nature tend to undergo changes towards lower energy and higher entropy.

Core Learning Activities

Specific Heat Calculation Practice

Calorimetry Calculation Practice
Phase Change POGIL

Phase Change Calculation Practice

Calorimetry POGIL

Calorimetry Lab

Heat vs. Temperature Lab

Heating Curve (Lauric Acid) Lab

Heating Curve Poster Project

Calorimetry POGIL.pdf
Specific Heat Calculations.pdf
Mixed Heat Calculations and Calorimetry.pdf
Phase Change POGIL.pdf
One Step Phase (Change) Problems .pdf
Phase Change Problems- guided multistep.pdf
Lauric Acid Lab student.pdf

Assessments

Phase Change Diagram Project
Formative: Lab Assignment
Students are assigned a substance and use data including melting and boiling points, specific heats of solid, liquid and gaseous forms, heats of fusion and vaporization and starting/ending temperatures. They use the data to construct a labelled heating/cooling curve and calculate the total heat required for the temperature transition.
Phase Change Diagram Project.pdf

Calorimetry (Determining the Specific Heat of Metals) Lab
Formative: Lab Assignment
Students perform calorimetry using insulated cups to measure temperature changes in water in order to determine the specific heat of various metals. They then

Resources

Professional & Student

Teacher Resources

- Teacher's Edition of Text:
  - T.Buthelezi, L. Dingrando, N. Hainen, C. Wistrom, Chemistry. McGraw Hill, Glencoe, 2008.
- ill Nye Video: Heat
- ACS Energy Resources
- ACS HS Chemistry Energy
- Video: Are Temperature and Heat the Same Thing?
- Demos with ice melting blocks (Flinn Scientific)

determine and assess their percent error for each experiment. Calorimetry Lab Directions.pdf Calorimetry Lab Data and Calculations Sheet.pdf **Heat vs Temperature Lab** **Formative: Lab Assignment** Students assess how mass and/or specific heat capacity affect internal heat energy. They also learn that internal heat energy and temperature are not the same. Copper Heat vs Temp Lab.pdf **Energy Test** **Summative: Written Test** Will include a combination of MC, short answer and calculations. Representative questions are illustrated in the test review. Energy Test Review .pdf	and the 5-rod heat conductometer (Ward's Scientific) **Students Resources:** • Student Text: T.Buthelezi, L. Dingrando, N. Hainen, C. Wistrom, Chemistry. McGraw Hill, Glencoe, 2008. • American Chemical Society: Science for Kids • Calorimetry Calculations • Phase Change Diagram Calculations • Types of Energy • Heat vs Temperature Explained
Student Learning Expectation & 21st Century Skills Information Literacy Critical Thinking Spoken Communication Written Performance	Interdisciplinary Connections

Unit Planner: Unit III: Matter
Chemistry (CPA/Honors)

Friday, February 24, 2023 9:14AM

Newtown High School / 2022-2023 / Grade 11 / Science / Chemistry (CPA/Honors) / Week 5 - Week 6

Last Updated: Today by Christopher Carley

Unit III: Matter

Berechid, Bridget; Carley, Christopher

- Unit Planner
- Lesson Planner

Concept-Based Unit Development Graphic Organizer (Download)

Unit Web Template (Optional)

Concepts / Conceptual Lens

Please attach your completed Unit Web Template here

Lens:

Changes in matter

Concepts:

Matter

Mass

Energy

Elements, compounds, and mixtures

Phases

Solid, liquid, gas, and plasma

Chemical properties

Physical properties

Chemical changes (reactions)

Physical changes

Conservation

G

Generalizations / Enduring Understandings

1. Matter composes all objects in the world, and has distinct chemical and physical properties.

Guiding Questions

Please identify the type of question: (F) Factual, (C) Conceptual, (P) Provocative [Debatable]

1. How is matter defined? (F)

2. Matter classifies as elements, compounds or (homogeneous or heterogeneous) mixtures.	2a. How are elements, compounds and mixtures defined? (F) 2b. How is matter categorized into elements, compounds and mixtures? (C)
3. All matter exists in phases including solids, liquids, gasses, and plasma.	3a. What are the four phases of matter? (F)
4. Matter interacts predictably based on its chemical and physical properties.	3b. How are the four phases of matter defined by their properties? (C) 3c. How does energy influence changes in matter? (C)
5. A change in energy drives the chemical and physical changes of matter.	4a. Can all matter be categorized based on chemical and physical properties? (P)
6. Chemical reactions conserve matter.	4b. How are physical properties used to separate a mixture into pure elements and compounds? (C) 5a. What is a physical change? (F) 5b. What is a chemical change (F) 5c. How can different types of matter be changed physically and/or chemically? (C) 5d. What are indicators of chemical change? (F) 5e. Are indicators always reliable markers of chemical change? (P) 6. What happens to matter during a chemical reaction? (C)

Standard(s)

Connecticut Core Standards / Content Standards

NGSS: Science and Engineering Practices

NGSS: 9-12

Practice 2. Developing and using models

Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism or system in order to select or revise a model that best fits the evidence or design criteria.

Design a test of a model to ascertain its reliability.

Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.

NGSS: Crosscutting Concepts

NGSS: 9-12

Crosscutting Statements

5. Energy and Matter: Flows, Cycles, and Conservation – Tracking energy and matter flows, into, out of, and within systems helps one understand their system's behavior.

The total amount of energy and matter in closed systems is conserved.

NGSS: Disciplinary Core Ideas

NGSS: 9-12

PS1: Matter and Its Interactions

PS1.A: Structure and Properties of Matter

The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HSPS1-3),(secondary to HS-PS2-6)

PS1.B: Chemical Reactions

The fact that atoms are conserved, together with knowledge ofthe chemical properties of the elements involved, can be used to describe and predict chemical reactions. (HS-PS1-2),(HS-PS1-7)

Access the interactive version of the NGSS here

Critical Content & Skills

*What students must **KNOW and be able to DO***

- Classify matter as a pure substance (elements or compounds) or mixture (homogeneous or heterogeneous).
- Know the symbols and names of commonly used elements on the periodic table.
- Predict how to separate mixtures based on their physical properties.
- Compare and contrast chemical and physical properties.
- Determine if a change in matter is chemical or physical.
- Describe indicators of chemical change.
- Demonstrate that matter is conserved during a chemical reaction.
- Calculate mass changes during chemical reactions.
- Compare and contrast the characteristics of solids, liquids and gases.
- Predict and explain how adding or subtracting heat energy alters the state of matter.
- Design and test an experiment to determine if mass is conserved during a chemical reaction.

Core Learning Activities

- Identifying Chemical and Physical Properties and Changes
- Physical Chemical Changes Lab
- Classifying Matter Practice
- States of Matter Activity
- Understanding Phase Change Diagrams
- Constructing and Analyzing Phase Change Diagrams
- Classifying Matter Lab
- Observing a Chemical Reaction Lab
- Conservation of Matter Calculations Practice
- Conservation of Matter Lab

Matter worksheets.pdf
Classification of Matter POGIL.pdf
Phase Change Diagrams.pdf
States of Matter Actvity.pdf
Phase Change Diagram wkst.pdf

Assessments

Classifying Matter Lab
Formative: Lab Assignment

Resources

Professional & Student

Students collaborate to decide whether a sample is a pure substance or a mixture. Students may use resources: notes, texts, and online research to defend their decision.
Substance ID Lab.pdf

Observing a Chemical Reaction Lab
Formative: Lab Assignment
Students observe and mix several different substances together. They must then distinguish between types of matter (elements/compounds/mixtures and types of changes (chemical or physical), as well as identifying indicators of chemical change. Alternatively, students observe and take notes on a demonstration where an aluminum soda can is placed into a solution of copper(II) chloride. Students observe the process over the next 5 classes, after which they use their data to identify indications that a chemical reaction occurred.
Observing a Chemical Reaction Lab.pdf

Physical and Chemical Changes Lab
Summative: Lab Assignment
Students perform various changes to matter and then determine whether those changes are physical or chemical based on their observations and data.
Physical and Chemical Changes.pdf

Conservation of Mass Lab
Summative: Lab Assignment
Students design and test an experiment for determining if the mass of the chemicals before and after a chemical reaction remains constant. The reaction between sodium bicarbonate and citric acid releases carbon dioxide as a gaseous product, requiring students to devise how to collect the gas in order to determine its mass as well.

Element Quiz
Summative: Written Test
Students demonstrate their knowledge of the names of common elements based on their atomic symbol, and vice versa.
element_quizA.doc

Matter Test
Summative: Written Test
Test will consist of multiple choice, short answer and calculation based questions. A test review with sample questions is included.
Matter Test Review.pdf

Teacher Resources

- Teacher's Edition of Text:
  - T.Buthelezi, L. Dingrando, N. Hainen, C. Wistrom, Chemistry. McGraw Hill, Glencoe, 2008.
- AACT Matter Resources
- Bill Nye Video: Phases of Matter

Students Resources:

- Student Text: T.Buthelezi, L. Dingrando, N. Hainen, C. Wistrom, Chemistry. McGraw Hill, Glencoe, 2008.
- ChemWiki: Physical Properties of Matter
- ChemWiki: Periodic Table of Elements
- States of Matter
- States of Matter Video
- States of Matter PhET
- American Chemical Society: Science for Kids
- http://www.webelements.com
- Chemical and Physical Changes
- Classification of Matter
- The Law of Conservation of Matter

Student Learning Expectation & 21st Century Skills

Information Literacy
Critical Thinking
Spoken Communication
Written Performance

Interdisciplinary Connections

Unit Planner: Unit IV: Atomic Structure
Chemistry (CPA/Honors)

Friday, February 24, 2023 9:15AM

Newtown High School / 2022-2023 / Grade 11 / Science / Chemistry (CPA/Honors) / Week 7 - Week 10

Last Updated: Today by Christopher Carley

Unit IV: Atomic Structure

Berechid, Bridget; Carley, Christopher

- Unit Planner
- Lesson Planner

Concept-Based Unit Development Graphic Organizer (Download)

Unit Web Template (Optional)

Concepts / Conceptual Lens

Please attach your completed Unit Web Template here

Lens:

Properties

Concepts:

Matter

Atoms

Subatomic particles

Nucleus

Isotope

Coulomb's Law

Charge

Ion

Force

Energy

Element

Electromagnetic radiation(EMR)

Quantum mechanics

Stability

Radioactivity

Half-life

Fission

Fusion

G Generalizations / Enduring Understandings	Guiding Questions ***Please identify the type of question: (F) Factual, (C) Conceptual, (P) Provocative [Debatable]***
1. Fundamental particles called atoms compose matter.	1. What fundamental observations and experiments led to the current understanding of the atomic model? (C)
2. Subatomic particles comprise atoms.	2a. What are the properties of protons, neutrons, and electrons? (F) 2b. Where are subatomic particles located in an atom? (F) 2c. What are the relative charges and masses of subatomic particles? (F)
3. Coulomb's Law predicts that particles with opposite charges attract each other and particles with similar charge repel each other.	3a. What happens when two positively charged particles interact? (F) 3b. What happens when a positively charged particle and a negatively charged particle interact? (F) 3c. How does the magnitude of the charge impact the force between charged particles? (C) 3d. How does the distance between charged particles impact the force between them? (C)
4. An atom's structure determines its elemental identity.	4a. How do scientists determine the number of protons, neutrons, and electrons for a particular element? (C) 4b. Can two different elements consist of the same number of protons, neutrons, and electrons? (P) 4c. Will more elements be added to the periodic table? (P) 4d. How can manipulating the number of protons, neutrons, and electrons alter the identity, mass, and charge of an atom/ion? (C)
5. Isotopes represent atoms of the same element consisting of different masses.	5a. Which subatomic particle determines the elemental identity of an atom? (F) 5b. Which subatomic particles contribute to the mass of an atom? (F)
6. Atoms of an element absorb and emit unique amounts of energy in the form of electromagnetic radiation that travels as waves.	
7. Quantum mechanics explains the behavior of electrons.	
8. An imbalance of protons and neutrons in the nucleus can render the nucleus unstable, leading to radioactive decay or fission.	
9. The half-life of a radioactive isotope predicts the decay time of that isotope.	
10. Strong forces can merge two nuclei, transforming	

them into a different nucleus. (Fusion)	5c. How many different isotopes can an element have? (C) 5d. How is the weighted average mass of an element calculated from its isotopes? (C) 6a. How can electrons in an atom be excited and what happens when they return to ground state? (C) 6b. How are wavelength, frequency, and energy related to each other in EMR waves? (C) 6c. How do wavelength, frequency, and energy change across the EMR spectrum? (C) 6d. How can atomic line spectra be used to identify elements? (C) 7a. What is the difference between a quantum particle and a classical particle? (C) 7b. How does the quantum behavior of an electron affect its movement? (C) 8a. What are the types of radioactive decay? (F) 8b. What happens to the nucleus during radioactive decay? (C) 8c. Why are neutrons an essential component of the nucleus? (C) 8d. What is nuclear fission? (F) 8e. How are radioactive decay and nuclear fission different? (C) 8f. How is nuclear fission used to generate power? (C) 8g. Are the benefits of nuclear power worth the risks? (P) 9a. What is a half-life? (F) 9b. How is the half-life of a radioactive isotope determined? (C) 9c. How can half-life be used to calculate the rate of radioactive decay? (C)

	9d. Do all isotopes have different half-lives? (P) 9e. Can/should radioactive half-life be used constructively? (P) 10a. What is nuclear fusion? (F) 10b. How does the sun generate energy through nuclear fusion? (C) 10c.How are man-made elements created? (C) 10d. Is there a limit to the size of a nucleus that can be generated through nuclear fusion? (P)

Standard(s)

Connecticut Core Standards / Content Standards

NGSS: Science Performance Expectations (2017)

NGSS: HS Physical Sciences

HS.Structure and Properties of Matter

Performance Expectations

HS-PS1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.

HS-PS1-8. Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.

HS.Forces and Interactions

Performance Expectations

HS-PS2-4. Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.

HS.Waves and Electromagnetic Radiation

Performance Expectations

HS-PS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.

HS-PS4-3. Evaluate the claims, evidence, and reasoning behind behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.

NGSS: Science and Engineering Practices

NGSS: 9-12

Practice 5. Using mathematics and computational thinking

Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic

thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.

Apply techniques of algebra and functions to represent and solve scientific and engineering problems.

Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3, acre-feet, etc.).

NGSS: Disciplinary Core Ideas

NGSS: 9-12

PS1: Matter and Its Interactions

PS1.A: Structure and Properties of Matter

Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1)

The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HSPS1-3),(secondary to HS-PS2-6)

Stable forms of matter are those in which the electric and magnetic field energy is minimized. A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. (HS-PS1-4)

PS3: Energy

PS3.C: Relationship Between Energy and Forces

When two objects interacting through a field change relative position, theenergy stored in the field is changed. (HS-PS3-5)

PS4: Waves and Their Applications in Technologies for Information Transfer

PS4.A: Wave Properties

The wavelength and frequency of a wave are related to one another by thespeed of travel of the wave, which depends on the type of wave and the medium through which it is passing. (HS-PS4-1)

[From the 3–5 grade band endpoints] Waves can add or cancel one anotheras they cross, depending on their relative phase (i.e., relative position ofpeaks and troughs of the waves), but they emerge unaffected by each other.(Boundary: The discussion at this grade level is qualitative only; it can bebased on the fact that two different sounds can pass a location in differentdirections without getting mixed up.) (HS-PS4-3)

PS4.B: Electromagnetic Radiation

Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features.(HS-PS4-3)

When light or longer wavelength electromagnetic radiation is absorbed inmatter, it is generally converted into thermal energy (heat). Shorterwavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) canionize atoms and cause damage to living cells.(HS-PS4-4)

Atoms of each element emit and absorb characteristic frequencies of light.These characteristics allow identification of the presence of an element, even in microscopic quantities. (secondary to HS-ESS1-2)

Access the interactive version of the NGSS here

Critical Content & Skills

*What students must **KNOW and be able to DO***

- Describe the mass, charge and location of protons, neutrons, and electrons.
- Define mass number and atomic number.

- Determine the mass, charge and elemental identity of an atom/ion based on the atomic number/mass number and/or the number of protons, neutrons, and electrons.
- Calculate the average atomic mass of an element.
- Compare the Quantum Mechanical model of the atom to the Bohr model.
- Construct Bohr models of atoms/ions.
- Distinguish between principal energy levels, sublevels and orbitals in the Quantum Mechanical model of the atom.
- Write electron configurations and orbital diagrams for atoms or ions.
- Define what is meant by ground state versus excited state when referring to the position of electrons in atoms.
- Describe the movement of an electron in an atom when it absorbs or releases energy.
- Determine how the distance an electron falls impacts the type of EMR released by the atom.
- Calculate the wavelength, frequency and energy of EMR waves.
- Explain the difference between fission and fusion.
- Compare and contrast the different types of radiation including alpha, beta and gamma.
- Write and balance nuclear reaction equations.
- Calculate the half-life of an isotope.
- Describe how nuclear power works and its benefits/detriments.

Core Learning Activities

- Calculating Atomic Number, Mass Number, and Charge of Atoms and Isotopes
- Calculating the Average Atomic Mass of an Element
- Pennium Isotope Lab
- Calculating the Wavelength, Frequency, and Energy of EMR
- Constructing Electron Diagrams
- Writing Electron Configurations
- Flame Test Lab
- Spectroscopy Lab
- Creating Bohr Models of Atoms and Ions
- Calculating Half-life of Isotopes
- Writing Nuclear Equations
- Nuclear Atom POGIL
- Radioactive Decay of Candium Lab

Atomic Structure packet.pdf
EMR and electrons POGIL.pdf
Average Atomic Mass POGIL.pdf
Introduction to EMR Problems .pdf
Bohr Model of Ions.pdf
Nuclear equations worksheet and answers.pdf
Nuclear Atom POGIL.pdf
Half life Problems.pdf

Assessments

Pennium Lab
Formative: Lab Assignment
Pennies from before and after 1982 are counted and masses in order to calculate the average atomic mass of Pennium (the weighted average).
Pennium Lab.doc
Spectroscopy Lab
Formative: Lab Assignment
Spectroscopes are used to view quantized visible light energy emitted from ionized glass tubes. Students use the wavelengths of the EMR to calculate the frequency and energy of the emitted light. Students must also view a spectral pattern and identify the unknown element(s) present.

Resources

Professional & Student

Teacher Resources:

- Teacher's Edition of Text:
  - T.Buthelezi, L. Dingrando, N. Hainen, C. Wistrom, Chemistry. McGraw Hill, Glencoe, 2008.

- PBS Nova: Fireworks
- PBS Nova: Kaboom!
- Fireworks: Webquest--Kaboom! www.pbs.org/wgbh/nova/kaboom

Neon Lights PhET Simulation Lab .pdf

Flame Test Lab

Formative: Lab Assignment

Flame tests of metallic ions are performed as standards in order to determine the identify of metallic ion(s) present in several unknown solutions.

Flame Test Lab.doc

Radioactive Decay of Candium Lab

Formative: Lab Assignment

Students experimentally determine the half life of Candium, an imaginary element, in order to learn about the process of radioactive decay.

Half Life Candium Lab .pdf

Atomic Structure and Electrons Test

Summative: Written Test

Includes MC, short answer and calculations. A test review with sample questions is included.

Atomic Structure Electrons EMR Test Review .pdf

Nuclear Chemistry Test

Summative: Written Test

Includes a combination of MC, short answer and calculation based questions. Sample questions are included in the test review.

Nuclear Chemistry Test Review .pdf

- PBS Nova: Fabric of the Cosmos: Quantum Leap
- PBS: Uranium, Twisting the Dragon's Tail, 2015
- BBC: Hiroshima, 2005
- Bill Nye: Atoms and Molecules
- Bill Nye: Light and Color
- Video: Atom: Clash of the Titans

Students Resources:

- Student Text: T.Buthelezi, L. Dingrando, N. Hainen, C. Wistrom, Chemistry. McGraw Hill, Glencoe, 2008.
- ChemWiki: Atomic Theory
- ChemWiki: Electron Configurations
- Orbital Simulation
- Electronic Structures
- Atomic Orbitals
- For Atomic Structure Web Quest: Electron Arrangement
- Chemwiki: Orbitals
- Atomic Orbitals
- Building and Atom PhET
- Neon Lights PhET
- Radioactive Decay
- Half Life

Student Learning Expectation & 21st Century Skills

Information Literacy
Critical Thinking
Spoken Communication
Written Performance

Interdisciplinary Connections

Unit Planner: Unit V: Periodic Law
Chemistry (CPA/Honors)

Friday, February 24, 2023 9:16AM

Newtown High School / 2022-2023 / Grade 11 / Science / Chemistry (CPA/Honors) / Week 11 - Week 12

Last Updated: Today by Bridget Berechid

Unit V: Periodic Law

Berechid, Bridget; Carley, Christopher

- Unit Planner
- Lesson Planner

Concept-Based Unit Development Graphic Organizer (Download)

Unit Web Template (Optional)

Concepts / Conceptual Lens

Please attach your completed Unit Web Template here

Lens:

Patterns

Concepts:

Elements

Atomic structure

Period

Group

Periodicity

Trends

Radius

Nuclear Pull

Electronegativity

Ionization Energy

Reactivity

Metallic character

Generalizations / Enduring Understandings

G

1. The periodic table organizes elements according to

Guiding Questions

Please identify the type of question: (F) Factual, (C) Conceptual, (P) Provocative [Debatable]

their physical and chemical properties. 2. Scientists predict the chemical and physical properties of elements based on their atomic number and position on the periodic table due to the repeating patterns that are present. 3. Periods(rows) and families(columns) on the periodic table represent the structure of the atom. 4. Atomic structure determines atomic/ionic radius, electronegativity, ionization energy, reactivity, and metallic character.	1a. What are the different types of elements? (F) 1b. How do chemical and physical properties change across the periodic table? (C) 2a. How are the properties of elements in a family the same? How are they different? (C) 2b. How are the properties of elements in a period the same? How are they different? (C) 2c. Is the behavior of an element always predictable based on its atomic structure? (P) 3a. What does the period of an element represent? (F) 3b. What does the family of an element represent? (F) 3c. How do the number of valence electrons in atoms relate to their periodic trends? (C) 4a. What is meant by electronegativity, ionization energy, atomic/ionic radii, reactivity, and metallic character? (F) 4b. What periodic trends exist for electronegativity, ionization energy, atomic/ionic radius, reactivity, and metallic character? (C) 4d. Are there defined boundaries between metals, nonmetals, and metalloids? (P)

Standard(s)

Connecticut Core Standards / Content Standards

NGSS: Science Performance Expectations (2017)

NGSS: HS Physical Sciences

HS.Structure and Properties of Matter

Performance Expectations

HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

HS-PS1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.

HS.Chemical Reactions

Performance Expectations

HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.

NGSS: Disciplinary Core Ideas

NGSS: 9-12

PS1: Matter and Its Interactions

PS1.A: Structure and Properties of Matter

Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1)

The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1),(HSPS1-2)

The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HSPS1-3),(secondary to HS-PS2-6)

Access the interactive version of the NGSS here

Critical Content & Skills

*What students must **KNOW and be able to DO***

- Explain how chemical and physical properties of elements repeat periodically when arranged by increasing atomic number according to Periodic Law.
- Identify the number of valence electrons an element has based upon its group/column on the periodic table.
- Identify the ionic charge of an element based upon its group/column on the periodic table.
- Classify elements as metals, nonmetals, and metalloids based on their position on the periodic table.
- Describe the properties of metals, non-metals and metalloids.
- Identify the location of alkali metals, alkaline earth metals, transition metals, inner transition metals, halogens and noble gasses on the periodic table.
- Define the terms nuclear pull, atomic radius, electronegativity, ionization energy.
- Predict and explain trends in nuclear pull, atomic radius, electronegativity, and ionization energy as you move across and down the periodic table.
- Predict the chemical behavior of an element based on its atomic number and location on the periodic table.

Core Learning Activities

- Periodic Table Coloring Activity
- Periodic Trends POGIL
- Properties of Metals, Metalloids and Non-metals Lab
- Graphically Interpreting Periodic Trends Lab
- Periodic Metallic Trends Lab

Periodic Table Coloring Activity.pdf
Periodic Trends POGIL.pdf

Assessments

Periodic Metallic Trends Lab

Resources

Professional & Student

Formative: Lab Assignment
Students perform experiments to determine periodic trends in reactivity of metals.
Metallic Periodic Trends Lab.pdf
Graphically Interpreting Periodic Trends Lab
Formative: Lab Assignment
Students graph values of atomic radii, electronegativity and ionization energy and analyze the graphs for periodic trends.
Periodic Trends Lab.pdf
Properties of Metals, Metalloids and Non-metals Lab
Formative: Lab Assignment
Students make observations of chemical and physical properties to classify elements as metals, nonmetals and metalloids.
Metal Nonmetal Metalloid Lab.pdf
Periodic Trends Test
Summative: Written Test
Includes a combination of MC and short answer questions. A test review is included to show sample questions.
Periodic Trends Review .pdf

Teacher Resources:

- Teacher's Edition of Text: T.Buthelezi, L. Dingrando, N. Hainen, C. Wistrom, Chemistry. McGraw Hill, Glencoe, 2008.
- AACT periodic trends

Student Resources:

- Student Text: T.Buthelezi, L. Dingrando, N. Hainen, C. Wistrom, Chemistry. McGraw Hill, Glencoe, 2008.
- ChemWiki: Periodic Table of Elements
- Periodic Table of Elements
- Periodic Trends

Student Learning Expectation & 21st Century Skills

Information Literacy
Critical Thinking
Spoken Communication
Written Performance

Interdisciplinary Connections

Unit Planner: Unit VI: Chemical Bonding Chemistry (CPA/Honors)

Newtown High School / 2022-2023 / Grade 11 / Science / Chemistry (CPA/Honors) / Week 13 - Week 16

Last Updated: Today by Bridget Berechid

Unit VI: Chemical Bonding

Berechid, Bridget; Carley, Christopher

- Unit Planner
- Lesson Planner

Concept-Based Unit Development Graphic Organizer (Download)

Unit Web Template (Optional)

Concepts / Conceptual Lens

Please attach your completed Unit Web Template here

Lens:
Interactions

Concepts:

Chemical bonding

Atoms

Compounds

Stability

Energy

Electron structure

Valence electrons

Electrostatics

Polarity

Intermolecular Force (IMF)

Solid

Liquid

Gas

Plasma

G Generalizations / Enduring Understandings	Guiding Questions ***Please identify the type of question: (F) Factual, (C) Conceptual, (P) Provocative [Debatable]***

1. Atoms form compounds through chemical bonding.	1a. Which subatomic particles are involved in chemical bonding? (F) 1b. Do all elements form chemical bonds? (P)
2. Atoms manipulate their valence electrons in order to produce more stable electron configurations.	2a. What is a cation? (F)
3. Ionization energy and electronegativity determine the type of chemical bond formed.	2b. What is an anion? (F) 2c. How can it be determined whether an atom will gain or lose electrons when bonding? (C)
4. The breaking or forming of chemical bonds requires the absorption or release, respectively, of energy.	2d. How do the interactions of electrons differ in covalent, ionic and ionic bonding? (C)
5. Electron structure determines the shape and polarity of a molecule.	3a. What are the types of chemical bonds? (F) 3b. How do ionization energy and electronegativity determine the type of bond formed? (C)
6. Molecules and atoms attract to each other by electrostatic forces called intermolecular forces(IMFs).	3c. How do differences in electronegativity between atoms determine the polarity of a covalent bond? (C) 3d. Can an element form more than one type of chemical bond? (C)
	4a. Is it more energetically favorable to break or form a chemical bond? (F) 4b. Why does forming a chemical bond release energy? (C)
	5a. How is the shape of a molecule determined? (C) 5b. What differentiates a polar from a non-polar molecule? (C)
	6a. What are the types of intermolecular forces (IMFs)? (F) 6b. How do IMFs influence the state of matter of a substance? (C) 6c. Which exerts a greater influence on the properties of a substance: the type or the number of IMFs between molecules? (P)

Standard(s)

Connecticut Core Standards / Content Standards

NGSS: Science Performance Expectations (2017)

NGSS: HS Physical Sciences

HS.Structure and Properties of Matter

Performance Expectations

HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

HS-PS1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.

HS.Chemical Reactions

Performance Expectations

HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.

HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.

NGSS: Disciplinary Core Ideas

NGSS: 9-12

PS1: Matter and Its Interactions

PS1.A: Structure and Properties of Matter

The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HSPS1-3),(secondary to HS-PS2-6)

Stable forms of matter are those in which the electric and magnetic field energy is minimized. A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. (HS-PS1-4)

PS2: Motion and Stability: Forces and Interactions

PS2.B: Types of Interactions

Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects.(HS-PS2-4)

Attraction and repulsion between electric charges at the atomicscale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.(HS-PS2-6),(secondary to HS-PS1-1),(secondary to HS-PS1-3)

PS3: Energy

PS3.C: Relationship Between Energy and Forces

When two objects interacting through a field change relative position, theenergy stored in the field is changed. (HS-PS3-5)

PS3.D: Energy in Chemical Processes and Everyday Life

Although energy cannot be destroyed, it can be converted to less usefulforms—for example, to thermal energy in the surrounding environment.(HS-PS3-3),(HS-PS3-4)

Access the interactive version of the NGSS here

Critical Content & Skills

*What students must **KNOW and be able to DO***

- Write the names of chemical compounds based on their formulas.
- Write the chemical formulas of compounds based on their names.
- Know the seven diatomic elements.
- Describe why atoms form bonds
- Compare the characteristics of ionic, covalent and metallic compounds
- Predict the type of bonding that two elements will engage in given their location on the periodic table.
- Use electronegativity differences to determine the type of chemical bond that will form.
- Know the difference between cations and anions.
- Represent the valence structure of atoms and ions using Lewis Dot Diagrams.
- Draw Lewis structures to show how electrons are transferred between atoms in an ionic bond or shared between atoms in a covalent bond
- Predict the shape and polarity structure of molecules using Lewis Dot Diagrams.
- Determine the hybridization of a central atom in a molecule.
- Identify the type(s) of intermolecular forces present between molecules.
- Assess the relative strength of intermolecular attractions between different molecules/atoms.

Core Learning Activities

- Bonding Webquest
- Classifying Chemical Bonds
- Criss Cross Formula Writing
- Constructing Lewis Dot Diagrams of Ionic and Molecular Compounds
- Ionic and Covalent Naming and Formula Writing Practice
- Putting Ions in their Hands Lab
- Heat Treatment of Steel Lab
- Molecular Modeling Lab

Bonding Webquest.pdf
Classifying Chemical Bonds.pdf
Covalent Bonding with Lewis Dots Practice.pdf
Criss Cross Formula Writing.pdf
Lewis Dots with Ionic Bonding Practice.pdf
Mixed Ionic Covalent Formulas and Naming Practice .pdf

Assessments

Heat Treatment of Steel Lab
Formative: Lab Assignment
After hardening, annealing and tempering steel bobby pins, students compare their springiness and ability to bend or break. They then connect these properties to the steel's crystalline structure on the atomic/molecular level.
Heat treatment of Steel Lab.pdf

Molecular Geometry Lab
Formative: Lab Assignment
Students use the model kits to learn about VESPR theory and learn how to correlate 2D Lewis structures with 3D geometrical shapes.
Molecular Geometry Reference orig.pdf
Molecular Geometry Lab .pdf

Putting Ions in their Hands Lab (Flinn Scientific)
Formative: Lab Assignment
Students use paper cut outs of cations and anions, which are sized proportionally to their charges, to build models of

Resources

Professional & Student

Teacher Resources:

- Teacher's Edition of Text: T.Buthelezi, L. Dingrando, N. Hainen, C. Wistrom, Chemistry. McGraw Hill, Glencoe, 2008.
- AACT Bonding Resources
- AACT Bonding Activities
- PBS NOVA: Secrets of the Viking Sword
- PBS NOVA: Secrets of the Samaurai Sword

Student Resources:

- Student Text: T.Buthelezi, L. Dingrando, N. Hainen, C. Wistrom, Chemistry. McGraw Hill, Glencoe, 2008.

electrically neutral ionic compounds. Students then use the models as the basis for the compounds' formulas and names. Putting Ions in their Hands Lab.PDF **Naming and Formula Writing of Ionic and Covalent Compounds** **Summative: Written Test** Students will be given a series of quizzes on the writing and naming of ionic and covalent compounds CFA Ionic and Covalent Naming & Formula Writing Sample Quiz.pdf **Bonding Test** **Summative: Written Test** Will include a combination of MC and short answer. Sample test questions can be found in the test review. Bonding review.pdf	• ChemWiki: Nomenclature of Inorganic Compounds • ChemWiki: Introduction to Chemical Bonding • Handbook of Chemistry and Physics • ChemWiki: Molecular Geometry • Lewis Structures • Ionic and Covalent Bonding • Writing Covalent Formulas • Writing Ionic Formulas • Naming Ionic Compounds • Polarity of Covalent Bonds
Student Learning Expectation & 21st Century Skills Information Literacy Critical Thinking Spoken Communication Written Performance	Interdisciplinary Connections

Unit Planner: Unit VII: Chemical Reactions Chemistry (CPA/Honors)

Friday, February 24, 2023, 9:18AM

Newtown High School / 2022-2023 / Grade 11 / Science / Chemistry (CPA/Honors) / Week 17 - Week 20

Last Updated: Today by Christopher Carley

Unit VII: Chemical Reactions

Berechid, Bridget; Carley, Christopher

- Unit Planner
- Lesson Planner

Concept-Based Unit Development Graphic Organizer (Download)

Unit Web Template (Optional)

Concepts / Conceptual Lens

Please attach your completed Unit Web Template here

Lens:

Change

Concepts:

Chemical bonds

Conservation

Reactions

Reactant

Product

Energy

Heat of reaction

Balancing

Rates

Reversible reaction

Equilibrium

G

Generalizations / Enduring Understandings

1. Chemical bonds break and then new bonds form to produce new substances.

Guiding Questions

Please identify the type of question: (F) Factual, (C) Conceptual, (P) Provocative [Debatable]

1a. What is a reactant? (F)

	1b. What is a product? (F)
2. Chemical reactions conserve matter.	1c. Why must bonds be broken in order to form new bonds? (C)
3. The type of reactants determines the type of reaction that occurs.	1d. Do all bonds in a molecule always need to break in a chemical reaction? (P)
4. Substances lose or gain energy during a reaction as chemicals bonds are broken and formed.	2a. How do balanced chemical reactions represent the conservation of matter? (C)
5. The difference between the energy of the products and reactants determines the heat of reaction.	2b. Why must a chemical reaction conserve matter? (C)
	3a. What are the five basic types of reactions? (F)
6. Balanced chemical equations represent chemical reactions.	3b. How is a reaction type predicted from the reactants? (C)
	3c. Do all chemical reactions fall into these five types of reaction? (P)
7. The rate of a reaction relates the quantity of a substance reacted to the time required to react it.	
	4a. Is it more favorable for a reaction to gain energy or lose energy? (F)
8. The rate of a reaction correlates to changes in temperature, concentration, surface area, and the addition of a catalyst.	4b. Can the amount of energy gained or released by a reaction change? (C)
9. Reversible reactions proceed until the forward rate of reaction equals the reverse rate of reaction and establish equilibrium.	5a. How is the heat of reaction calculated using the energy of the reactants and products? (C)
	5b. Can the heat of a reaction be determined experimentally? (P)
	6a. What is the significance of coefficients in the balanced equation? (F)
	6b. Why can't chemical formulas be changed to balance a chemical equation? (C)
	7a. What is the definition of "rate"? (F) 7b. How are rates expressed? (F)
	7c. Can the rate of a reaction change over time? (P)

	8a. How does increasing the temperature change the rate of a reaction? (C) 8b. How does increasing the concentration of a reactant change the rate of a reaction? (C) 8c. How does increasing the surface area of a reactant change the rate of a reaction? (C) 8d. Why does the addition of a catalyst cause the rate of reaction to increase? (C) 9a. What is a reversible reaction? (F) 9b. Are all reactions reversible? (P) 9c. Can equilibrium be disturbed? (i.e. can a reaction leave equilibrium?) (C) 9d. Do all reversible systems reach equilibrium in the same amount of time? (C)

Standard(s)

Connecticut Core Standards / Content Standards

NGSS: Science Performance Expectations (2017)

NGSS: HS Physical Sciences

HS.Chemical Reactions

Performance Expectations

HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.

HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.

HS-PS1-6. Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.*

HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

NGSS: Disciplinary Core Ideas

NGSS: 9-12

PS1: Matter and Its Interactions

PS1.A: Structure and Properties of Matter

The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-

PS1-1),(HSPS1-2)

Stable forms of matter are those in which the electric and magnetic field energy is minimized. A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. (HS-PS1-4)

PS1.B: Chemical Reactions

Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes inkinetic energy. (HSPS1-4),(HS-PS1-5)

In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. (HS-PS1-6)

The fact that atoms are conserved, together with knowledge ofthe chemical properties of the elements involved, can be used to describe and predict chemical reactions. (HS-PS1-2),(HS-PS1-7)

PS3: Energy

PS3.B: Conservation of Energy and Energy Transfer

Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1),(HSPS3-4)

PS3.D: Energy in Chemical Processes and Everyday Life

Although energy cannot be destroyed, it can be converted to less usefulforms—for example, to thermal energy in the surrounding environment.(HS-PS3-3),(HS-PS3-4)

Access the interactive version of the NGSS here

Critical Content & Skills

*What students must **KNOW and be able to DO***

- Explain how mass and energy are conserved during all chemical reactions.
- Use coefficients to balance chemical equations.
- Write balanced chemical equations and net ionic equations.
- Identify and use symbols to represent states of matter and reaction conditions in chemical equations.
- Classify reactions as combination, decomposition, combustion, single displacement or double displacement reactions based on the reactants and products present.
- Given a set of reactants, predict the products for different types of chemical reactions.
- Use an activity series to predict whether single replacement reactions will occur.
- Use a solubility table to predict whether double replacement reactions will occur.
- Calculate the rate of a reaction.
- Describe how the rate of a reaction depends on the nature of the reactants, the concentration of the reactants, the surface area of the reactants, the temperature, and whether a catalyst or inhibitor is present.
- Describe how the use of a catalyst increases the rate of a reaction by lowering its activation energy by changing the reaction's pathway.
- Calculate the enthalpy of a reaction.
- Determine if a reaction is endothermic or exothermic based upon the sign of the enthalpy value (positive = endothermic, negative = exothermic).

Core Learning Activities

- Balancing Equations Practice
- Classifying Chemical Reactions Practice and POGIL
- Writing Chemical Equations Practice
- Predicting Single and Double Replacement Reactions
- Activity Series of Metals (Single Replacement) Lab
- Creating a Solubility Table (Double Replacement) Lab
- Obtaining Copper from its Ore Lab

- Classification of Chemical Reactions Lab
- Factors that Affect the Rate of a Chemical Reaction Lab

Shall We Dance POGIL.pdf
Balancing Equations 1-5.pdf
Writing Chemical Equations 1 and 2.pdf
Single and Double Replacement Reactions.pdf
Lab- Refining a copper ore.pdf

Assessments

Chemical Reactions Lab
Formative: Lab Assignment
Students will perform a series of chemical reactions and make observations. Students must then use their chemistry knowledge to predict products, write balanced chemical equations, classify reaction types and list indicators of chemical change.
Classifying Chemical Reactions Lab.pdf
Classifying Chemical Reactions Lab Answer Sheet.pdf
Solubility Table (Double Replacement) Lab
Formative: Lab Assignment
Students will perform experiments to create a solubility table to learn about double replacement reactions.
Double Replacement Lab .pdf
Activity Series of Metals (Single Replacement) Lab
Formative: Lab Assignment
Students will perform experiments to create an activity series of metals to learn about single replacement reactions.
Single Replacement Lab.pdf
Factors that Affect Rates of Reaction Lab
Summative: Lab Assignment
An inquiry-based lab where students will determine two factors that could affect the rate of a reaction and then design an experiment to test their hypothesis
Factors that Affect Rates of Reaction.pdf
Chemical Reactions Test
Summative: Written Test
Will include a combination of MC and short answer. A test review with sample questions is included.
Chemical Reactions Test Review .pdf

Resources

Professional & Student

Teacher Resources:

- Teacher's Edition of Text: T.Buthelezi, L. Dingrando, N. Hainen, C. Wistrom, Chemistry McGraw Hill, Glencoe, 2008.
- AACT resources
- Bill Nye *Chemical Reactions* Movie
- PBS NOVA: Kaboom!
- Demonstrations:
  - sacrificing a Gummy Bear(decomposition)
  - burning magnesium ribbon (synthesis/combustion)
  - whoosh bottle(combustion)
  - decomposition of hydrogen peroxide with/without a catalyst(rate)
  - surface area & burning steel wool(rate)

- Hyperphysics Heat and Thermodynamics
- Enthalpy
- PHET Reaction Rates
- PHET Reversible Reactions

Student Resources:

- Student Text: T.Buthelezi, L. Dingrando, N. Hainen, C. Wistrom, Chemistry. McGraw Hill, Glencoe, 2008.
- Balancing Chemical Reactions
- Types of Chemical Reactions
- Predicting Products 1
- Predicting Products 2
- Net Ionic Equations
- Rate of Reactions
- Calculating Enthalpy Change

Student Learning Expectation & 21st Century Skills

Information Literacy
Critical Thinking
Spoken Communication
Written Performance

Interdisciplinary Connections

Unit Planner: Unit VIII: The Mole and Stoichiometry Chemistry (CPA/Honors)

Friday, February 24, 2023 9:18AM

Newtown High School / 2022-2023 / Grade 11 / Science / Chemistry (CPA/Honors) / Week 21 - Week 24

Last Updated: Friday, February 3, 2023 by Bridget Berechid

Unit VIII: The Mole and Stoichiometry

Berechid, Bridget; Carley, Christopher

- Unit Planner
- Lesson Planner

Concept-Based Unit Development Graphic Organizer (Download)

Unit Web Template (Optional)

Concepts / Conceptual Lens

Please attach your completed Unit Web Template here

Lens:

Conversions

Concepts:

The Mole

Hydrate

Atoms, molecules, formula units

Mass

Conservation

Reactants

Products

Limiting

Excess

Theoretical yield

Actual yield

G

Generalizations / Enduring Understandings

1. The mole conveys a quantity of atoms, molecules, or formula units in a sample.

Guiding Questions

Please identify the type of question: (F) Factual, (C) Conceptual, (P) Provocative [Debatable]

1a. How many atoms, molecules or formula units are in one mole of a substance? (F)

2. Atoms, molecules, and formula units react in ratios of quantity. 3. The mass of a reactant determines the mass of a product produced. 4. One reactant limits the amount of product produced, while all other reactants remain as excess. 5. Stoichiometry predicts the theoretical yield of a producible product. 6. In practice, chemical reactions produce less product than the theoretical yield, called the actual yield.	1b. How can the number of moles of a substance be calculated from the mass or volume of that substance? (C) 2a. Why do atoms, molecules and formula units react based on quantity? (C) 2b. Can the number of moles or particles (atoms, molecules, formula units) be measured directly? (C) 3a. What is the relationship between the amount of a reactant and the amount of product in a chemical reaction? (P) 3b. How can the amount of a product be calculated using the amount of a reactant in a chemical reaction? (C) 4a. What is a limiting reactant? (F) 4b. What is an excess reactant? (F) 4c. What happens to a reaction when a reactant is totally consumed? (F) 4d. Why does only one reactant control the yield of a reaction? (C) 4e. Can any amount of the limiting reactant remain after a reaction has completed? (C) 5. Why does stoichiometry not predict the actual amount of product that will be produced? (C) 6a. What is the yield of a reaction? (F) 6b. Can a reaction ever produce an experimental yield that is more than the theoretical yield? (C) 6c. How is the experimental yield calculated as a percentage of the theoretical yield? (C) 6d. What could cause a reaction to produce a yield that is less than the theoretical yield? (C)

Standard(s)

Connecticut Core Standards / Content Standards

NGSS: Science Performance Expectations (2017)

NGSS: HS Physical Sciences

HS.Chemical Reactions

Performance Expectations

HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.

HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

NGSS: Science and Engineering Practices

NGSS: 9-12

Practice 5. Using mathematics and computational thinking

Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.

Apply techniques of algebra and functions to represent and solve scientific and engineering problems.

Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3, acre-feet, etc.).

NGSS: Disciplinary Core Ideas

NGSS: 9-12

PS1: Matter and Its Interactions

PS1.B: Chemical Reactions

In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. (HS-PS1-6)

The fact that atoms are conserved, together with knowledge ofthe chemical properties of the elements involved, can be used to describe and predict chemical reactions. (HS-PS1-2),(HS-PS1-7)

Access the interactive version of the NGSS here

Critical Content & Skills

*What students must **KNOW and be able to DO***

- Calculate molar mass of a substance.
- Convert between moles of a substance and the mass, volume, or number of particles in the substance.
- Calculate the percent composition of a substance, including the percent water in a hydrate using laboratory data or empirical formulas.
- Define and calculate empirical and molecular formulas given the percent composition of a compound.
- Use stoichiometric calculations to convert between any two substances participating in a chemical reaction.
- Use stoichiometry to determine the limiting reactant and the amount of excess reactant remaining at the end of the chemical reaction.
- Calculate the percent yield of a chemical reaction.

Core Learning Activities

- One and Two Step Mole Conversions Practice
- Calculating Percent Composition Practice
- Calculating Empirical and Molecular Formulas Practice
- Molar Quantities Lab
- Moles of Candle Lab
- Calculating the Percent Mass of Water in a Hydrate Lab
- Calculating Empirical Formulas of Hydrates (Triple Hydrate) Lab
- Stoichiometry Practice: Moles, Mass, Volume & Percent Yield
- Stoichiometry and Limiting Reactant Practice
- Chalk Lab
- Decomposition of Baking Soda Lab

Mixed 1&2 Step Mole Conversions #2.pdf
Molar Quanitites Lab .pdf
Determining Percent Composition, EF & MF Practice.pdf
Stoichiometry Problems 1-4 Moles, Mass, Volume & Percent Yield.pdf
Stoichiometry and Limiting Reactants.pdf

Assessments

Decomposition of Baking Soda Lab
Formative: Lab Assignment
Students experimentally decompose baking soda and use their stoichiometry calculations and percent yield data to determine which of three possible reaction pathways actually occurred.
Decomposition of Baking Soda Lab .pdf

Chalk Lab
Formative: Lab Assignment
Students perform a chemical reaction to synthesize calcium carbonate (chalk). They perform stoichiometric calculations to determine how their yield compares to the theoretical value and use this information to evaluate the effectiveness of their lab technique
Chalk Lab.pdf

Determining the Empirical Formula of a Hydrate Lab
Formative: Lab Assignment
Students use the masses of three different hydrates, before and after heat treatment, to calculate the empirical formulas for each. They then calculate their percent error based upon the theoretical values for each to evaluate where experimental errors may have occured.
Empirical Formula of a Hydrate Lab Triple Hydrate Lab .pdf

Hydrate Lab
Formative: Lab Assignment
Students use masses of magnesium sulfate heptahydrate, before and after heating, in order to calculate the percent water in their hydrate sample. They then use the empirical formula of the compound to calculate the theoretical value for the percent water in the hydrate and use this to evaluate their percent error for the experiment.
Determination of the Percentage of Water of Hydration in a Crystalline Salt Lab .pdf

Moles of Candle Lab
Formative: Lab Assignment
Students mass a candle before and after burning for ten minutes. They then perform calculations to determine the number of moles of candle wax burned during this time.
Moles of Candle Lab.pdf

Mole Test
Summative: Written Test

Resources

Professional & Student

Teacher Resources:

- Teacher's Edition of Text: T.Buthelezi, L. Dingrando, N. Hainen, C. Wistrom, Chemistry. McGraw Hill, Glencoe, 2008.
- AACT Stoichiometry
- AACT Calculating Moles
- PHET Stoichiometry

Students Resources:

- Student Text: T.Buthelezi, L. Dingrando, N. Hainen, C. Wistrom, Chemistry. McGraw Hill, Glencoe, 2008.
- Mole Day
- Mole Conversions Video
- Percent Composition Video
- Empirical and Molecular Formulas Video
- Stoichiometry: Mol-Mol, Gram-Gram Video
- Solution Stoichiometry Video
- Stoichiometry: Liming and Excess Reactant & Percent Yield

Includes MC and short answer questions and calculations. Sample problems can be found in the test review. Mole Test Review.pdf **Stoichiometry Test** **Summative: Written Test** A combination of MC, short answer and calculations will be included. The attached test review includes sample test questions. Stoichiometry Test Review with LR.pdf	
Student Learning Expectation & 21st Century Skills Information Literacy Critical Thinking Spoken Communication Written Performance	Interdisciplinary Connections

Unit Planner: Unit IX: Aqueous Systems Chemistry (CPA/Honors)

Friday, February 24, 2023 9:23AM

Newtown High School / 2022-2023 / Grade 11 / Science / Chemistry (CPA/Honors) / Week 25 - Week 26

Last Updated: Friday, June 24, 2022 by Christopher Carley

Unit IX: Aqueous Systems

Berechid, Bridget; Carley, Christopher

- Unit Planner
- Lesson Planner

Concept-Based Unit Development Graphic Organizer (Download)

Unit Web Template (Optional)

Concepts / Conceptual Lens

Please attach your completed Unit Web Template here

Lens:

Interactions

Concepts:

Solute

Solvent

Solution

Saturation

Physical Properties

Energy
Concentration

Quantity

Stoichiometry

Dilution

G

Generalizations / Enduring Understandings

1. A solvent dissolving a solute creates a solution.

2. Electrostatic attractions facilitate a solvent dissolving a solute.

Guiding Questions

Please identify the type of question: (F) Factual, (C) Conceptual, (P) Provocative [Debatable]

1a. What are the components of a solution? (F)

1b. What does a solvent do to a solute? (F)

3. A solution's physical properties exhibit differences from the pure solute and solvent. 4. A solvent dissolving a solute results in an exothermic or endothermic process. 5. The concentration of a solution conveys the amount of solute dissolved in a set amount of solvent. 6. Solution concentrations can facilitate stoichiometric calculations. 7. A solution maintains the same amount of solute when diluted to a lower concentration.	2a. What forces are present to attract a solute and solvent to each other? (C) 2b. Can all solvents and solutes attract to each other? (P) 2c. What types of substances are most likely to dissolve together? (C) 2d. Can a solute become a solvent and vice versa? (P) 3a. What physical properties might change when a substance dissolves into a solution? (C) 3b. Are the physical properties of a solution a combination of the properties of the solute and solvent? (P) 3c. Do the physical properties of a solution change as concentration changes? (C) 4a. Is the separation of solute particles from each other an exothermic or endothermic process? (F) 4b. Is the separation of solvent particles from each other an exothermic or endothermic process? (F) 4c. Is the attraction between a solute and solvent exothermic or endothermic? (F) 4d. What is required for the overall process of dissolving a solute into a solvent to be classified as exothermic or endothermic? (C) 5a. In what ways can the concentration of a solution be recorded? (F) 5b. Are all types of concentration equally applicable in all scenarios? (P) 5c. How can the concentration of a solution be calculated? (C) 5d. What is an unsaturated solution? (F) 5e. What is a saturated solution? (F) 5f. What is a supersaturated solution? (F)

	6a. What units are used to measure the amount of a solution? (F) 6b. How can the amount of a solution relate to the moles of the solute? (C) 6c. Does a solution's change in concentration during a chemical reaction invalidate the stoichiometric calculations? (P) 7a. Why do the moles of solute remain constant when a solution is diluted? (C) 7b. How can the concentration of a solution be calculated after dilution? (C)

Standard(s)

Connecticut Core Standards / Content Standards

NGSS: Science Performance Expectations (2017)

NGSS: HS Physical Sciences

HS.Structure and Properties of Matter

Performance Expectations

HS-PS1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.

HS.Chemical Reactions

Performance Expectations

HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.

NGSS: Science and Engineering Practices

NGSS: 9-12

Practice 3. Planning and carrying out investigations

Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled.

Select appropriate tools to collect, record, analyze, and evaluate data.

Make directional hypotheses that specify what happens to a dependent variable when an independent variable is manipulated.

Manipulate variables and collect data about a complex model of a proposed process or system to identify failure points or improve performance relative to criteria for success or other variables.

NGSS: Disciplinary Core Ideas

NGSS: 9-12

PS1: Matter and Its Interactions

PS1.A: Structure and Properties of Matter

The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HSPS1-3),(secondary to HS-PS2-6)

PS2: Motion and Stability: Forces and Interactions

PS2.B: Types of Interactions

Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects.(HS-PS2-4)

PS3: Energy

PS3.A: Definitions of Energy

At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HSPS3-2) (HS-PS3-3)

These relationships are better understood at the microscopic scale, atwhich all of the different manifestations of energy can be modeled as either motions of particles or energy stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. (HSPS3-2)

Access the interactive version of the NGSS here

Critical Content & Skills

*What students must **KNOW and be able to DO***

- Determine how unequal charge distribution makes water a polar molecule.
- Explain how water molecules are attracted and held together by strong intermolecular forces called hydrogen bonds.
- Explain how the ability of water molecules to form hydrogen bonds results in such properties as high surface tension, high heat capacity, low vapor pressure, and low density as a solid.
- Distinguish between a solute, solvent and solution.
- Describe how a solution is a homogenous mixture of a solute and solvent.
- Explain how the solubility of a solute in water is dependent on the temperature and chemical nature of the solute.
- Explain why dissolving some solutes is exothermic while dissolving others is endothermic.
- Describe how aqueous solutions can be electrolytes or nonelectrolytes depending on the nature of the solute.
- Analyze solubility curves.
- Describe factors that influence the solubility of solids and gases.
- Calculate the concentration of a solution in terms of moles per liter.
- Make a solution of a specified concentration and volume and know how to perform the calculations that are involved.
- Make a dilution of a concentrated solution and know how to perform the calculations that are involved.

Core Learning Activities

- Molarity POGIL
- Molarity Calculation Practice
- Making a Molar Solution of Sucrose
- Dilutions Practice
- Potion Dilution Lab
- Saturated and Unsaturated Solution POGIL
- Solubility Chart Practice
- Factors that Affect Solubility (Rates of Solubility) Experiment
- Making a Solubility Curve (KNO_3) Lab
- Hot and Cold Pack Inquiry Lab
- Dilutions with the Spec-20 Lab

Molarity POGIL.pdf

More Molarity by Dilutions.pdf
Making a Molar solution of Sucrose.pdf
Molarity Problems 2 .pdf
Dilutions Problems .pdf
Potion Dilution Lab A.pdf
Saturated and Unsaturated Solutions POGIL.pdf
Solubility Curves Practice .pdf

Assessments

Hot and Cold Pack (Heat of Solution) Inquiry Lab
Formative: Lab Assignment
Students design and conduct an experiment to quantitatively determine the best solute to use in a water-based cold and hot pack.
Heat of Solutions Cold & Hot Pack Lab.pdf

Factors that Affect Solubility Lab
Formative: Lab Assignment
Students perform experiments to explore factors that influence the solubility of solids and gases.
Preparation of a Solubility Curve Lab .pdf

Determining Solution Concentration by Colorimetric Analysis
Formative: Lab Assignment
Students create solutions of $CuSO_4$ and use their concentrations and light absorption values to create a standardized data curve graph. This graph is used to assess the concentrations of unknown samples of $CuSO_4$.
Determining the Concentration with Colorimetry.pdf

Preparation of a Solubility Curve Lab
Formative: Lab Assignment
Students conduct an experiment to obtain the data needed to prepare a solubility curve so that the solubility of potassium nitrate can be predicted for any temperature.
Preparation of a Solubility Curve Lab .pdf

Aqueous Solutions Test
Summative: Written Test
Will include MC, short answer and calculation based questions. A test review with sample questions is included.
Aqueous Solutions Test Review .pdf

Resources

Professional & Student

Teacher Resources:

- Teacher's Edition of Text: T.Buthelezi, L. Dingrando, N. Hainen, C. Wistrom, Chemistry. McGraw Hill, Glencoe, 2008.
- AACT Solubility Resources
- PHET Solubility
- Supersaturated Solutions Demo Video

Students Resources:

- Student Text: T.Buthelezi, L. Dingrando, N. Hainen, C. Wistrom, Chemistry. McGraw Hill, Glencoe, 2008.
- Molarity Calculations Video
- Molarity Stoichiometry Video
- Molarity and Dilutions Video
- Solubility Curves Video
- Saturated Solutions Video
- Dissolving Process Video

Student Learning Expectation & 21st Century Skills

Information Literacy
Critical Thinking
Spoken Communication
Written Performance

Interdisciplinary Connections

Unit Planner: Unit X: Acids and Bases Chemistry (CPA/Honors)

Friday, February 24, 2023, 9:23AM

Newtown High School / 2022-2023 / Grade 11 / Science / Chemistry (CPA/Honors) / Week 27 - Week 30

Last Updated: Saturday, February 4, 2023 by Bridget Berechid

Unit X: Acids and Bases

Berechid, Bridget; Carley, Christopher

- Unit Planner
- Lesson Planner

Concept-Based Unit Development Graphic Organizer (Download)

Unit Web Template (Optional)

Concepts / Conceptual Lens

Please attach your completed Unit Web Template here

Lens:

Interactions

Concepts:

Aqueous

Ions

Ionization

Concentration

Neutralization

Balance

pH

Strength of acids and bases

G

Generalizations / Enduring Understandings

1. All aqueous systems consist of small concentrations of hydrogen ions and hydroxide ions.

2. An acid donates a hydrogen ion to base.

Guiding Questions

Please identify the type of question: (F) Factual, (C) Conceptual, (P) Provocative [Debatable]

1a. Where do hydrogen ions and hydroxide ions come from in an aqueous system? (C)

1b. Why does pure water have an equal concentration of hydrogen ions and hydroxide ions? (C)

3. A base accepts a hydrogen ion from an acid. 4. An acid neutralizes a base and vice versa. 5. Changes in the balance between hydrogen ions and hydroxide ions manipulates the pH of a solution. 6. Strong acids and bases ionize completely while weak acids and bases ionize partially.	2a. What behavior defines an acid? (F) 2b. What are the properties of an acid? (F) 2c. Do all substances that contain hydrogen behave as acids? (P) 3a. What behavior defines a base? (F) 3b. What are the properties of a base? (F) 3c. Does a substance require hydroxide ions to behave as a base? (P) 4a. What is the outcome of an acid-base neutralization? (C) 4b. How are the stoichiometric amounts of acid and base needed for neutralization calculated? (C) 4c. How is a neutralized solution identified? (C) 5a. What is the pH of pure water? (F) 5b. Does in increase in hydrogen ion concentration increase or decrease the pH? (F) 5c. How is pH calculated from the concentration of hydrogen ions or hydroxide ions? (C) 5d. Is the pH of a neutralized solution always the same? (P) 6a. What defines a strong acid/base? (F) 6b. What defines a weak acid/base? (F) 6c. Why do some acids/bases only ionize partially? (C) 6d. How does the extent of ionization for an acid/base affect the pH of a solution? (C)

Standard(s)

Connecticut Core Standards / Content Standards

NGSS: Science Performance Expectations (2017)

NGSS: HS Physical Sciences

HS.Chemical Reactions

Performance Expectations

HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.

HS-PS1-5. Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.

HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

NGSS: Science and Engineering Practices

NGSS: 9-12

Practice 4. Analyzing and interpreting data

Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.

Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.

Practice 5. Using mathematics and computational thinking

Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.

Apply techniques of algebra and functions to represent and solve scientific and engineering problems.

Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3, acre-feet, etc.).

Access the interactive version of the NGSS here

Critical Content & Skills

*What students must **KNOW and be able to DO***

- Describe the properties of acids and bases.
- Identify Arrhenius acids and bases.
- Identify Brønsted-Lowry acids and bases.
- Construct Brønsted-Lowry conjugate acid-base pairs.
- Describe the relationship between H^+ concentrations [H+] and OH^- concentrations [OH-] in aqueous solutions.
- Calculate the pH, pOH, [H+] and [OH-] of aqueous solutions.
- Predict the products of neutralization reactions.
- Write balanced chemical equations for a neutralization reactions.
- Use an indicator to identify pH values, changes in pH, or the end point of neutralization reactions.
- Analyze a titration curve.
- Calculate the concentration of an acid or base during a titration experiment.
- Calculate the molar mass of an acid during a titration experiment.
- Describe the difference in behavior between strong and weak acids and bases in aqueous solution.
- Calculate the percent dissociation of a weak acid or base.

Core Learning Activities

- Acids and Bases Comparison Chart
- pH and pOH Calculations Practice
- Predicting the Products of Neutralization Reactions
- Determining Bronsted Lowry Acid Base Pairs
- Titration Calculations Practice
- Determining the Molar Mass of a Solid Acid Lab
- Standardizing a Base lab
- pH Calculations of Various Household Items (Indicator) Lab
- Determining the Percentage of Acetic Acid in Vinegar Lab

Properties of Acids and Bases Chart.pdf
pH and pOH problems .pdf
Bronsted Lowry Acid Base Pairs.pdf
Predicting Products of Neutralization Reactions.pdf
Titrations Worksheet.pdf
Indicator Lab.pdf

Assessments

Standardizing a Base Solution
Formative: Lab Assignment
Students determine the concentration of a sodium hydroxide solution through titration. A reliable acid standard, KHP, is used.
Lab -Standardizing a solution.pdf

Determining the Molar Mass of a Solid Acid
Formative: Lab Assignment
Students analyze a sample of a solid acid with a known mass through titrations with a standardized solution of sodium hydroxide. The data is used to calculate the molar mass of the acid.
Lab -Molar mass of solid acid.pdf

Determining the Percent Acetic Acid in Vinegar Lab
Summative: Lab Assignment
Students will determine the concentration of acetic acid one brand of vinegar by titrating with a known concentration of sodium hydroxide, using phenolphthalein as an indicator. In addition, they will use the molarity of acetic acid in vinegar to calculate the percentage of acetic acid by mass in the vinegar.
Titration of Vinegar Lab .pdf

Acids and Bases Test
Summative: Written Test
Will include a combination of MC, short answer and calculation based questions. The test review provides sample questions.
Acids and Bases Test Review Complete.pdf

Resources

Professional & Student

Teacher Resources:

- Teacher's Edition of Text: T.Buthelezi, L. Dingrando, N. Hainen, C. Wistrom, Chemistry. McGraw Hill, Glencoe, 2008.
- AACT Acids and Bases Resources
- Acids and Bases
- PHET pH

Students Resources:

- Student Text: T.Buthelezi, L. Dingrando, N. Hainen, C. Wistrom, Chemistry. McGraw Hill, Glencoe, 2008.
- What are Acids and Bases Video
- Intro to Acids and Bases Video
- Virtual Titration of Vinegar Lab
- Conjugate Acid Base Pairs Video
- Calculating pH, pOH, [H+], and [OH-] Video
- Titration Calculations Video
- Neutralization Reactions Video

Student Learning Expectation & 21st Century Skills

Information Literacy
Critical Thinking
Spoken Communication
Written Performance

Interdisciplinary Connections

Unit Planner: Unit XI: Gases Chemistry (CPA/Honors)

Friday, February 24, 2023 9:24AM

Newtown High School / 2022-2023 / Grade 11 / Science / Chemistry (CPA/Honors) / Week 31 - Week 33

Last Updated: Friday, June 24, 2022 by Bridget Berechid

Unit XI: Gases

Berechid, Bridget; Carley, Christopher

- Unit Planner
- Lesson Planner

Concept-Based Unit Development Graphic Organizer (Download)

Unit Web Template (Optional)

Concepts / Conceptual Lens

Please attach your completed Unit Web Template here

Lens:

Behavior

Concepts:

Gases

Ideality

Kinetic molecular theory

Particles

Volume

Temperature

Pressure

Quantity

Compressibility

Empty space

Fractions

Stoichiometry

G

Generalizations / Enduring Understandings

1. Ideal gases obey the kinetic molecular theory.

Guiding Questions

Please identify the type of question: (F) Factual, (C) Conceptual, (P) Provocative [Debatable]

2. Every ideal gas particle expresses identical behavior to every other ideal gas particle.	1a. What are the tenants of kinetic molecular theory? (F) 1b. The violation of which tenants of kinetic molecular theory cause non-ideal behavior? (C)
3. Equal volumes of gases at the same pressure and temperature consist of the same number of particles.	1c. Is it possible for a gas to have perfectly ideal behavior? (P)
4. The large amounts of empty space between gas particles renders them highly susceptible to compression and expansion.	2a. What behaviors do ideal gases exhibit? (F) 2b. Why do two ideal gas particles behave identically? (C)
5. The ideal gas equation, $PV = nRT$, predicts the relationship between the pressure(P), volume(V), moles of particles(n), and temperature(T) of a gas.	3a. How do the number of gas particles impact the volume, pressure, and temperature of a gas? (F) 3b. What volume does one mole of gas occupy at standard temperature and pressure? (C)
6. The mole fraction of a gas mixture determines the partial pressure of each gas.	4a. Why do gas particles have large amounts of empty space between them? (C)
7. The partial pressure of a gas facilitates stoichiometric calculations.	4b. What changes are necessary to compress or expand a gas? (C) 4c. Is there a limit to how much a gas can be compressed? (P)
	5a. How are temperature and pressure related? (C) 5b. How are temperature and volume related? (C) 5c. How are pressure and volume related? (C) 5d. How are moles of gas particles and volume related? (C) 5e. How can the ideal gas constant, R, be experimentally determined? (C) 5f. Which part(s) of the ideal gas equation would be affected by non-ideal behavior? (P)
	6a. How is the mole fraction calculated? (F) 6b. Why does the mole fraction directly relate to a gas's

	partial pressure? (C) 6c. Why do the partial pressure of a gaseous mixture add up to the total pressure of the mixture? (C) 7a. How can the partial pressure of a gas be related to moles of the gas? (C) 7b. Can changes in the overall pressure of a system be determined as a chemical reaction proceeds? (P)

Standard(s)

Connecticut Core Standards / Content Standards

NGSS: Science Performance Expectations (2017)

NGSS: HS Physical Sciences

HS.Structure and Properties of Matter

Performance Expectations

HS-PS1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.

HS.Forces and Interactions

Performance Expectations

HS-PS2-4. Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.

HS.Energy

Performance Expectations

HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).

HS-PS3-4. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).

HS-PS3-5. Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.

NGSS: Science and Engineering Practices

NGSS: 9-12

Practice 4. Analyzing and interpreting data

Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.

Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and

reliable scientific claims or determine an optimal design solution.

Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success.

Practice 5. Using mathematics and computational thinking

Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system.

Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.

Apply techniques of algebra and functions to represent and solve scientific and engineering problems.

Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3, acre-feet, etc.).

NGSS: Disciplinary Core Ideas

NGSS: 9-12

PS3: Energy

PS3.B: Conservation of Energy and Energy Transfer

Mathematical expressions, which quantify how the stored energy in asystem depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior. (HS-PS3-1)

Access the interactive version of the NGSS here

Critical Content & Skills

*What students must **KNOW and be able to DO***

- Describe how ideal gases behave according to the Kinetic molecular theory,
- Explain the difference between real and ideal gases behavior and identify the conditions under which their behaviors diverge.
- Convert between Celsius and Kelvin temperature scales.
- Convert between different units of pressure.
- Calculate the partial pressure of a gas.
- Calculate the total pressure of gases in a system using the partial pressure of each gas.
- Explain how volume, pressure, temperature, and the quantity of gas particles are related using the gas laws.
- Calculate a change in volume, pressure, or temperature using the combined gas law.
- Calculate the volume, pressure, temperature, molar mass, density, or quantity of gas particles using the ideal gas equation.
- Use Graham's Law to explain the relative effusion and diffusion rates of gases at the same temperature.

Core Learning Activities

Practice with Temperature and Pressure Conversions

Gas Laws Practice Calculations

Boyle's Law Lab

Determining the Molar Mass of an Unknown Gas Lab

Determining the Ideal Gas Constant (Ideal Gas Law) Lab

Crush the Can Activity (Charles's Law)

Extrapolating the Value of Absolute Zero (Gay Lussac) Lab
KMT and Diffusion -Graham's Law Lab

Gas Laws Temp & Pressure Conversions Practice.pdf
Ideal Dalton Graham Gas Laws Practice.pdf
Boyle Charles GayLussac Combined Gas Law Practice.pdf
KMT Diffusion w Grahams Law BTB Activity.pdf
Crush the Can.pdf
Absolute Zero Lab.pdf

Assessments

Boyle's Law Lab
Formative: Lab Assignment
Students perform an experiment to discover the relationship between the pressure and the volume of a gas and to review the terminology of experimentation such as hypothesis, independent variable, dependent variable and control.
Boyle's Law Lab.pdf

Determining the Ideal Gas Law Constant Lab
Formative: Lab Assignment
Students experimentally determine the value of R, the universal gas constant, using knowledge of stoichiometry and gas laws.
Determining the Ideal Gas Constant Lab.pdf

Air Bag Lab
Formative: Lab Assignment
Students use their knowledge of stoichiometry and gas laws and perform calculation with the goal of inflating a ziplock bag with the optimal amount of carbon dioxide.
Air Bag Lab.pdf

Determining the Molar Mass of an Unknown Gas Lab
Formative: Lab Assignment
Students will perform an experiment and use knowledge of multiple gas laws in order to determine identity of an unknown gas by calculating it's molar mass.
Determining the Molar Mass of an Unknown Gas Lab.pdf

Gas Laws Test
Summative: Written Test
A combination of MC, short answer and calculation based questions. Sample questions are included in the test review.
Gas Laws Test Review .pdf

Resources

Professional & Student

Teacher Resources:

- Teacher's Edition of Text: T.Buthelezi, L. Dingrando, N. Hainen, C. Wistrom, Chemistry. McGraw Hill, Glencoe, 2008.
- AACT Gas Laws Resources
- Gas Law Simulations
- PHET Gas Properties
- Crush the Can Video
- Peeps in a Bell Jar Video
- Graham's Law with HCl and NH_4Cl Video

Students Resources:

- Student Text: T.Buthelezi, L. Dingrando, N. Hainen, C. Wistrom, Chemistry. McGraw Hill, Glencoe, 2008.
- Gas Laws
- Gas Law Simulations
- ChemWiki: Gases
- Gas Laws Video
- Ideal Gas Law Calculations
- Combined Gas Law Calculations
- Studying Boyle's Law Simulation

Student Learning Expectation & 21st Century Skills

Information Literacy
Critical Thinking
Spoken Communication
Written Performance

Interdisciplinary Connections

Unit Planner: Unit XII: Organic Chemistry and Polymers Chemistry (CPA/Honors)

Friday, February 24, 2023 9:25AM

Newtown High School / 2022-2023 / Grade 11 / Science / Chemistry (CPA/Honors) / Week 34 - Week 36

Last Updated: Friday, June 24, 2022 by Bridget Berechid

Unit XII: Organic Chemistry and Polymers

Berechid, Bridget; Carley, Christopher

- Unit Planner
- Lesson Planner

Concept-Based Unit Development Graphic Organizer (Download)

Unit Web Template (Optional)

Concepts / Conceptual Lens

Please attach your completed Unit Web Template here

Lens:

Properties

Concepts:

Organic

Life

Molecules

Functional groups

Properties

Biological

Monomer

Polymer

Plastic

G

Generalizations / Enduring Understandings

1. Carbon-based compounds compose all known life.

2. Carbon atoms form complex molecules that promote diversity in form and function.

Guiding Questions

Please identify the type of question: (F) Factual, (C) Conceptual, (P) Provocative [Debatable]

1a. What element are organic molecules primarily composed of? (F)

1b. What other elements are commonly found in organic molecules? (F)

3. Functional groups dictate the properties of organic molecules.	2a. What type of chemical bonding exists in organic molecules? (F)
	2b. Why is carbon able to create a wide variety of molecules? (C)
4. Some organic molecules, such as proteins, lipids, carbohydrates and nucleic acids provide important structures and functions in living organisms.	2c. What is the simplest organic molecule? (F)
	2d. Is there a limit to the number of different organic molecules that could exist? (P)
5. Repeating chains of monomers construct polymers.	
	3a. What are the primary functional groups? (F)
6. Polymers form many modern materials, including plastics.	3b. What are some functional groups contained in common substances? (C)
	3c. Do all functional groups serve a purpose? (P)
	4a. What is a protein? (F)
	4b. What is a carbohydrate? (F)
	4c. What is a lipid? (F)
	4d. What is a nucleic acid? (F)
	4e. What role do the four categories of macromolecules play in biological systems? (C)
	4f. Are any organic molecules harmful to biological systems? (C)
	5a. What is a monomer? (F)
	5b. What is a polymer? (F)
	5c. How are monomers used to create polymers? (C)
	5d. Can a polymer be composed of different monomers? (P)
	5e. How are the properties of a monomer and a polymer the same? How are they different? (C)
	6a. What are some types of plastics? (F)

	6b. What are plastics used for? (F) 6c. Do the benefits of using plastics outweigh the risks? (P)

Standard(s)

Connecticut Core Standards / Content Standards

NGSS: Science Performance Expectations (2017)

NGSS: HS Physical Sciences

HS.Structure and Properties of Matter

Performance Expectations

HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

HS-PS1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.

HS.Chemical Reactions

Performance Expectations

HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.

HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.

NGSS: Science and Engineering Practices

NGSS: 9-12

Practice 3. Planning and carrying out investigations

Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled.

Access the interactive version of the NGSS here

Critical Content & Skills

*What students must **KNOW and be able to DO***

- Name organic compounds using the IUPAC system.
- Draw simple organic molecules.
- Identify saturated and unsaturated hydrocarbons.
- Determine the functional groups present in an organic molecule and their properties.
- Distinguish between isomers of organic compounds.
- Explain the role of organic molecules in biological systems.
- Describe the polymerization process.
- Identify the various applications of plastics in every day life.

- Analyze the benefits and risks of using plastics.

Core Learning Activities

- Naming Organic Compounds and Identifying Functional Groups Practice
- Polymer Labs (Making Shrinky Dinks, Bouncy Balls, etc)
- Organic Compound Modeling Lab
- Synthesizing Esters Lab
- Soap Lab

Hydrocarbon Naming Practice.pdf
Naming Organic Compounds Blue Book Practice.pdf
Organic Naming Practice PHS.pdf
Making Shrinky Dinks
Making Shrinky Dinks at Home
Paul's Polymer Labs
Synthetic Polymers and Plastics Lab

Assessments

Soap Lab
Formative: Lab Assignment
Students will experimentally synthesize soap, using vegetable oil as their starting material. They will then compare the properties of their soap to those of both commercial soap and commercial detergent.
Soap Lab.pdf
Synthesizing Ester Lab
Formative: Lab Assignment
Students experimentally synthesize an array of ester compounds, which are the basis of fruity scents encountered in everyday life.
Organic Modeling Lab
Formative: Lab Assignment
Students use kits to build models of a wide array of organic molecules to learn about their structures.
Organic Model Lab Guide.pdf
Organic Model Lab Chart.pdf
Organic Chemistry Test
Summative: Written Test
Includes MC and short answer questions. Sample questions can be found in the test review.
Organic Test Review.pdf

Resources

Professional & Student

Teacher Resources:

- Teacher's Edition of Text: T.Buthelezi, L. Dingrando, N. Hainen, C. Wistrom, Chemistry. McGraw Hill, Glencoe, 2008.
- AACT Organic Chemistry Resources
- Virtual Textbook of Organic Chemistry

Students Resources:

- Student Text: T.Buthelezi, L. Dingrando, N. Hainen, C. Wistrom, Chemistry. McGraw Hill, Glencoe, 2008.
- Naming Organic Compounds- Straight Chain Alkanes- Video
- Naming Organic Compounds- Branched Chain Alkanes- Video
- Hydrocarbons: Naming and Writing Formulas Video
- Drawing Alkenes Video
- Organic Functional Groups Video
- Macromolecules

Student Learning Expectation & 21st Century Skills

Information Literacy
Critical Thinking
Spoken Communication
Written Performance

Interdisciplinary Connections

Newtown Public Schools

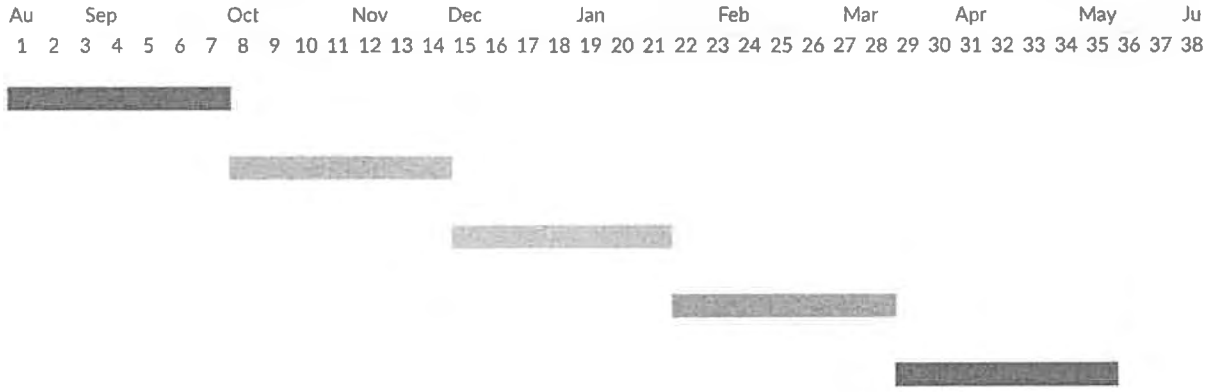
Atlas

Multivariable Calculus

4 Curriculum Developers | Last Updated: Thursday, Jan 19, 2023 by Hall, Eugene

Unit Calendar by Year

Unit	Lessons
Vectors and the Geometry of...	0
Vector Valued Functions	0
Functions of Several Variables	0
Multiple Integrals	0
Vector Analysis	0



5 Units found

Previous Year

Unit Planner: Vectors and the Geometry of Space
Multivariable Calculus

Newtown High School / 2022-2023 / Grade 12 / Mathematics / Multivariable Calculus / Week 1 - Week 7

Last Updated: Tuesday, January 17, 2023 by Eugene Hall

Vectors and the Geometry of Space

Cavataro, Charlotte; Hall, Eugene; Hyman, Paige; Raccio, Keristen

- Unit Planner
- Lesson Planner

Concept-Based Unit Development Graphic Organizer (Download)

Unit Web Template (Optional)

Concepts / Conceptual Lens

Please attach your completed Unit Web Template here

Concept: Vectors and the Geometry of Space

- coordinate plane
- octants
- surface
- plane
- sphere
- cylinder
- quadric surfaces
- vector
- magnitude
- direction
- scalar
- scalar multiplication
- vector addition
- zero vector
- unit vector
- standard basis vector
- dot product
- orthogonal
- scalar projection
- vector projection
- cross product
- determinant
- vector equation
- plane
- normal vector
- equation of a plane

Lens: Representation

G

Generalizations / Enduring Understandings

Strand 1: Three-Dimensional Coordinate Systems

Concepts:

Guiding Questions

Please identify the type of question: (F) Factual, (C) Conceptual, (P) Provocative [Debatable]

Generalization 1:

- coordinate plane
- octants
- surface
- plane
- sphere
- cylinder
- quadric surfaces

Generalization:

1) The three-dimensional coordinate system divides space into eight octants.

2) An equation in *x*, *y*, and *z* represents a surface in three dimensions.

3) Three-dimensional graphs include planes, spheres, cylinders, and quadric surfaces

Strand 2: Vectors

Concepts:

- vector
- magnitude
- direction
- scalar
- scalar multiplication
- vector addition
- zero vector
- unit vector
- standard basis vector

Generalization:

4) *A vector is used to indicate a quantity that has both magnitude and direction.*
5) *Scalar multiplication and vector addition are operations performed on vectors and scalars.*

6) The zero vector, unit vector, and standard basis vectors are the most basic form of a vector.

Strand 3: The Dot Product

Concepts:

- dot product
- orthogonal
- scalar projection
- vector projection

What are octants? (F)

Generalization 2:

How can two-dimensional curves be extended to three-dimensional surfaces?(C)

Generalization 3:

What are the traces of a surface? How is this found? (C)

Where are quadratic surfaces seen in the real world? (P)

What is the equivalent of using traces to draw surfaces in two dimensions? (P)

How is perspective used to represent three-dimensional objects in two-dimensional planes? (P)

Generalization 4:

What is the formula for finding the displacement vector? (F)

Generalization 5:

What is the difference between a vector and a scalar? (F)

How are two vectors added geometrically?(C)

How are two vectors added algebraically? (C)

If **a** is a vector and *c* is a scalar, how is *c***a** related to **a** geometrically? (C)

If **a** is a vector and *c* is a scalar, how is *c***a** found algebraically? (C)

How are two vectors added geometrically?(C)

Generalization 6:

How is the dot product $\mathbf{a} \cdot \mathbf{b}$ of two vectors found if their lengths and the angle between them are known? What if

Generalization:

7) The dot product of two vectors results in a scalar quantity.

8) Orthogonal vectors dot product evaluates to zero.

9) The scalar and vector projections of one vector onto another require the dot product.

Strand 4: The Cross product

Concepts:

- cross product
- determinant

Generalizations:

10) Calculating the determinant of the two vectors and the standard basis vectors creates a cross-product of two vectors.

Strand 5: Equations of Lines and Planes

Concepts:

- vector equation
- plane
- normal vector
- equation of a plane

Generalizations:

11) A vector equation represents a line in the three-dimensional coordinate plane.

12) An equation of a plane is determined by a point in the plane and the vector orthogonal to the plane called the normal vector.

their components are known? (F)

Generalization 7:

How are dot products useful? (P)

Generalization 8:

How are expressions written for scalar and vector projections of **b** onto **a**? (F)

When are two vectors perpendicular? (C)

Generalization 9:

When are two vectors parallel? (S3)

Generalization 10:

How is the cross product **a** × **b** of two vectors found if their lengths and the angle between them are known? What if their components are known? (F)

How is the area of a parallelogram determined by **a** and **b** found? (F)

How is the volume of a parallelepiped determined by **a**, **b**, and **c** found? (F)

How are cross-products useful? (P)

Generalization 11:

How are vector equations, parametric equations, and symmetric equations for a line written?(C)

How is the distance from a point to a line found? (C)

How is the distance between two lines found? (C)

Generalization 12:

	How is a vector perpendicular to a plane found? (C) How is the angle between two intersecting planes found? (C) When are two planes parallel? (C) How is a vector equation and a scalar equation for a plane found? (C) How is the distance from a point to a plane found? (C)

Standard(s)

Connecticut Core Standards / Content Standards

Critical Content & Skills

*What students must **KNOW and be able to DO***

Students must be able to:

- Use the three dimensional coordinate system.
- Apply properties of vectors.
- Apply the dot product to multiple vectors.
- Apply the cross product to multiple vectors.
- Describe lines and planes in three dimensions.

Core Learning Activities

In this unit, students will be given the opportunity to work collaboratively and independently.

Use the three dimensional coordinate system.

- Identify equations that represents a plane, spherical, cylindrical, and quadric surface.
- Write inequalities to describe a region.

Apply properties of vectors.

- Find a vector with representation specified by given line segments.
- Draw equivalent representations of vectors starting at the origin.
- Find the sum of vectors.
- Find vectors of the same direction.

Apply the dot product to multiple vectors.

- Find $\mathbf{a} \cdot \mathbf{b}$.
- Determine if vectors are orthogonal, parallel, or neither.
- Find direction cosines and direction angles of vectors.
- Find scalar and vector projections of vectors.

Apply the cross product to multiple vectors.

- Find the cross product of two vectors and verify that it is orthogonal to both.
- Find a vector, not with determinants, but by using properties of cross products.
- Find the magnitude of the cross product.
- Find nonzero vectors orthogonal to a plane through three given points.
- Find the volume of a parallelepiped.

Describe lines and planes in three dimension

- Find vector and parametric equations for a line.
- Find parametric and symmetric equations for a line.
- Determine whether lines are parallel, skew, or intersecting.
- Find the equation of a plane.
- Use intercepts to sketch a plane.
- Find the point at which a line intersects a plane.
- Determine whether planes are parallel, perpendicular, or neither.
- Find the angle between planes.
- Find parametric and symmetric equations for the line of intersection of planes.
- Find the distance from a point to a given line.
- Find the distance between parallel planes.
- Describe a method for determining whether three points *P, Q,* and *R* lie on the same line.
- Describe a method for determining whether four points *P, Q, R,* and *S* lie in the same plane.

MVC - Unit 1 Core Learning Activities.pdf

Assessments

Vectors and the Geometry of Space - Unit Assessment
Summative: Written Test
MVC - Unit 1 Assessment.pdf

Resources

Professional & Student

Department developed materials on google drive.

James Stewart, Multivariable Calculus Early Transcendentals

Student Learning Expectation & 21st Century Skills

Information Literacy
Critical Thinking
Spoken Communication
Written Performance

Interdisciplinary Connections

Physics - resultant force, work, Kepler's First Law, and torque.

Architecture - Circular paraboloids are used to collect and reflect light, sound, and radio and television signals. Cooling towers for nuclear reactors are usually in the shape of hyperboloids. Pairs of hyperboloids are used to transmit rotational motion between skew axis.

Unit Planner: Vector Valued Functions
Multivariable Calculus

Newtown High School / 2022-2023 / Grade 12 / Mathematics / Multivariable Calculus / Week 8 - Week 14

Last Updated: Thursday, January 19, 2023 by Eugene Hall

Vector Valued Functions

Cavataro, Charlotte; Hall, Eugene; Hyman, Paige; Raccio, Keristen

- Unit Planner
- Lesson Planner

Concept-Based Unit Development Graphic Organizer (Download)

Unit Web Template (Optional)

Concepts / Conceptual Lens

Please attach your completed Unit Web Template here

Concept: Vector Values Functions

- vector valued function
- space curve
- parametric equations
- parameter
- derivative
- tangent vector
- second derivative
- definite integral
- arc length
- curvature
- Binormal vector
- normal plane
- position vector
- velocity
- speed
- acceleration

Lens: Functions

G

Generalizations / Enduring Understandings

Strand 1: Vector Functions and Space Curves

Concepts:

- vector-valued function
- space curve
- parametric equations
- parameter

Generalization:

1) Vector-valued functions create curves and surfaces in space.

Guiding Questions

Please identify the type of question: (F) Factual, (C) Conceptual, (P) Provocative [Debatable]

Generalization 1:

What is a vector function? (F)

What is the connection between vector functions and space curves? (C)

When are vector-valued functions more efficient than a function of two variables? (P)

2) Parametric equations give the coordinates of all points on a space curve based on a given parameter.

Strand 2: Derivatives and Integrals of Vector Functions

Concepts:

- derivative
- tangent vector
- second derivative
- definite integral

Generalizations:

3) The derivative of **r**(t) is **r**'(t) and represents the tangent vector to the curve.

4) The methods for finding the derivative, second derivative, and definite integrals in real-valued functions can be extended to vector-valued functions.

Strand 3: Arc Length and Curvature

Concepts:

- arc length
- curvature
- Binormal vector
- normal plane

Generalizations:

5) *The length and curvature of a space curve are determined by specific formulas related to the vector-valued function.*

6) The cross-product of the unit tangent vector and the unit normal vector results in the binormal vector.

7) *The normal plane is determined by the tangent vector and the osculating plane is determined by the binormal vector.*

Strand 4: Motion in Space

Concepts:

- position vector
- velocity
- speed

Generalization 2:

How can a function of two variables be represented as a parametric equation? (C)

Generalization 3:

How is the tangent vector to a smooth curve at a point found? (C)

How is the tangent line found? (C)

How is the unit tangent vector found? (C)

Generalization 4:

How are the derivative and integral of a vector function found? (C)

Generalization 5:

What is the formula for the curvature of a plane curve with equation $y = f(x)$? (F)

How is the length of a space curve given by a vector function **r**(t) found? (C)

What is the definition of curvature? (C)

How is the curvature of a space curve determined in terms of **r**'(t) and **T**'(t)? (C)

How is the curvature of a space curve determined in terms of **r**'(t) and **r**''(t). (C)

Generalization 6:

What are the formulas for the unit normal and binormal vectors of a smooth space curve **r**(t)? (F)

Generalization 7:

What is the normal plane of a curve at a point? (F)

What is the osculating plane? (F)

- acceleration

Generalizations:

8) The first and second derivatives of the position vector give the velocity and acceleration vectors.

9) *Speed is a scalar quantity found by taking the magnitude of the velocity vector.*

What is the osculating circle? (F)

How can a rider on a rollercoaster be connected to the tangent, normal, and binormal vectors? (C)

Generalization 8:

How are the velocity, speed, and acceleration of a particle that moves along a space curve found? (S4)

Generalization 9:

How is speed related to velocity? (C)

How is the calculation for speed related to the Pythagorean Theorem? (C)

Standard(s)

Connecticut Core Standards / Content Standards

Critical Content & Skills

*What students must **KNOW and be able to DO***

Students must be able to:

- Model vector-valued function.
- Find the derivative of vector functions.
- Find the integral of vector functions.
- Relate tangent vectors, normal vectors, and curvature to the study of the motion of an object.

Core Learning Activities

In this unit, students will be given the opportunity to work collaboratively and independently.

Model vector-valued function.

- Find the domain of vector functions.
- Sketch the curve of a vector equation.
- Find parametric and vector equations for line segments joining two points.
- Match parametric equations with graphical representation.

- Find vector functions that represent the curve of intersection of two surfaces.

Find the derivative of vector functions.

- Find the derivative of vector functions.
- Sketch the position of vectors and their tangent vector for given values of *t*.
- Find unit tangent vectors.
- Find parametric equations for tangent lines to a curve.
- Use differentiation to find curvature.
- Write the rules for differentiating composite vector functions.

Find the integral of vector functions.

- Evaluate integrals of vector functions.
- Use integration of vectors to find the length of a curve.
- Reparametrize curves with respect to arc length measured from a point.

Relate tangent vectors, normal vectors, and curvature to the study of the motion of an object.

- Find the velocity, acceleration, and speed of a particle with a given position function.
- Find the velocity and position vectors of a particle given its acceleration, initial velocity, and initial position.
- Find the tangential and normal components of an acceleration vector.
- State Kepler's Laws.

MVC - Unit 2 Core Learning Activities.pdf

Assessments

Vector Functions - Unit Assessment
Summative: Written Test
MVC - Unit 2 Assessment.pdf

Resources

Professional & Student

Department developed materials on google drive.

James Stewart, Multivariable Calculus Early Transcendentals

Student Learning Expectation & 21st Century Skills

Information Literacy
Critical Thinking
Spoken Communication
Written Performance

Interdisciplinary Connections

Physics - Keplar's Three Laws of Planetary Motion, Newtown's Second Law of Motion and Law of Gravitation

Computer Science - three dimensional imaging

Biology - DNA mapping

Unit Planner: Functions of Several Variables
Multivariable Calculus

Thursday, March 9, 2023, 12:23PM

Newtown High School / 2022-2023 / Grade 12 / Mathematics / Multivariable Calculus / Week 15 - Week 21

Last Updated: Thursday, January 19, 2023 by Eugene Hall

Functions of Several Variables

Cavataro, Charlotte; Hall, Eugene; Hyman, Paige; Raccio, Keristen

- Unit Planner
- Lesson Planner

Concept-Based Unit Development Graphic Organizer (Download)

Unit Web Template (Optional)

Concepts / Conceptual Lens

Please attach your completed Unit Web Template here

Concept: Functions of Several Variables

- independent variable
- dependent variable
- function of two variables
- level curve
- function of *n* variables
- limit
- continuity
- partial derivative
- second order partial derivatives
- tangent plane
- linear approximation
- differential
- chain rule
- implicit differentiation
- directional derivative
- gradient vector
- tangent plane to the level surface
- critical point
- local minimum
- local maximum
- absolute maximum
- absolute minimum
- extreme value theorem
- second derivative test
- saddle point
- Lagrange multipliers

Lens: Function

G

Generalizations / Enduring Understandings

Strand 1: Functions of Several Variables

Concepts:

Guiding Questions

Please identify the type of question: (F) Factual, (C) Conceptual, (P) Provocative [Debatable]

Generalization 1:

- independent variable
- dependent variable
- function of two variables
- level curve
- function of *n* variables

Generalization:

1)* A function of two variables is a rule that assigns each ordered pair of independent variables (x,y) a dependent variable *z*.*

2) *The level curve of a function is the set of all points (x,y) at which the function takes on a certain value.*

3)* A function of *n* variables is a function rule with a set of *n*-tuple independent variables.*

Strand 2: Limits and Continuity

Concepts:

- limit
- continuity

Generalization:

4) The definitions of limits and continuity for multivariable functions follow from those of their single-variable counterparts.

Strand 3: Partial Derivatives

Concepts:

- partial derivative
- second order partial derivatives

Generalization:

5) *A partial derivative of a function of several variables is the derivative with respect to one of those variables, with the others held constant.*

6) *A second-order partial derivative is the derivative of the first-order partial derivative.*

Strand 4: Tangent Planes and Linear Approximations

Concepts:

- tangent plane
- linear approximation

What is a function of two variables? (F)

What is a function of three variables? (F)

How can a function of three variables be visualized? (C)

Generalization 2:

What are the three methods for visualizing a function of two variables? (F)

Generalization 3:

How can the concepts of a function of two variables be extended to a function of n-variables? (C)

Generalization 4:

What does it mean to say that f is continuous at (a, b)? (C)

If f is continuous on $\mathbb{R}^2$, what can be said about its graph? (C)

Generalization 5:

If $f(x, y)$ is given by a formula, how do you calculate f_x and f_y? (F)

How can expressions for the partial derivatives $f_x(a, b)$ and $f_y(a, b)$ as limits be written? (C)

How can $f_x(a, b)$ and $f_y(a, b)$ be interpreted geometrically? (C)

How can $f_x(a, b)$ and $f_y(a, b)$ be interpreted as rates of change? (C)

What does it mean to say that f is differentiable at (a, b)? (C)

How is differentiability verified? (C)

Generalization 6:

- differential

Generalizations:

7) The tangent plane to a surface at a point *P* provides a linear approximation of the function at that point.

8) A differential of a function represents a change in the linearization of the function with respect to one or more variables.

Strand 5: The Chain Rule

Concepts:

- chain rule
- implicit differentiation

Generalizations:

9) *The chain rule and implicit differentiation are techniques used to easily differentiate otherwise difficult equations.*

Strand 6: Directional Derivatives and the Gradient Vector

Concepts:

- directional derivative
- gradient vector
- tangent plane to the level surface

Generalizations:

10) *The gradient vector is a vector function whose components are the directional derivatives with respect to x and y.*

11) *The tangent plane to the level surface is a plane defined using the gradient as the normal vector.*

Strand 7: Maximum and Minimum Values

Concepts:

- critical point
- local minimum
- local maximum
- absolute maximum
- absolute minimum

What does Clairaut's Theorem say? (F)

Generalization 7:

What is the linearization of some function *f* at *(a, b)? (F)*

What is the linear approximation of some function *f* at *(a, b)*? (F)

What is the geometric interpretation of a linear approximation? (F)

Generalization 8:

If $z = f(x, y)$, what are the differentials dx, dy, and dz? (F)

Generalization 9:

What is the Chain Rule for the case where $z = f(x, y)$ and *x* and *y* are functions of one variable? (F)

What is the Chain Rule for the case where $z=f(x,y)$ and *x* and *y* are functions of two variables? (F)

If z is defined implicitly as a function of *x* and *y* by an equation of the form $F(x, y, z) = 0$, how is *dz/dx* and *dz/dy* found? (F)

Generalization 10:

What is the gradient vector for a function *f* of two or three variables? (F)

How is a limit for the directional derivative or r at (x_0, y_0) in the direction of a unit vector $\boldsymbol{u}\langle a, b\rangle$ interpreted as a rate? (C)

Is there a geometric significance of the gradient? (P)

Generalization 11:

How is a tangent plane to a graph of a function of two variables, $z = f(x,y)$ found? (C)

Generalization 12:

- extreme value theorem
- second derivative test
- saddle point

Generalizations:

12) *Local minimum and local maximum values are located at critical points where one or both partial derivatives are either equal to zero or undefined.*

13) *The extreme value theorem guarantees there is at least one absolute minimum and one absolute maximum value on a closed set.*

14) *The second derivative test is a method for determining whether a critical point is a local minimum, maximum, or saddle point.*

Strand 8: Lagrange Multipliers

Concepts:

- Lagrange multipliers

Generalizations:

15) Lagrange multipliers are an alternative method for locating critical points5

What is a critical point of a function *f*? (F)

What does it mean for a function *f* to have a local maximum at *(a, b)*? (F)

What does it mean for a function *f* to have an absolute maximum at *(a, b)*? (F)

What does it mean for a function *f* to have a local minimum at *(a, b)*? (F)

What does it mean for a function *f* to have a saddle point at *(a, b)*? (F)

If *f* has a local maximum at *(a, b)*, what can be said about its partial derivatives at *(a, b)*? (C)

Generalization 13:

What does it mean for a function *f* to have an absolute minimum at *(a, b)*? (F)

What is a closed set in $\mathbb{R}^2$? What is a bounded set? (F)

What is the Extreme Value Theorem for functions of two variables.?(F)

How are the values that the Extreme Value Theorem guarantees found? (C)

Generalization 14:

What is the Second Derivative's Test? (F)

Generalization 15:

How do the graphs of the space curve and constraint curve connect to calculating Lagrange Multipliers? (C)

Standard(s)

Connecticut Core Standards / Content Standards

Critical Content & Skills

*What students must **KNOW and be able to DO***

Students must be able to:

- Model functions of several variables.
- Evaluate limits.
- Find partial derivatives.
- Use the equations of tangent planes for linear approximations.
- Apply the chain rule.
- Find the gradient vector and directional derivatives of functions.
- Identify critical points.
- Use Lagrange multipliers.

Core Learning Activities

In this unit, students will be given the opportunity to work collaboratively and independently.

Model functions of several variables.

- Find and sketch the domain of a given function.
- Sketch the graph given a function.
- Use contour maps to make a rough sketch of the graph of a given function.
- Draw a contour map of a function.
- Sketch both a contour map and a graph of a function.
- Describe level surfaces of a function.

Evaluate limits.

- Find the limit of a function, if it exists, or show that it does not exist.
- Determine the set of points at which a function is continuous.
- Use polar coordinates to find a limit.

Find partial derivatives.

- Determine the signs of the partial derivatives for a given function.
- Identify surfaces of a function and its partial derivative.
- Find partial derivatives with respect to different variables.
- Find the first partial derivatives of a function.

- Use implicit differentiation to find second partial derivatives.
- Verify Clairaut's Theorem.

Use the equations of tangent planes for linear approximations.

- Find the equation of the tangent plane to a given surface at a specified point.
- Graph a surface and its tangent plane at any given point.
- Explain why a function is differentiable at a given point and find the linearization of the function at that point.
- Find the differential of a function.
- Show that a function is differentiable.

Apply the chain rule.

- Use the chain rule to differentiate composite functions.
- Use the chain rule to find partial derivatives.
- Prove the Implicit Function Theorem.

Find the gradient vector and directional derivatives of functions.

- Find directional derivatives of a function at a given point in a direction indicated by an angle.
- Find the gradient of a function.
- Evaluate the gradient of a function at a point.
- Find the rate of change of a function at a point in the direction of a given vector.
- Find the directional derivative of a function at a given point in the direction of a given vector.
- Find the maximum rate of change of a function at a given point and the direction in which it occurs.
- Find equations of tangent planes and normal lines to a given surface at a specified point.

Identify critical points.

- Use level curves to predict the location of the critical points of a function.
- Use the Second Derivative Test to confirm the existence of critical points.
- Find local extrema and saddle point(s) of a function.
- Show that functions can have an infinite number of critical points.
- Use a graph and/or level curves to estimate local extrema and saddle points of a function.
- Find the absolute extrema of a function on a set.

Use Lagrange Multipliers.

- Use Lagrange multipliers to find relative extrema values of a function and a given constraint.
- Use Lagrange multipliers to give alternate solutions to exercises.

MVC - Unit 3 Core Learning Activities.pdf

Assessments

Functions of Several Variables - Unit Assessment
Summative: Written Test
MVC - Unit 3 Assessment.pdf

Resources

Professional & Student

Department developed materials on google drive.

James Stewart, Multivariable Calculus Early Transcendentals

Student Learning Expectation & 21st Century Skills

Information Literacy
Critical Thinking
Spoken Communication
Written Performance

Interdisciplinary Connections

Economics - Cobb Douglas production function

Civil Engineering - Hydro-turbine optimatization

Unit Planner: Multiple Integrals
Multivariable Calculus

Thursday, March 9, 2023 1:03PM

Newtown High School / 2022-2023 / Grade 12 / Mathematics / Multivariable Calculus / Week 22 - Week 28

Last Updated: Thursday, January 19, 2023 by Eugene Hall

Multiple Integrals

Cavataro, Charlotte; Hall, Eugene; Hyman, Paige; Raccio, Keristen

- Unit Planner
- Lesson Planner

Concept-Based Unit Development Graphic Organizer (Download)

Unit Web Template (Optional)

Concepts / Conceptual Lens

Please attach your completed Unit Web Template here

Concept: Multiple Integrals

- volume
- double integral
- double Reimann sum
- average value
- iterated integral
- Fundamental Theorem of Calculus
- triple Reimann sum
- triple integral
- polar coordinates
- spherical coordinates
- transformation
- determinant
- Jacobian
- change of variables

Lens: Connection

G

Generalizations / Enduring Understandings

Strand 1: Double Integrals

Concepts:

- volume
- double integral
- double Reimann sum
- average value
- iterated integral
- Fundamental Theorem of Calculus

Generalizations:

1) *A double Reimann sum is used to approximate a double integral which represents the volume under a

Guiding Questions

Please identify the type of question: (F) Factual, (C) Conceptual, (P) Provocative [Debatable]

Generalization 1:

What does the double Reimann sum of a function represent? (F)

What is the definition of the double integral of $f(x,y)$ as a limit? (F)

What is the geometric interpretation of a double integral of $f(x,y)$ if $f(x,y) \geq 0$? What if f takes on both positive and negative values? (F)

What does the Midpoint Rule for double integrals say? (F)

surface and above a rectangular region in the *xy*-plane.*

2) *The average value of a function of two variables is found by dividing the volume by the area of the region in the xy-plane.*

3) The Fundamental Theorem of Calculus provides a method for calculating the exact volume under a surface using iterated integrals.

Strand 2: Triple Integrals

Concepts:

- triple Reimann sum
- triple integral
- polar coordinates
- spherical coordinates

Generalizations:

4) *Triple Reimann sums and triple integration are extensions of double integration for functions of three variables.*

5) *Iterated integration is performed in different coordinate systems such as polar coordinates and spherical coordinates.*

Strand 3: Change of Variables in Multiple Integrals

Concepts:

- transformation
- determinant
- Jacobian
- change of variables

Generalizations:

6) *The Jacobian of a transformation is defined to be the determinant resulting from the cross-product of the transformation vectors.*

7) *Change of variables in a double integral is an extension of substitution for one variable functions.*

What are type I and type 2 region for double integrals? (F)

How is the double integral of *f(x,y)* evaluated in a type I region? (C)

How is the double integral of *f(x,y)* evaluated in a type II region? (C)

What are the properties of double integrals? (F)

How is the double integral of *f(x,y)* evaluated? (C)

Generalization 2:

How can an expression for the average value of *f* be written? (C)

Generalization 3:

What is the significance of changing rectangular coordinates to polar coordinates? (F)

How are rectangular coordinates changed to polar coordinates in a double integral? (C)

How is the double integral of *f(x,y)* defined if the bounded region is not a rectangle? (C)

Generalization 4:

What is the definition of the triple integral of *f* over a rectangular box *B*? (F)

What is the definition of the triple integral of *f(x,y,z)* if the bounded solid region is not a box? (F)

What is a type I, type 2, and type 3 solid region for triple integrals? (F)

If a double integral calculates the volume of a region, what does a triple integral calculate? (P)

What is the next dimension? (P)

Generalization 5:

When is it appropriate to change from rectangular

coordinates to cylindrical or spherical coordinates? (F)

If a transformation T is given by $x=g(u,v)$, $y=h(u,v)$, what is the Jacobian of T? (F)

How is the triple integral of $f(x,y,z)$ evaluated? (C)

How is the triple integral of $f(x,y,z)$ evaluated in type 1, type 2, and type 3 solid region? (C)

How are rectangular coordinates changed to cylindrical coordinates in a triple integral? (C)

How are rectangular coordinates changed to spherical coordinates in a triple integral? (C)

Generalization 6:

How can an intuitive approach be used to create the jacobian for a transformation from rectangular to polar coordinates? (C)

How does the region of integration change when a transformation is created? (C)

Generalization 7:

How is the change of variables for a function of one variable and a function of many variables different? (F)

How are double integrals used to change variables? (C)

How are triple integrals used to change variables? (C)

Standard(s)

Connecticut Core Standards / Content Standards

Critical Content & Skills

*What students must **KNOW and be able to DO***

Students must be able to:

- Evaluate double integrals.
- Evaluate triple integrals.
- Use double and triple integrals to change variables.

Core Learning Activities

In this unit, students will be given the opportunity to work collaboratively and independently.

Evaluate double integrals.

- Estimate the volume of solids that lie below a surface and above a rectangular region.
- Evaluate a double integral by first identifying it as the volume of a solid.
- Calculate iterated integrals.
- Calculate double integrals.
- Sketch a solid whose volume is given by an iterated integral.
- Find the average value of a function over a given rectangle.
- Evaluate double integrals.
- Find the volume of a given solid.
- Sketch a region of integration and change the order of integration.
- Evaluate integrals be reversing the order of integration.
- Evaluate integrals by changing to polar coordinates.
- Use a double integral to find the area of a region.
- Use polar coordinates to find the volume of a given solid.
- Evaluate iterated integrals by converting to polar coordinates.
- Find the mass and center of mass of a lamina that occupies a given region with a given density function.
- Find moments of inertia and radii of gyration.

Evaluate triple integrals.

- Evaluate triple integrals.
- Evaluate iterated integrals.
- Use triple integrals to find the volume of solids.
- Uses the Midpoint Rule for triple integrals to estimate the value of integrals.
- Sketch a solid whose volume is given by given iterated integrals.
- Evaluate integral expressions for the mass, the center of mass, and the moment of inertia about the *z*-axis.
- Plot cylindrical and spherical coordinates.
- Convert rectangular coordinates to cylindrical and spherical coordinates and vice versa.
- Write rectangular equations in spherical and cylindrical coordinates.
- Evaluate integrals by changing to spherical and cylindrical coordinates.

Use double and triple integrals to change variables.

- Find the Jacobian of transformations.
- Find the image set under given transformations.
- Use transformations to evaluate integrals.
- Evaluate integrals by making the appropriate change of variables.

MVC - Unit 4 Core Learning Activities.pdf

Assessments

Multiple Integrals
Summative: Written Test

Resources

Professional & Student

Department developed materials on google drive.

James Stewart, Multivariable Calculus Early Transcendentals

Student Learning Expectation & 21st Century Skills

Interdisciplinary Connections

Information Literacy Critical Thinking Spoken Communication Written Performance	Physics - Applications of inertia and gyration of a lamina.

Unit Planner: Vector Analysis
Multivariable Calculus

Newtown High School / 2022-2023 / Grade 12 / Mathematics / Multivariable Calculus / Week 29 - Week 35

Last Updated: Thursday, January 19, 2023 by Eugene Hall

Vector Analysis

Cavataro, Charlotte; Hall, Eugene; Hyman, Paige; Raccio, Keristen

- Unit Planner
- Lesson Planner

Concept-Based Unit Development Graphic Organizer (Download)

Unit Web Template (Optional)

Concepts / Conceptual Lens

Please attach your completed Unit Web Template here

Concept: Vector Analysis

- vector field
- gradient vector field
- curl
- divergence
- line integral
- Fundamental Theorem of Line Integrals
- Green's Theorem
- parametric surface
- surface area
- surface integral
- Stokes' Theorem
- Divergence Theorem

Lens: Analysis

G

Generalizations / Enduring Understandings

Strand 1: Vector Fields

Concepts:

- vector field
- gradient vector field
- curl
- divergence

Generalizations:

1)* A vector field is a function that assigns every point in its domain a three-dimensional vector.*

2) *A gradient vector of a function at a point is part of a larger gradient vector field.*

3) *Curl and Divergence are two operations performed

Guiding Questions

Please identify the type of question: (F) Factual, (C) Conceptual, (P) Provocative [Debatable]

Generalization 1:

What is a vector field? (F)

What are three examples of vector fields that have a physical meaning? (F)

What is a conservative vector field? (F)

What is a potential function? (F)

What does it mean to say that the integral of a vector field is independent of the path? (C)

on vector fields that are useful in applications of vector calculus.*

Strand 2: Line Integrals

Concepts:

- line integral
- Fundamental Theorem of Line Integrals
- Green's Theorem

Generalizations:

4) A line integral is an extension of the single integral process applied over a curve.

5) The Fundamental Theorem of line integrals provides one method for evaluating the line integral of a gradient vector field using the endpoints of the curve.

6) Green's Theorem gives the relationship between a line integral around a closed curve and a double integral over the corresponding plane.

Strand 3: Parametric Surfaces and their Areas

Concepts:

- parametric surface
- surface area
- surface integral
- Stokes' Theorem
- Divergence Theorem

Generalizations:

7) Vector functions are used to describe parametric surfaces and compute their surface areas.

8) The relationship between surface integrals and surface area is an extension of the relationship between line integrals and arc length.

9) Stokes' Theorem and the Divergence Theorem are higher-dimensional versions of Green's Theorem.

Generalization 2:

Generalization 3:

What is the definition of the curl of a vector on $\mathbb{R}^3$? (F)

What is the definition of the divergence of a vector on $\mathbb{R}^3$? (F)

If **F** is a velocity field in fluid flow, what are the physical interpretations of curl **F** and div **F**? (F)

Generalization 4:

What is the definition of the line integral of a scalar function along a smooth curve with respect to arc length? (F)

What are the definitions of the line integrals along a smooth curve of a scalar function with respect to *x*, *y*, and *z*? (F)

What is the definition of the line integral of a vector field along a smooth curve given by a vector function? (F)

What does the line integral of a force field represent? (F)

How is the line integral of a scalar function along a smooth curve with respect to arc length evaluated? (C)

How is the expression for the mass and center of mass of a thin wire shaped like a curve if the wire has linear density function $\rho(x,y)$ written? (C)

How are the line integrals along a smooth curve of a scalar function with respect to *x*, *y*, and *z* evaluated? (C)

How is the expression written for the area enclosed by a curve in terms of line integrals around that curve? (C)

Generalization 5:

What is the connection between the line integral of a vector field **F** and the line integrals of the component functions *P*, *Q*, and *R*, if $\mathbf{F}=\langle P,Q,R\rangle$? (F)

What is the Fundamental Theorem for Line Integrals? (F)

Generalization 6:

What is Green's Theorem? (F)

If $\mathbf{F}=P\mathbf{i}+Q\mathbf{j}$, what is the test to determine whether **F** is conservative? (F)

If **F** is a vector field on $\mathbb{R}^3$, what is the test to determine whether **F** is conservative? (F)

Generalization 7:

What is a parametric surface? (F)

What are the grid curves of a parametric surface? (F)

Generalization 8:

What is the area of a surface given by an equation $z=g(x,y)$? (F)

What is the definition of the surface integral of a scalar function over a surface? (F)

What is an oriented surface? (F)

What are some examples of a non-orientable surface? (F)

If a thin sheet has the shape of a surface, and the density at (x,y,z) is $\rho(x,y,z)$, what is the expression for the mass and center of mass of the sheet? (F)

What is the definition of the surface integral (or flux) of a vector field over an oriented surface with a unit normal vector? (F)

How is the expression written for the area of a parametric surface? (C)

How is the integral of a parametric surface given by a vector function $\mathbf{r}(u,v)$ evaluated? (C)

How is the surface integral (or flux) of a vector field over an oriented surface with a unit normal vector evaluated if the surface is parametric given by a vector function $\mathbf{r}(u,v)$? (C)

Generalization 9:

	What is Stokes' Theorem? (F) What is the Divergence Theorem? (F) In what ways are the Fundamental Theorem for Line Integrals, Green's Theorem, Stokes' Theorem, and the Divergence Theorem similar? (P)

Standard(s)

Connecticut Core Standards / Content Standards

Critical Content & Skills

*What students must **KNOW and be able to DO***

Students must be able to:

- Use vector fields in applications of vector calculus.
- Evaluate line integrals.
- Use parametric surfaces.

Core Learning Activities

In this unit, students will be given the opportunity to work collaboratively and independently.

Use vector fields in applications of vector calculus.

- Sketch and match vector fields in $\mathbb{R}^2$.
- Match vector fields in $\mathbb{R}^3$.
- Find and sketch the gradient vector field of a function.
- Plot gradient vector fields and contour maps of a function.
- Find the curl and the divergence of a field vector.
- Determine whether or not a vector field is conservative.
- Prove vector identities, assuming that the appropriate partial derivatives exist and are continuous.

Evaluate line integrals.

- Evaluate line integrals where C is a curve.
- Evaluate a line integral of a vector field where the curve is given by a given vector function.
- Determine whether or not a vector field is a conservative vector field.
- Show that a line integral is independent of path and evaluate the integral.
- Find the work done by a force field in moving an object.
- Evaluate a line integral using Green's Theorem.

- Use Green's Theorem to evaluate the integral of a vector field.

Use parametric surfaces.

- Determine whether two points lie on a given surface.
- Identify a surface with given vector equations.
- Find parametric representations for a surface.
- Find the area of a surface.
- Evaluate surface integrals.
- Use Stokes' Theorem to evaluate the double integral of the curl of a vector field.
- Use Stokes' Theorem to evaluate the integral of a vector field.
- Verify the Divergence Theorem.
- Use the Divergence Theorem to calculate surface integrals.

MVC - Unit 5 Core Learning Activities.pdf

Assessments

Vector Analysis
Summative: Written Test
MVC - Unit 5 Assessment.pdf

Resources

Professional & Student

Department developed materials on google drive.

James Stewart, Multivariable Calculus Early Transcendentals

Student Learning Expectation & 21st Century Skills

Information Literacy
Critical Thinking
Spoken Communication
Written Performance

Interdisciplinary Connections

Engineering - Work of a piston in a 4 stroke engine, Greens Theorem, Stokes' Theorem.

Please Note: These minutes are pending Board approval.

Board of Education
Newtown, Connecticut

Minutes of the Board of Education meeting held on April 4, 2023, at 7:00 p.m. in the Council Chambers, 3 Primrose Street.

D. Zukowski, Chair
J. Vouros, Vice Chair
D. Ramsey, Secretary
D. Cruson
J. Kuzma
J. Larkin (arrived 7:27 p.m.)
A. Plante
K. Kunzweiler
D. Godino
C. Melillo
A. Uberti
T. Vadas
7 Staff
70 Public
1 Press

Ms. Zukowski called the meeting to order at 7:02 p.m.

Item 1 – Pledge of Allegiance

Item 2 – Celebration of Excellence

Dr. Kim Longobucco spoke about the National Merit Scholarship Program which is associated with the PSAT for our juniors and the following year being given a list of commended students, semifinalists and finalists. The Board members recognized finalist Kirtana Kunzweiler and semi-finalists Paige Armstrong, Joseph Augustine, Jennifer Dushi, Colin Edwards, Lauren Jacobs, Shreyas Potnuru, Anabel Saunders, Kate Shirk, Nicholas Tetreault, and Siddath Vakacherla.

Item 3 – Consent Agenda

MOTION: Mrs. Kuzma moved that the Board of Education approve the consent agenda which includes the donations to Newtown High School and Newtown Middle School, the Newtown Middle School field trip to the National Jazz Festival in Philadelphia, Pennsylvania, and the correspondence report. Mr. Cruson seconded. Motion passes unanimously.

Item 4 – Public Participation

Lynn Edwards, 3 Sand Hill Road, referred to the minutes of March 21, 2023 and asked that the minutes be amended to reflect the parent's comments.

Item 5 – Reports

Chair Report: Ms. Zukowski reported that she and other Board members were guest readers in our schools, and the annual district art show opened yesterday in the municipal center where it will be for two weeks. The following two weeks the Hawley student art will be displayed. We are participating in negotiations with the Custodian and Maintenance Association and the Federation of Educational Personnel. Our interviews for the Director of Facilities have started, the Board also received several Citizen's Request for Reconsideration of Library Media Materials forms and asked if the books would be available for the Board members, to which Mr. Melillo said he would provide.

Superintendent's Report: Mr. Melillo read the book "Potato Pants" to Mrs. Whitmore's Hawley kindergarten class on March 20 which the students enjoyed. Last week he also read to a Head O'Meadow fourth grade class and Hawley kindergarten classes. The middle school drama club will present the "Lion King" on April 27 and 28.

Committee Reports:
Mr. Cruson noted that the Policy Committee met March 22 to review the suspension and expulsion policy and will continue going through the staff medical policy.

Mr. Vouros said the Curriculum & Instruction Committee met regarding the CP Honors Chemistry curriculum and Multivariable Calculus curriculum being presented tonight.

Mr. Ramsey said the Communications Sub-committee met and discussed the current district highlights and were pleased that over 1,000 people read it. They also discussed the next issue which will center around the arts.

Mr. Cruson reported that the Town had their tabletop emergency drill this morning. The scenario was a test which included three bomb threats and two robberies in town. It went very well and the private schools were also represented. It was needed, well executed, and shows the district is taking it seriously

Student Representatives Report:
Ms. Kunzweiler noted that AP Spanish students went to the Wadsworth Museum and a group also went to Yale. A college fair took place last week. Yesterday students assisted in the art show. Spring sports began this week. This is a stressfull, but exciting time for seniors.

Item 6 – Presentations
Chemistry (CPA Honors) Curriculum:
Bridget Berechid and Chris Carley presented Chemistry CPA Honors Curriculum.
Multivariable Calculus:
Gene Hall, Math Dept. Chair, presented the Multivariable Calculus Curriculum.

Middle School Art Course Change Proposal:
MOTION: Mrs. Kuzma moved that the Board of Education approve the middle school art course change proposal. Mrs. Plante seconded.

Leigh Anne Hildebrandt, Kristen Ladue and Michelle Hiscavich spoke about the course changes which includes phasing out the art enrichment program for grade seven and eight and have the course offerings of General Art, 2D Studio Art, 3D Studio Art and Practical Arts. There has been a decrease in students applying for art courses because of reduced interest. Additional enrichment opportunities in the arts in the middle school include National Junior Art Honor Society, Jazz Band, Theater Production, and Chorus Club.
Motion passes unanimously.

Item 7 – Old Business
Medical Spanish Curriculum:
MOTION: Mrs. Kuzma moved that the Board of Education approve the Medical Spanish Curriculum. Mr. Vouros seconded. Motion passes unanimously.
Business Spanish Curriculum:
MOTION: Mrs. Kuzma moved that the Board of Education approve the Business Spanish Curriculum. Mr. Vouros seconded. Motion passes unanimously.

Item 8 – New Business
Hawley Move Plan:
MOTION: Mrs. Kuzma moved that the Board of Education approve the adjustment in the school calendar for the Hawley move. Mr. Cruson seconded.

Mr. Melillo said there are constraints in moving Hawley classes back from Sandy Hook and Reed. Teachers work 187 days. Moving in at the start of school this year we had major issues as to when walk throughs would happen and we had to move professional development to the summer but not everyone participated because it was not in their contract. Unpacking takes time and we looked to address all issues and that we lost a lot of PD time this year because of unpacking. The State mandates a new reading program this coming year and we want to be sure teachers have time to prepare. The State requires 180 school days and our students go 182 days so we plan to close Hawley two days earlier for the move. June 13 and 14 Hawley students can choose to go to the Community Center for educational presentations. Teachers will pack on June 13 and movers will be there June 14. Teachers will work one day over the summer to unpack. This plan is least impactful for Hawley students. It's a calendar change for Hawley and the Pre-K students
Motion passes unanimously.

Propane Fuel Contract:
MOTION: Mrs. Kuzma moved that the Board of Education award Hocon Gas the propane fuel contract. Mrs. Plante seconded. Motion passes unanimously.

Policy 5114 Suspension and Expulsion/Due Process:
Mr. Cruson said the change in this policy focused around expulsion hearings and brought by Mr. Melillo because of the difficulties in getting a quorum for the hearings which have to be held within 10 days. A hearing officer could be used when we can't reach a quorum. We also met with legal counsel on this problem and was told Board members aren't supposed to know more on the issues of the expulsion. There was not a complete agreement with the Board members on the Policy Committee. Some wanted the Board to be involved and some wanted to appoint a hearing officer. These hearings are difficult for those attending. Mr. Melillo feels he can get a hearing officer within the timeline if we can't get Board members. Ms. Zukowski said we might form a subcommittee of Board members who would commit to doing these hearings. If we can't get three to come in we would get a hearing officer.

Mrs. Kuzma was concerned the Board wouldn't find out about issues happening regularly if we used a hearing officer.

Ms. Zukowski wanted to build in flexibility to find the three people. We would create the committee with three members and an alternate.

Mr. Melillo said our Board members are members of the community. If they have a connection with any community members associated with the family, they need to take themselves off the committee. There are a lot of schedules that need to be aligned so it's good to have another choice.

Mr. Vouros said it was key that Board members are on the expulsion hearings. He would not like a hearing officer to take over such an important duty. It's rewarding to know this district takes care of the children and important that at least one of us is there.

Newtown Middle School Moving up and Newtown High School Graduation Dates:
MOTION: Mrs. Kuzma moved that the Board of Education approve June 12 for the Newtown Middle School Moving-up Ceremony and June 13 as the Newtown High School graduation date with June 14 as the rain date. Mr. Ramsey seconded. Motion passes unanimously.

Non-renewal list:
MOTION: Mrs. Kuzma moved that the Board of Education approve the 2022-2023 non-renewal list. Mrs. Plante seconded. Motion passes unanimously.

Minutes of March 21, 20232
MOTION: Mrs. Kuzma moved that the Board of Education approve the minutes of March 21, 2023. Mr. Ramsey seconded.

MOTION: Ms. Zukowski moved to amend the minutes to replace 'expressed her negative experiences while her son attended Newtown Public Schools' with 'stated that for "well over a decade her son faced systematic racism, microaggression, and retaliation which has negatively impacted his education," that she says were never addressed'.
Mr. Cruson seconded. Vote: 6 ayes, 1 abstained (Mrs. Larkin)

Ms. Zukowski said Mrs. Pranger's public comment was deeply disturbing and learned that her son was attending school out of district for several years. Since joining the Board, we have worked diligently on policies related to racism and supported actions taken by the administration to ensure our schools' culture and climate welcome and embrace all of our students. We adopted policies related to equity and diversity, racial harassment, minority recruitment and more and include DEI presentations including providing all students access to the Anonymous Alert App. These efforts came after Ms. Pranger's son left the district but they are providing key tools needed to ensure that all Newtown students, including black children, feel welcome in our schools and can participate fully in our classes, services and activities.

Mr. Cruson asked to put into consideration for future minutes we provide language with a link to the town site so anyone will be able to watch the meeting. He reviewed the policy on minutes and this does not go against our policy to put that in place.

Mr. Ramsey noted that with this circumstance he feels we need to have a good sense of judgement in taking the minutes but those taking the minutes are not stenographers. The meetings are video-taped so verbatim accounts shared by the public are on the record.

Mr. Vouros thought we had investigated the ruling on notetaking and what is actually required. Ms. Zukowski recommended that Mr. Cruson reach out to each member regarding thoughts on this, make a proposal, and have an agenda item on how to improve minutes.

Vote on amended minutes: 6 ayes, 1 nay (Mrs. Larkin) Motion passes.

Item 9 – Public Participation
Please click here to view the public participation.

Glenn Boyle, 23 Park Lane, spoke about what good education means.
Don Lococo, 27 Hi Barlow Road, referred to our code of ethics and the March 21 meeting.
Jack Tanner, 13 Dodgingtown Road, spoke about the time involved in serving on the Board of Education.
Dave Mason, 35 Hi Barlow Road, spoke about banning the book.
Melissa Gomez, 6 Old Gate Lane, spoke about banning the book.
Tatum McGrady, 26 Philo Curtis Road, spoke about Black Lives Matter and being ally.
Aaron Malin, 5 Fleetwood Drive, spoke about the book.
Arlina Carias, 88 Hattertown Road, spoke about banning books.

David Landa, 13 Wiley Lane, spoke asked about a second grade teacher at Middle Gate.
Tim Stan, 6 Monitor Hill Road, spoke about banning books.
Julie Stan, 6 Monitor Hill Road, spoke about children not being accepted in school.
Danielle Lozer, 1 Grays Plain Road, spoke about a book being questioned at Reed and suggested an app for parents regarding book choices.
Karin LaBanca, 33 Paugussett Road, spoke about banning books.
Chris Smith, 22 Wills Road, spoke about banning books.
Dave Zupan, 29 Mountain Manor Road, spoke about banning books.
Dylan Thomas, 15 Butterfield Road, appreciates what the Board and administrators do and for listening to the parents.
William DeRosa, 60 Taunton Hill Road, protested the book being in a school library.
Laura Miller, 8 Diamond Drive, spoke about parents restricting books.
Alex Villamil, 11 Antler Pine Road, spoke about the book.
Treasa O'Sullivan, 10 Farmery Lane, named other books that could be questioned.
Steve Landau, 8 Walnut Tree Hill Road, spoke about the book.
Lara Clouden, 5 Meadowbrook Road, spoke about banning books.
Aiden Herbstman, 10 Pearl Street, spoke about the book.
Camryn Guion, 10 West Street, spoke about giving children what they deserve to grow up.
Kate McGrady, 26 Philo Curtis Road, spoke about banning books.
Linda O'Sullivan, 10 Farmery Lane, spoke about banning books.
Doug Lord, Newtown Librarian, 24 Main Street, spoke about banning books.
Keith Alexander, 8 Fawnwood Road, spoke about librarians making the decision on books.
Marc Carias, 88 Hattertown Road, spoke about the book.
Nicole Maddox, 14 Nighthawk Lane, spoke about banning books.
Lisa Kessler, 13 Pepperidge Road, spoke about banning books.
Wendy Leon Gambetta 19 Saw Mill Ridge Road, spoke about banning books.

MOTION: Mr. Cruson moved to adjourn. Mr Vouros seconded. Motion passes unanimously.

Item 10 – Adjournment
The meeting adjourned at 10:52 p.m.

Respectfully submitted:

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Donald Ramsey
Secretary