**FAIRFIELD PUBLIC SCHOOLS**

**10-11-2022, 7:30 PM**

**501 Kings Highway East, CO Board Room**

Regular Meeting Agenda

**MEMBERS OF THE PUBLIC:**

This meeting will be conducted in-person only. There will be no opportunity to call-in with public comment. Per CDC Guidelines, masks are optional for all attendees regardless of vaccination status.

The best way to listen or watch the meeting remotely is:

1. FairTV's cable channel (78 for Cablevision); or
2. Webex*: Call 408-418-9388, and use Meeting Number (access code): 233 075 52039
   *(*Audio only. All callers will be automatically muted and will not be heard by the BoE.)*
3. FairTV's Livestream; or
4. FairTV's YouTube Education Channel *(not live)*

To view all agendas, minutes and enclosures, please click here.

***Please Note:*** *Guidance on public comment (per BoE Bylaws, Article V, Section 6):*
*PUBLIC COMMENT ON AGENDA ITEMS*
*"As a means of encouraging public participation during Board meetings, the Chair shall solicit comments from the public with regard to agenda items, as proposed or amended, that the Board will be discussing and/or will be acting upon by vote. The Chair may limit Public Comment in any manner appropriate to the orderly and efficient conduct of Board meetings. The following parameters will pertain to Public Comment:*

1. *Up to three (3) minutes may be allotted to each speaker. The Chair may modify this limitation at the beginning of a meeting, or at the start of public comment within a meeting, if the number of persons wishing to speak makes it advisable to do so.*
2. *A member of the public can only speak to a topic once at a meeting. Public Comment on agenda items will take place at the beginning and end of the meeting. Public Comment on Old Business will also take place following Board discussion of those items and prior to when any vote is taken."*

Board of Education Regular Meeting Agenda
Tuesday, October 11, 2022, 7:30 PM

1. Call to Order of the Regular Meeting of the Board of Education and Roll Call
2. Pledge of Allegiance
3. Public Comment
4. Presentations

   A. Presentation: AP Physics I, AP Physics II, Physics Curriculum Changes
   *(Enclosure Nos. 1, 2, 3,4)*

   B. First Reading of Course: Physics of Music
   *(Enclosure Nos. 5, 6, 7)*

   C. Summer Boost Update
   *(Enclosure No. 8)*

5. Old Business
   A. Approval of North Stratfield, Osborn Hill and Fairfield Woods Ed Specs
   **Recommended Motion:** "that the Board of Education approve the North Stratfield Ed Specs"
   **Recommended Motion:** "that the Board of Education approve the Osborn Hill Ed Specs"
   **Recommended Motion:** "that the Board of Education approve the Fairfield Woods Ed Specs"

B. Approval of Capital Non-Recuring and Capital Projects
**Recommended Motion:** "that the Board of Education approve the following capital non-recurring projects:

- North Stratfield Elementary School Vestibule Project
- Osborn Hill Elementary School Vestibule Project
- Fairfield Woods Middle School Vestibule Project
- Fairfield Warde HS Boiler Burner Replacement Project (Design Only)
- Fairfield Warde HS Knapps Hwy Tennis Courts and Basketball Court (Design Only)

And the following capital project:

- Holland Hill Elementary School Partial Roof Replacement (Design Only)"

C. Approval of Course: Yoga, Mindfulness, and Personal Fitness II
**Recommended Motion:** "that the Board of Education approve Yoga, Mindfulness, and Personal Fitness II"
*(Enclosure No. 9)*

D. Approval of Course: Advanced Pottery
**Recommended Motion:** "that the Board of Education approve the Advanced Pottery course"
*(Enclosure No. 10)*

E. Approval of Course: Advanced Sculpture
**Recommended Motion:** "that the Board of Education approve the Advanced Sculpture course"
*(Enclosure No. 10)*

F. Adoption of Policy 3542.43, Business/Non-Instructional Operations: Food Service Charging
**Recommended Motion:** "that the Board of Education adopt Policy 3542.43, Business/Non-Instructional Operations: Food Service Charging"

6. New Business
A. Approval of Fairfield Warde Ed Specs
**Recommended Motion:** "that the Board of Education approve the Fairfield Warde Ed Specs"
*(Enclosure No. 11)*

B. Approval of Budget Transfers
**Recommended Motion:** "that the Board of Education approve three transfers amongst major classifications in the amount of:

- $163,779 from 'Support Expense' to 'Personnel Services' to support the hiring of crossing guards;
- $689,829 from 'Personnel Services' to 'Pupil Personnel' to support the hiring of contractual paraeducators to meet shortage needs in special education services; and
- $44,200 from 'Support Expense' to 'Maintenance' to fund a virtual firewall"

C. First Reading of Policies

- First Reading of Policy 6146, Students: Requirements for Graduation
- First Reading of Policy 6999, Students: District Provided Distance Learning

D. Discussion of BoE Budget Priorities

7. Approval of Minutes
   **Recommended Motion**: "that the Board of Education approve the 9-13-2022 BoE Regular Meeting Minutes"
   *(Enclosure No. 12)*

8. Superintendent's Report
   - Illustrative Math Resource Update, Dr. Zavodjancik, Dr. Rasmussen

9. Committee/Liaison Reports
10. Open Board Comment
11. Public Comment
12. Adjournment
    **Recommended Motion**: "that this Regular Meeting of the Board of Education adjourn"

CALENDAR OF EVENTS

| | | |
|---|---|---|
| October 25, 2022 | 7:30 PM<br>Regular Meeting | 501 Kings Highway East<br>CO Board Room, Fairfield 06825 |

*RELOCATION POLICY NOTICE*

*The Fairfield Public Schools System provides services to ensure students, parents and other persons have access to meetings, programs and activities. The School System will relocate programs in order to ensure accessibility of programs and activities to disabled persons. To make arrangements, please contact the office of Special Education, 501 Kings Highway East, Fairfield, CT 06825, Telephone: (203) 255-8379.*

Enclosure No. 1
October 11, 2022

# FAIRFIELD BOARD OF EDUCATION
# AGENDA ITEM

**For Consideration by the Board of Education at the Meeting of**: October 11, 2022

**Prepared By:** Dr. James Zavodjancik, Chief Academic Officer

**Presented By:** Mrs. Justine LaSala, Program Director for Secondary Science and STEAM

**Attachments:** (a) AP Physics I Curriculum; (b) AP Physics II Curriculum; (c) Physics Curriculum; (d) Curriculum updates for AP Physics I, II, and Physics

**Subject:** Curriculum updates to AP Physics I, AP Physics II Curricula, and Physics

**Relation to District Improvement Plan:** Key Performance Indicator 5 (see below)- Science Performance, as measured by the NGSS proficiency indicator (5, 8, 11) will close the gap between subgroup performance by 15% and raise the bar by 8% from baseline 2021 district performance in a positive direction.

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**Background:**
AP Physics I and AP Physics II frameworks are being realigned to the College Board expectations and as a result, our current course curriculum requires updates to reflect the changes. A presentation and discussion of the updates will be presented and explained. These courses are already approved and in our Program of Studies.

Moreover, the current Physics curriculum requires updates for alignment to the NGSS standards. By doing so, the course will offer both an honors and college preparatory level.

All courses are currently approved and part of the high school's program of studies. These updates to existing courses and curriculum will better align with standards and student expectations as expected and measured by the NGSS assessment and AP Physics I and II assessment.

NGSS Performance - Relation to the District Improvement Plan Goal

| **Group** | **2021** | **2022** |
|---|---|---|
| All Students | 67% | 67% |
| High Needs | 41% | 40% |
| Non-high Needs | 76% | 77% |
| Black/African American | * | 43% |
| Hispanic/Latino | 51% | 49% |
| Two or more races | 70% | 75% |
| White | 70% | 70% |

**RECOMMENDATION:**

Advanced Placement Physics I for presentation/update to the Fairfield Board of Education

Advanced Placement Physics II for presentation/update to the Fairfield Board of Education

Physics presentation/update to the Fairfield Board of Education

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**Recommended by the Superintendent:** Steve Tracy

**Agenda Item #** 4A

# Fairfield Public Schools

## Course Curricula Updates

10/11/2022

# Science Department

## *Curricular Updates: Physics, AP Physics 1 and AP Physics 2*

10/11/2022

# Updates to *Physics* Curriculum beginning 2023-2024

- Inclusion of additional standards to meet student learning expectations outlined in the Next Generation Science Standards (NGSS) and prepare students for the CT SDE NGSS Assessment, specifically:
  - PS1: Matter and Its Interactions (PS1.C Nuclear Processes)
  - ESS1: Earth Place in the Universe (ESS1.A The Universe and Its Stars; ESS1.B Earth and the Solar System)
  - ESS2 Earth's Systems (ESS2.A Earth Materials and Systems; ESS2.B Plate Tectonics and System Interactions)

- Reorganization of units to reflect a phenomenon/engineering design approach in learning science concepts.

  Phenomenon and design problems are an essential part of implementing the NGSS. For more information: https://www.nextgenscience.org/resources/phenomena

- Levels: Honors/College Prep

  *In general, Honors course includes additional content beyond the scope of CT SDE NGSS assessment boundaries as well as more quantitative analysis.*

# Updates to Advanced Placement *Physics 1 and 2* curricula for 2023-2024

The College Board is revising their curriculum frameworks for AP Physics 1 and 2 to more accurately reflect the current expectations of introductory college courses. There is a need to make changes to our current curriculum to align with these changes.

In summary:

- ❏ Waves and Electricity topics will be moved from AP Physics 1 to AP Physics 2
- ❏ Fluid Mechanics will be moved from AP Physics 2 to AP Physics 1
- ❏ In AP Physics 1, for some units, the organization of the existing course content has been restructured into more manageable units that focus on a smaller number of learning objectives. For example, content previously in Unit 1 would be distributed over the first 2 units in the updated AP Physics 1.

**In addition, we will be requesting adoption of a new AP Physics 1/2 textbook.

- ➔ The current text was published in 2003 and does not include a digital text or adaptive resources.

# Current Program of Studies Science Trajectory

| Grade 9 | Grade 10* | Grade 11 and 12 |
|---|---|---|
| **COURSE OPTIONS:**<br><br>**Full Year Courses:**<br>○ Biology (L)<br>○ Biology Honors (L) | **COURSE OPTIONS:**<br><br>**Full Year Courses:**<br>○ Chemistry (P)<br>○ Chemistry Honors (P)<br>○ Environmental Chemistry (E/P)<br>○ Environmental Chemistry Honors (E/P)<br>○ AP Chemistry (P)<br><br>**If desired, students may take additional courses in 10th grade for elective credit*<br>*Semester courses open for Grade 10 additional elective credit:*<br>• *Science of the Cosmos (E)*<br>• *Earth-Dangerous Planet (E)*<br>• *The Planet's Oceans (E)*<br>*Full year courses open for Grade 10 additional elective credit:*<br>• *Physics (P)*<br>• *AP Physics 1 (P)* | **COURSE OPTIONS:**<br><br>**Full Year Courses:**<br>○ Physics (P)<br>○ AP Environmental Science (E/L)<br>○ AP Chemistry (P)<br>○ AP Biology (L)<br>○ AP Physics 1 (P)<br>○ AP Physics 2 (P)<br>○ AP Physics C (P)<br>**Semester Courses:**<br>○ Earth-Dangerous Planet (E)<br>○ Science of the Cosmos (E)<br>○ Marine Science (E/L)<br>○ The Planet's Oceans (E)<br>○ Human A&P – Blood, Guts, Senses & Defenses (L)<br>○ Human A&P – Brains, Bones & Brawn (L)<br>○ Nutritional Chemistry (P)<br>○ Chemistry of Medicines (P)<br>○ Forensics I: Without a Trace (L)<br>○ Forensics II: Fake the Prints (L) |

KEY: (L) – life science (E) – earth/space science (P) – physical science

# Resource Allocation

- Textbook Adoption for Spring 2023 ~$32,000
- No changes in personnel/staffing allocations
- Curriculum Implementation Guide writing (Summer 2023) - $2,000


# *AP Physics I and II Physics*

## Questions and Comments

FAIRFIELD PUBLIC SCHOOLS

## Course Information

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| **Grade(s):** | 10, 11, 12 |
| **Discipline/Course:** | Science/AP Physics 1 |
| **Course Title:** | Advanced Placement Physics 1 |
| **Prerequisite(s):** | "B" or better in Algebra I and Geometry and concurrently enrolled or successful completion of Algebra II |
| **Course Description:** *Program of Studies* | The AP Physics I course is a university level course that focuses on the big ideas typically included in the first semester (and parts of a second semester) of an algebra-based, introductory college-level physics sequence and provides students with enduring understandings to support future advanced course work in the sciences. Through inquiry-based learning, students will develop critical thinking and reasoning skills, as defined by the AP Science Practices. Students will cultivate their understanding of physics and science practices as they explore the following topics: forces and interactions, momentum and energy, circular motion and rotation, harmonic motion and waves (I) and electricity (I). This course requires that 25 percent of the instructional time will be spent in hands-on laboratory work, with an emphasis on inquiry-based investigations that provide students with opportunities to apply the science practices. Students in AP Physics I are learners with demonstrated mathematical and problem-solving ability. Students wishing to prepare for the AP Physics II examination should take AP Physics I and AP Physics II. |
| **Course Essential Questions:** | ● What are forces?<br>● How can they describe the interactions between or among objects?<br>● How do interactions between systems change those systems?<br>● How are changes that occur as a result of interactions explained by conservation laws?<br>● What are the constraints of those changes? |

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| **Course Enduring Understandings:** | Big Idea 1 - Systems: A physical system is a portion of the physical universe chosen for analysis.<br><br>Big Idea 2 - Interactions: Objects and system interactions can be described using concepts such as force and energy.<br><br>Big Idea 3 - Change: Changes in the properties of a system can be used to predict future states of the system.<br><br>Big Idea 4 - Conservation: Changes that occur because of interactions are constrained by conservation laws. |
| **AP Science Practices** | AP Science Practices<br><br>Science Practice 1: Creating Representations Create representations that depict physical phenomena.<br>1.A Create diagrams, tables, charts, or schematics to represent physical situations.<br>1.B Create quantitative graphs with appropriate scales and units, including plotting data.<br>1.C Create qualitative sketches of graphs that represent features of a model or the behavior of a physical system.<br><br>Science Practice 2: Mathematical Routines Conduct analyses to derive, calculate, estimate, or predict physical phenomena.<br><br>2.A Derive a symbolic expression from known quantities by selecting and following a logical mathematical pathway.<br>2.B Calculate or estimate an unknown quantity with units from known quantities, by selecting and following a logical computational pathway. |

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| | 2.C Qualitatively compare physical quantities between two or more scenarios or at different times and/or locations within a single scenario.<br>2.D Quantitatively predict new values or factors of change of physical quantities when variables are changed using the functional dependence between variables.<br><br>Science Practice 3: Scientific Questioning & Argumentation Describe experimental procedures and methods, interpret their results, and scientifically support claims.<br><br>3.A Create experimental procedures that are appropriate for a given scientific question.<br>3.B Identify and describe possible sources of experimental uncertainty.<br>3.C Apply an appropriate law, definition, theoretical relationship, or model to make a claim.<br>3.D Support a claim using evidence from experimental data, physical representations, or physical principles or laws. |
| **Duration:** | Full year/1.0 credit |
| **Course Materials/ Resources:** | *In Review for Proposal Textbook: Knight, Randall D., Brian Jones, and Stuart Field. 2023. College Physics: A Strategic Approach. 4e ed., AP® ed. Boston: Pearson* |
| **FPS Course Academic Expectation(s):** | Synthesizing and Evaluating<br>Conveying Ideas |
| **Year at a Glance (Units)** | Unit 1: Kinematics<br>Unit 2: Force and Translational Dynamics<br>Unit 3: Work, Energy, and Power<br>Unit 4: Linear Momentum<br>Unit 5: Torque and Rotational Dynamics<br>Unit 6: Energy and Momentum of Rotating Systems<br>Unit 7: Oscillations<br>Unit 8: Fluids |

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| **Unit Number and Title:** | Unit 1: Kinematics |
| **Duration:** | Approximately 4-5 weeks |
| **Resource(s):** | *Proposed Textbook: Knight, Randall D., Brian Jones, and Stuart Field. 2023. College Physics: A Strategic Approach. 4e ed., AP® ed. Boston: Pearson* |
| **Unit Overview:** | The world is in a constant state of motion. To understand the world, students must first understand movement. Unit 1 introduces students to the study of motion and serves as a foundation for all of AP Physics 1 by beginning to explore the complex idea of acceleration and showing them how representations can be used to model and analyze scientific information as it relates to the motion of objects. By studying kinematics, students will learn to represent motion—both uniform and accelerating—in narrative, graphical, and/or mathematical forms and from different frames of reference. These representations will help students analyze the specific motion of objects and systems while also dispelling some common misconceptions they may have about motion, such as exclusively using negative acceleration to describe an object slowing down. Additionally, students will have the opportunity to go beyond their traditional understanding of mathematics. Instead of solving equations, students will use them to support their reasoning and tighten their grasp on the laws of physics. Lastly, students will begin making predictions about motion and justifying claims with evidence by exploring the relationships between the physical quantities of acceleration, velocity, position, and time. This is an important starting point for students, as these fundamental science practices will spiral throughout the course and appear in multiple units |
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| **Standard(s):** | 1.1 Position, Velocity, and Acceleration<br>● VectorMeasurements of displacement and velocity<br>● Vector addition and subtraction<br>● Systems of directional designations<br>● Acceleration and related quantities |

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| | ● Relative Velocity<br><br>1.2 Representations of Motion<br>● Gravitational Acceleration<br>● Vector Addition Using Pythagorean theorem, law of sines and cosine law<br>● Projectile motion<br><br>Science Practices:<br>● Science Practice 1: Creating Representations Create representations that depict physical phenomena<br>● Science Practice 2: Mathematical Routines Conduct analyses to derive, calculate, estimate, or predict physical phenomena.<br>● Science Practice 3: Scientific Questioning & Argumentation Describe experimental procedures and methods, interpret their results, and scientifically support claims. |
| **Essential Question(s):** | ● What happens when systems of objects interact?<br>● How do we describe the interaction of an object with other objects? |
| **Enduring Understandings** | Big Idea 1 - Systems: A physical system is a portion of the physical universe chosen for analysis.<br>Big Idea 3 - Change: Changes in the properties of a system can be used to predict future states of the system. |
| **Learning Goal(s):**<br>*Students will be able to use their learning to:* | 1.1.A Describe a vector or scalar quantity using magnitude and direction, as appropriate.<br>1.1.B Describe a vector sum in one dimension.<br>1.2.A Describe a change in an object's position.<br>1.2.B Describe the average velocity and acceleration of an object.<br>1.2.C Describe the displacement, instantaneous velocity, and acceleration of an object as functions of time.<br>1.3.A Describe the position, velocity, and acceleration of an object using representations of that motion. |

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| | 1.4.A Describe the reference frame of a given observer.<br>1.4.B Describe the motion of objects as measured by observers in different inertial reference frames.<br>1.5.A Describe the perpendicular components of a vector quantity.<br>1.5.B Describe the motion of an object moving in two dimensions. |

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| **Unit Number and Title:** | Unit 2: Force and Translational Dynamics |
| **Duration:** | Approximately 4-5 weeks |
| **Resource(s):** | *In Review for Proposal Textbook: Knight, Randall D., Brian Jones, and Stuart Field. 2023. College Physics: A Strategic Approach. 4e ed., AP® ed. Boston: Pearson* |
| **Unit Overview:** | In Unit 2, students are introduced to the term force, which is the interaction of an object with another object. Part of the larger study of dynamics, forces are used as the lens through which students analyze and come to understand a variety of physical phenomena. This is accomplished by revisiting and building upon the representations presented in Unit 1, specifically the introduction to the free-body diagram. Translation, however, is key in this unit: Students must be able to portray the same object–force interactions through different graphs, diagrams, and mathematical relationships. Students will continue to make meaning from models and representations that will help them further analyze systems, the interactions between systems, and how these interactions result in change. Alongside mastering the use of specific force equations, Unit 2 also encourages students to derive new expressions from fundamental principles to help them make predictions in unfamiliar, applied contexts. The skill of making predictions will be nurtured throughout the course to help students craft sound scientific arguments.<br><br>Further in Unit 2, students will continue to enhance their understanding of the physical world using models and representations to create a more complete and complex model of motion, particularly as it relates to gravitational mass and inertial mass. Specific preconceptions will be addressed in this unit, such as the idea of a centrifugal force. Students will also have opportunities to wrestle with the idea of field models, which will be expanded upon in AP Physics 2. |
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| **Standard(s):** | 2.1: Systems and Center of Mass<br>2.2: Forces and FreeBody Diagrams<br>2.3: Newton’s Third Law<br>2.4: Newton’s First Law |

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| | 2.5: Newton's Second Law<br>2.6: Gravitational Force<br>2.7: Kinetic and Static Friction<br>2.8: Spring Forces<br>2.9: Inertial and Gravitational Mass<br>2.10: Circular Motion<br><br>Science Practices:<br>● Science Practice 1: Creating Representations Create representations that depict physical phenomena<br>● Science Practice 2: Mathematical Routines Conduct analyses to derive, calculate, estimate, or predict physical phenomena.<br>● Science Practice 3: Scientific Questioning & Argumentation Describe experimental procedures and methods, interpret their results, and scientifically support claims. |
| **Essential Questions:** | ● What are forces? How can they describe the interactions between or among objects?<br>● How does the Law of Universal Gravitation govern the interaction of objects in the universe? |
| **Enduring Understandings:** | Big Idea 1 - Systems: A physical system is a portion of the physical universe chosen for analysis.<br>Big Idea 2 - Interactions: Objects and system interactions can be described using concepts such as force and energy.<br>Big Idea 3 - Change: Changes in the properties of a system can be used to predict future states of the system. |
| **Learning Goal(s):**<br>*Students will be able to use their learning to:* | 2.1.A Describe the collection of objects that will be analyzed as a system.<br>2.1.B Describe the location of a system's center of mass with respect to the system's constituent parts.<br>2.1.C Describe the properties of a system based on its substructure.<br>2.2.A Describe a force as an interaction between two objects and identify both objects for any force.<br>2.2.B Describe the forces exerted on an object using a free-body diagram. |

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| | 2.3.A Describe the interaction of two objects using Newton's third law and the representation of paired forces exerted on each object.<br>2.4.A Describe or identify the conditions under which a system's velocity remains constant.<br>2.5.A Describe or identify the conditions under which a system's velocity changes.<br>2.6.A Describe the gravitational interaction between two objects with mass.<br>2.6.B Describe situations in which the gravitational force can be considered constant.<br>2.6.C Describe the conditions under which the magnitude of a system's apparent weight is different from the magnitude of the gravitational force exerted on that system.<br>2.7.A Describe kinetic friction between two surfaces<br>2.7.B Describe static friction between two surfaces.<br>2.8.A Describe the force exerted on an object by an ideal spring.<br>2.9.A Describe the differences between inertial mass and gravitational mass.<br>2.10.A Describe the motion of an object traveling in a circular path.<br>2.10.B Describe circular orbits using Kepler's third law. |

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| **Unit Number and Title:** | Unit 3: Work, Energy, and Power |
| **Duration:** | Approximately 4 weeks |
| **Resource(s):** | *In Review for Proposal Textbook: Knight, Randall D., Brian Jones, and Stuart Field. 2023. College Physics: A Strategic Approach. 4e ed., AP® ed. Boston: Pearson* |
| **Unit Overview:** | In Unit 3, students will be introduced to the idea of conservation as a foundational model of physics, along with the concept of work as the agent of change for energy. As in earlier units, students will once again utilize both familiar and new models and representations to analyze physical situations, now with force or energy as major components. Students will be encouraged to call upon their knowledge of Units 1–3 to determine the most appropriate technique and will be challenged to understand the limiting factors of each. Describing, creating, and using these representations will also help students grapple with common misconceptions that they may have about energy, such as whether or not a single object can "have" potential energy. A thorough understanding of these energy models will support students' ability to make predictions—and ultimately justify claims with evidence—about physical situations. This is crucial, as the mathematical models and representations used in Unit 3 will mature throughout the course and appear in subsequent units. As students' comprehension of energy (particularly kinetic, potential, and microscopic internal energy) evolves, they will begin to connect and relate knowledge across scales, concepts, and representations, as well as across disciplines, particularly physics, chemistry, and biology. |
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| **Standard(s):** | 3.1: Translational Kinetic Energy<br>3.2: Work<br>3.3: Potential Energy<br>3.4: Conservation of Energy<br>3.5: Power<br><br>Science Practices: |

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| | ● Science Practice 1: Creating Representations Create representations that depict physical phenomena<br>● Science Practice 2: Mathematical Routines Conduct analyses to derive, calculate, estimate, or predict physical phenomena.<br>● Science Practice 3: Scientific Questioning & Argumentation Describe experimental procedures and methods, interpret their results, and scientifically support claims. |
| **Essential Questions:** | ● How can we use models to illustrate that energy can be accounted for as a combination of energy associated with the motion of particles and the energy associated with the relative position of particles?<br>● How can we model the change in energy of one component of the system when the change in energy of the other component(s) and of the system are known?<br>● How can we use energy to predict the motion or displacement of objects? |
| **Enduring Understandings:** | Big Idea 1 - Systems: A physical system is a portion of the physical universe chosen for analysis.<br>Big Idea 2 - Interactions: Objects and system interactions can be described using concepts such as force and energy.<br>Big Idea 3 - Change: Changes in the properties of a system can be used to predict future states of the system.<br>Big Idea 4 - Conservation: Changes that occur because of interactions are constrained by conservation laws. |
| **Learning Goal(s):**<br>*Students will be able to use their learning to:* | 3.1.A Describe the translational kinetic energy of an object in terms of the object's mass and velocity.<br>3.2.A Describe the work done on an object or system by a given force or collection of forces.<br>3.3.A Describe the potential energy of a system.<br>3.4.A Describe the energies present in a system.<br>3.4.B Describe the behavior of a system using conservation of mechanical energy principles.<br>3.4.C Describe how the selection of a system indicates whether the energy of that system changes<br>3.5.A Describe the transfer of energy into, out of, or within a system in terms of power |

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| **Unit Number and Title:** | Unit 4: Linear Momentum |
| **Duration:** | Approximately 3-4 weeks |
| **Resource(s):** | *In Review for Proposal Textbook: Knight, Randall D., Brian Jones, and Stuart Field. 2023. College Physics: A Strategic Approach. 4e ed., AP® ed. Boston: Pearson* |
| **Unit Overview:** | Unit 4 introduces students to the relationship between force, time, and momentum via calculations, data analysis, designing experiments, and making predictions. Students will learn how to use new models and representations to illustrate the law of the conservation of momentum of objects and systems while simultaneously building on their knowledge of previously studied representations. Using the law of the conservation of momentum to analyze physical situations gives students a more complete picture of forces and leads them to revisit their misconceptions surrounding Newton's third law. Students will also have the opportunity to make connections between the conserved quantities of momentum and energy to determine under what conditions each quantity is conserved. It's essential that students are not only comfortable solving numerical equations (such as the speed of a system after an inelastic collision) but also confident in their ability to discuss when momentum is conserved and how the type of collision affects the outcome. Threading such connections between physical quantities is fundamental to understanding the broader relationship between this unit and the rest of the course. Students will have more opportunities to apply conservation laws to make predictions and justify claims in Unit 6 when they are introduced to rotational quantities. |
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| **Standard(s):** | 4.1: Linear Momentum<br>4.2: Change in Momentum and Impulse<br>4.3: Conservation of Linear Momentum<br>4.4: Elastic and Inelastic Collisions |

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| | Science Practices:<br>● Science Practice 1: Creating Representations Create representations that depict physical phenomena<br>● Science Practice 2: Mathematical Routines Conduct analyses to derive, calculate, estimate, or predict physical phenomena.<br>● Science Practice 3: Scientific Questioning & Argumentation Describe experimental procedures and methods, interpret their results, and scientifically support claims. |
| **Essential Questions:** | How are impulse and momentum related? |
| **Enduring Understandings:** | Big Idea 1 - Systems: A physical system is a portion of the physical universe chosen for analysis.<br>Big Idea 2 - Interactions: Objects and system interactions can be described using concepts such as force and energy.<br>Big Idea 3 - Change: Changes in the properties of a system can be used to predict future states of the system.<br>Big Idea 4 - Conservation: Changes that occur because of interactions are constrained by conservation laws. |
| **Learning Goal(s):**<br>*Students will be able to use their learning to:* | 4.1.A Describe the linear momentum of an object.<br>4.2.A Describe the impulse delivered to a system.<br>4.2.B Describe the relationship between the impulse given to a system and the change in momentum of the system.<br>4.3.A Describe the behavior of a system using conservation of linear momentum.<br>4.3.B Describe how the selection of a system indicates whether the momentum of that system changes.<br>4.4.A Describe whether an interaction between systems is elastic or inelastic. |

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| **Unit Number and Title:** | Unit 5: Torque and Rotational Dynamics |
| **Duration:** | Approximately 4 weeks |
| **Resources:** | *In Review for Proposal Textbook: Knight, Randall D., Brian Jones, and Stuart Field. 2023. College Physics: A Strategic Approach. 4e ed., AP® ed. Boston: Pearson* |
| **Unit Overview:** | Units 5 and 6 continue the study of mechanical physics by introducing students to torque and rotational motion. Although these topics present more complex scenarios, the tools of analysis remain the same: The content and models explored in the first six units of AP Physics 1 set the foundation for Units 5 and 6. During their study of torque and rotational motion, students will be confronted with different ways of thinking about and modeling forces. As in previous units, students are given opportunities to create and use representations and models to make predictions and justify claims. Students derive new expressions from fundamental principles to help them make predictions in unfamiliar, applied contexts. Units 5 and 6 also focus on the mathematical practice of estimating quantities that can describe natural phenomena. For example, students need to be able to estimate the torque on an object caused by various forces in comparison to other situations. Throughout these units, students will have opportunities to compare and connect their understanding of linear and rotational motion, dynamics, energy, and momentum to make meaning of these concepts as a whole, rather than as distinct and separate units. |
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| **Standard(s):** | 5.1: Rotational Kinematics<br>5.2: Connecting Linear and Rotational Motion<br>5.3: Torque<br>5.4: Rotational Inertia<br>5.5: Rotational Equilibrium and Newton's First Law in Rotational Form<br>5.6: Newton's Second Law in Rotational Form |

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| | Science Practices:<br>● Science Practice 1: Creating Representations Create representations that depict physical phenomena<br>● Science Practice 2: Mathematical Routines Conduct analyses to derive, calculate, estimate, or predict physical phenomena.<br>● Science Practice 3: Scientific Questioning & Argumentation Describe experimental procedures and methods, interpret their results, and scientifically support claims. |
| **Essential Questions:** | ● How does circular motion differ from linear motion?<br>● How can we use rotational dynamics to predict rotational motion?<br>● How does exerting a torque affect an object's motion? |
| **Enduring Understandings:** | Big Idea 1 - Systems: A physical system is a portion of the physical universe chosen for analysis.<br>Big Idea 2 - Interactions: Objects and system interactions can be described using concepts such as force and energy.<br>Big Idea 3 - Change: Changes in the properties of a system can be used to predict future states of the system. |
| **Learning Goal(s):**<br>*Students will be able to use their learning to:* | 5.1.A Describe the rotation of a system with respect to time using angular displacement, angular velocity, and angular acceleration.<br>5.2.A Describe the linear motion of a point on a rotating rigid system that corresponds to the rotational motion of that point, and vice versa.<br>5.3.A Identify the torques exerted on a rigid system.<br>5.3.B Describe the torques exerted on a rigid system.<br>5.4.A Describe the rotational inertia of a rigid system relative to a given axis of rotation.<br>5.4.B Describe the rotational inertia of a rigid system rotating about an axis other than a rotational axis that passes through the system's center of mass. |

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| | 5.5.A Describe or identify the conditions under which a system's angular velocity remains constant using a dynamics analysis.<br>5.6.A Describe or identify the conditions under which a system's angular velocity changes using a dynamics analysis. |

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| **Unit Number and Title:** | Unit 6: Energy and Momentum of Rotating Systems |
| **Duration:** | Approximately 3-4 weeks |
| **Resources:** | *In Review for Proposal Textbook: Knight, Randall D., Brian Jones, and Stuart Field. 2023. College Physics: A Strategic Approach. 4e ed., AP® ed. Boston: Pearsonn* |
| **Unit Overview:** | Units 5 and 6 continue the study of mechanical physics by introducing students to torque and rotational motion. Although these topics present more complex scenarios, the tools of analysis remain the same: The content and models explored in the first six units of AP Physics 1 set the foundation for Units 5 and 6. During their study of torque and rotational motion, students will be confronted with different ways of thinking about and modeling forces. Students are given opportunities to create and use representations and models to make predictions and justify claims. Students will become comfortable deriving new expressions from fundamental principles to help them make predictions in unfamiliar, applied contexts. Units 5 and 6 also focus on the mathematical practice of estimating quantities that can describe natural phenomena. For example, students need to be able to estimate the torque on an object caused by various forces in comparison to other situations. |
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| **Standard(s):** | 6.1: Rotational Kinetic Energy<br>6.2: Torque and Work<br>6.3: Angular Momentum and Angular Impulse<br>6.4: Conservation of Angular Momentum<br>6.5: Rolling<br>6.6: Motion of Orbiting Satellites<br><br>Science Practices:<br>● Science Practice 1: Creating Representations Create representations that depict physical phenomena |

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| | ● Science Practice 2: Mathematical Routines Conduct analyses to derive, calculate, estimate, or predict physical phenomena.<br>● Science Practice 3: Scientific Questioning & Argumentation Describe experimental procedures and methods, interpret their results, and scientifically support claims. |
| **Essential Questions:** | ● How are angular acceleration, angular momentum and torque related? |
| **Enduring Understandings:** | Big Idea 1 - Systems: A physical system is a portion of the physical universe chosen for analysis.<br>Big Idea 2 - Interactions: Objects and system interactions can be described using concepts such as force and energy.<br>Big Idea 3 - Change: Changes in the properties of a system can be used to predict future states of the system.<br>Big Idea 4 - Conservation: Changes that occur because of interactions are constrained by conservation laws. |
| **Learning Goal(s):**<br>*Students will be able to use their learning to:* | 6.1.A Describe the rotational kinetic energy of an object or rigid system in terms of the object's or rigid system's rotational inertia and angular velocity.<br>6.2.A Describe the work done on an object or system by a given torque or collection of torques.<br>6.3.A Describe the angular momentum of an object or rigid system.<br>6.3.B Describe the angular impulse delivered to an object or rigid system by a torque.<br>6.3.C Relate an object's or rigid system's change in angular momentum to the angular impulse given to the object or rigid system.<br>6.4.A Describe the behavior of a system using conservation of angular momentum.<br>6.4.B Describe how the selection of a system indicates whether the angular momentum of that system changes.<br>6.5.A Describe the kinetic energy of a system that has translational and rotational motion.<br>6.5.B Describe the motion of a system that is rolling without slipping.<br>6.5.C Describe the motion of a system that is rolling while slipping.<br>6.6.A Describe the motions of an isolated object system consisting of two objects interacting only via gravitational forces. |

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| **Unit Number and Title:** | Unit 7: Oscillations |
| **Duration:** | Approximately 2-3 weeks |
| **Resources:** | *In Review for Proposal Textbook: Knight, Randall D., Brian Jones, and Stuart Field. 2023. College Physics: A Strategic Approach. 4e ed., AP® ed. Boston: Pearson* |
| **Unit Overview:** | In Unit 7, students will continue to use the same tools, techniques, and models that they have been using throughout this course. However, they will now use them to analyze a new type of motion: simple harmonic motion. Although simple harmonic motion is unique, students will learn that even in new situations, the fundamental laws of physics remain the same. Energy bar charts, as well as free-body diagrams, become increasingly important as students work toward determining which model is most appropriate for a given physical situation. Preconceptions—such as the relationship between the amplitude and period of oscillation—will also be addressed to provide students with a more nuanced awareness of simple harmonic motion. Students are expected to use the content knowledge they gained in the first six units to make and defend claims while also making connections in and across the content topics and big ideas. Because Unit 7 is the first unit in which students possess all the tools of force, energy, and momentum conservation, it's important that teachers scaffold lessons to help them develop a better understanding of each fundamental physics principle as well as its limitations. Throughout this unit, students will be asked to create force, energy, momentum, and position versus time graphs for a single scenario and to make predictions based on their representations. Students will enhance their study of motion when they learn about oscillatory motion in AP Physics 2. |
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| **Standard(s):** | 7.1: Defining Simple Harmonic Motion (SHM)<br>7.2: Frequency and Period of SHM<br>7.3: Representing and Analyzing SHM<br>7.4: Energy of Simple Harmonic Oscillators |

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| | Science Practices:<br>● Science Practice 1: Creating Representations Create representations that depict physical phenomena<br>● Science Practice 2: Mathematical Routines Conduct analyses to derive, calculate, estimate, or predict physical phenomena.<br>● Science Practice 3: Scientific Questioning & Argumentation Describe experimental procedures and methods, interpret their results, and scientifically support claims. |
| **Essential Questions:** | ● What properties affect the motion of an object in SHM?<br>● How can SHM be modeled as a wave?<br>● How do waves interact with each other?<br>● How are the principles of wave behavior and interactions with matter used to transmit and capture information and energy? |
| **Enduring Understandings:** | Big Idea 1 - Systems: A physical system is a portion of the physical universe chosen for analysis.<br>Big Idea 2 - Interactions: Objects and system interactions can be described using concepts such as force and energy.<br>Big Idea 3 - Change: Changes in the properties of a system can be used to predict future states of the system.<br>Big Idea 4 - Conservation: Changes that occur because of interactions are constrained by conservation laws. |
| **Learning Goal(s):**<br>*Students will be able to use their learning to:* | 7.1.A Identify simple harmonic motion.<br>7.2.A Describe the frequency and period of an object exhibiting simple harmonic motion.<br>7.3.A Describe the displacement, velocity, and acceleration of an object exhibiting SHM using representations of that motion.<br>7.4.A Describe the mechanical energy of a system exhibiting SHM. |

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| **Unit Number and Title:** | Unit 8: Fluids |
| **Duration:** | Approximately 4 weeks |
| **Resources:** | *Proposed Textbook: Knight, Randall D., Brian Jones, and Stuart Field. 2023. College Physics: A Strategic Approach. 4e ed., AP® ed. Boston: Pearson* |
| **Unit Overview:** | The unit provides a basic algebraic overview of the behavior of non-compressible Newtonian fluids. The unit covers static fluid behavior including buoyancy force calculations as well as hydraulics. It then moves on to dynamic fluid flow centered around the use of Bernoulli's equation as a representation of the conservation of energy of the fluid system. |
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| **Standard(s):** | 8.1: Internal Structure and Density<br>8.2: Pressure<br>8.3: Fluids and Newton's Laws<br>8.4: Fluids and Conservation Laws<br><br>Science Practices:<br>● Science Practice 1: Creating Representations Create representations that depict physical phenomena<br>● Science Practice 2: Mathematical Routines Conduct analyses to derive, calculate, estimate, or predict physical phenomena.<br>● Science Practice 3: Scientific Questioning & Argumentation Describe experimental procedures and methods, interpret their results, and scientifically support claims. |
| **Essential Questions:** | ● What is the buoyancy force and how does it act on objects in various liquids?<br>● How can we apply Bernoulli's equation to describe the conservation of energy in fluid flow?<br>● How can we apply the continuity equation to describe conservation of mass in fluid flow?<br>● What classical laws and principles define the behavior of fluids? |

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| **Enduring Understandings:** | Big Idea 1 - Systems: A physical system is a portion of the physical universe chosen for analysis.<br>Big Idea 2 - Interactions: Objects and system interactions can be described using concepts such as force and energy.<br>Big Idea 3 - Change: Changes in the properties of a system can be used to predict future states of the system.<br>Big Idea 4 - Conservation: Changes that occur because of interactions are constrained by conservation laws. |
| **Learning Goal(s):**<br>*Students will be able to use their learning to:* | 8.1.A Describe the properties of a fluid.<br>8.2.A Describe the pressure applied to a surface by a given force.<br>8.2.B Describe the pressure exerted by a fluid.<br>8.3.A* Describe or identify the conditions under which an object's or system's velocity changes.<br>8.3.B Describe the buoyant force exerted on an object interacting with a fluid.<br>8.4.A Describe the flow of an incompressible fluid through a cross-sectional area by using mass conservation.<br>8.4.B Describe the flow of a fluid as a result of a difference in energy of the fluid-Earth system between two locations. |

FAIRFIELD PUBLIC SCHOOLS

# Course Information

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| **Grade(s):** | 11, 12 |
| **Discipline/Course:** | Science / Advanced Placement Physics II |
| **Course Title:** | Advanced Placement Physics II |
| **Prerequisite(s):** | "B" or better in AP Physics I.<br>Teacher recommendation advised. |
| **Course Description:**<br>*Program of Studies* | AP Physics 2 is a full-year course that is the equivalent of a second-semester introductory college course in algebra-based physics and provides students with enduring understandings to support future advanced course work in the sciences. Through inquiry-based learning, students will develop critical thinking and reasoning skills, as defined by the AP Science Practices. Students will cultivate their understanding of physics and science practices as they explore the following topics: fluid mechanics, thermodynamics, electricity (II), magnetism, waves (II), electromagnetic radiation and optics, and modern and nuclear physics. This course requires that 25 percent of the instructional time engages students in hands-on laboratory work, with an emphasis on inquiry based investigations that provide students with opportunities to apply the science practices. Students in AP Physics II are learners with exceptional mathematical and problem-solving ability. |
| **Course Essential Questions:** | ● What are the properties of mass and charge?<br>● What internal structures do systems have?<br>● How can fields existing in space be used to explain interactions?<br>● What are forces? How can they describe the interactions between or among objects?<br>● How do interactions between systems change those systems?<br>● How are changes that occur as a result of interactions explained by conservation laws?<br>● What are the constraints of those changes? |

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| | ● What are waves? How do they transfer energy and momentum from one location to another without the permanent transfer of mass?<br>● How can waves serve as a mathematical model for the description of other phenomena?<br>● How can probabilities be used to describe the behavior of complex systems and interpret the behavior of quantum mechanical systems? |
| **Course Enduring Understandings:** | Big Idea 1 - Systems: A physical system is a portion of the physical universe chosen for analysis.<br>Big Idea 2 - Interactions: Objects and system interactions can be described using concepts such as force and energy.<br>Big Idea 3 - Change: Changes in the properties of a system can be used to predict future states of the system.<br>Big Idea 4 - Conservation: Changes that occur because of interactions are constrained by conservation laws. |
| **AP Science Practices** | **AP Science Practices**<br>Science Practice 1: Creating Representations Create representations that depict physical phenomena.<br>1.A Create diagrams, tables, charts, or schematics to represent physical situations.<br>1.B Create quantitative graphs with appropriate scales and units, including plotting data.<br>1.C Create qualitative sketches of graphs that represent features of a model or the behavior of a physical system.<br><br>Science Practice 2: Mathematical Routines Conduct analyses to derive, calculate, estimate, or predict physical phenomena.<br><br>2.A Derive a symbolic expression from known quantities by selecting and following a logical mathematical pathway.<br>2.B Calculate or estimate an unknown quantity with units from known quantities, by selecting and following a logical computational pathway. |

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| | 2.C Qualitatively compare physical quantities between two or more scenarios or at different times and/or locations within a single scenario.<br>2.D Quantitatively predict new values or factors of change of physical quantities when variables are changed using the functional dependence between variables.<br><br>Science Practice 3: Scientific Questioning & Argumentation Describe experimental procedures and methods, interpret their results, and scientifically support claims.<br><br>3.A Create experimental procedures that are appropriate for a given scientific question.<br>3.B Identify and describe possible sources of experimental uncertainty.<br>3.C Apply an appropriate law, definition, theoretical relationship, or model to make a claim.<br>3.D Support a claim using evidence from experimental data, physical representations, or physical principles or laws. |
| **Duration:** | Full year/1.0 credit |
| **Course Materials/ Resources:** | *Proposed Textbook: Knight, Randall D., Brian Jones, and Stuart Field. 2023. College Physics: A Strategic Approach. 4e ed., AP® ed. Boston: Pearson* |
| **FPS Course Academic Expectation(s):** | Synthesizing and Evaluating<br>Conveying Ideas |
| **Year at a Glance (Units)** | Unit 1: Thermodynamics<br>Unit 2: Electric Force, Field, and Potential<br>Unit 3: Electric Circuits<br>Unit 4: Magnetism and Electromagnetism<br>Unit 5: Waves, Sound, and Physical Optics<br>Unit 6: Geometric Optics<br>Unit 7: Modern Physics |

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| **Unit Number and Title:** | Unit 1: Thermodynamics |
| **Duration:** | Approximately 5-6 weeks |
| **Resource(s):** | *In Review for Proposal Textbook: Knight, Randall D., Brian Jones, and Stuart Field. 2023. College Physics: A Strategic Approach. 4e ed., AP® ed. Boston: Pearson* |
| **Unit Overview:** | This unit covers the Laws of Thermodynamics and Kinetic Theory of Gases. Instruction is centered around the Conservation of Energy (1st Law of Thermodynamics). Covered topics include Pressure Volume Diagrams, heat flow/energy transfer and work done on and by systems |
| **Learning Goals** | |
| **Standard(s):** | 9.1: Kinetic Theory of Temperature and Pressure<br>9.2: The Ideal Gas Law<br>9.3: Thermal Energy Transfer and Equilibrium<br>9.4: The First Law of Thermodynamics<br>9.5: Specific Heat and Thermal Conductivity<br>9.6: Entropy and the Second Law of Thermodynamics<br><br>Science Practices:<br>● Science Practice 1: Creating Representations Create representations that depict physical phenomena<br>● Science Practice 2: Mathematical Routines Conduct analyses to derive, calculate, estimate, or predict physical phenomena.<br>● Science Practice 3: Scientific Questioning & Argumentation Describe experimental procedures and methods, interpret their results, and scientifically support claims. |
| **Essential Questions:** | ● How does the internal structure of systems affect their properties?<br>● What is thermal conductivity and how does it relate to energy transfer?<br>● How is energy transferred by thermal processes? |

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| | ● How does the first law of thermodynamics relate to conservation of energy?<br>● How does the pressure of a system relate to changes in momentum of the particles contained in that system?<br>● How does probability describe the thermal equilibrium process? How does it describe the second law of thermodynamics? |
| **Enduring Understandings:** | Big Idea 1 - Systems: A physical system is a portion of the physical universe chosen for analysis.<br>Big Idea 3 - Change: Changes in the properties of a system can be used to predict future states of the system.<br>Big Idea 4 - Conservation: Changes that occur because of interactions are constrained by conservation laws. |
| **Learning Goal(s):**<br>*Students will be able to use their learning to:* | 9.1.A Describe the pressure a gas exerts on its container in terms of molecular motion within that gas.<br>9.1.B Describe the temperature of a system in terms of the molecular motion within that system.<br>9.2.A Describe the properties of an ideal gas.<br>9.3.A Describe the transfer of energy between two systems in thermal contact due to temperature differences of those two systems.<br>9.4.A Describe the internal energy of a system.<br>9.4.B Describe the behavior of a system using thermodynamic processes.<br>9.5.A Describe the energy required to change the temperature of an object by a certain amount.<br>9.5.B Describe the rate at which energy is transferred by conduction through a given material.<br>9.6.A Describe the change in entropy for a given system over time. |

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| **Unit Number and Title:** | Unit 2: Electric Force, Field, and Potential |
| **Duration:** | Approximately 6-7 weeks |
| **Resources:** | *Proposed Textbook: Knight, Randall D., Brian Jones, and Stuart Field. 2023. College Physics: A Strategic Approach. 4e ed., AP® ed. Boston: Pearson* |
| **Unit Overview:** | Unit 2 begins the study of electromagnetic phenomena at a fundamental level, introducing students to the concepts of electric charge, electric force, and electric field and potential. Despite the shift from examining fluids and gases to examining charged particles, the foundation of this unit continues to focus on relationships, change, and developing the science practice of making connections between scales, concepts, and representations. For instance, students will use the concept of equipotential lines to visualize the electric field and make connections between the isolines on topographic maps for gravitational fields and equipotential lines for the electric field. This unit will also help students better understand that interactions between systems result in changes within those systems—allowing students to further apply energy conservation principles in later units. Students are encouraged to apply what they know when learning about fields (gravitational and electric), how fields interact, and the complex concepts of static and dynamic electricity. This will help students better understand energy conservation principles, as well as develop the science practice of data analysis. Data analysis is essential in identifying patterns and relationships between variables and helps students become better prepared to engage in and craft scientific arguments that describe a mechanism through which a phenomenon occurs. |
| **Learning Goals** | |
| **Standard(s):** | 10.1: Electric Charge and Electric Force<br>10.2: Electric and Gravitational Forces<br>10.3: Conservation of Electric Charge and the Process of Charging<br>10.4: Electric Fields<br>10.5: Electric Permittivity<br>10.6: Electric Potential Energy<br>10.7: Electric Potential |

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| | 10.8: Capacitors<br>10.9: Conservation of Electric Energy<br><br>Science Practices:<br>● Science Practice 1: Creating Representations Create representations that depict physical phenomena<br>● Science Practice 2: Mathematical Routines Conduct analyses to derive, calculate, estimate, or predict physical phenomena.<br>● Science Practice 3: Scientific Questioning & Argumentation Describe experimental procedures and methods, interpret their results, and scientifically support claims. |
| **Essential Questions:** | ● How is electric charge conserved?<br>● What causes an electric field and how does it affect the electric force exerted on an object at various points in space?<br>● How does the electric field change between charged objects and charged plates?<br>● What are isolines and what are they used to represent? |
| **Enduring Understandings:** | Big Idea 1 - Systems: A physical system is a portion of the physical universe chosen for analysis.<br>Big Idea 2 - Interactions: Objects and system interactions can be described using concepts such as force and energy.<br>Big Idea 3 - Change: Changes in the properties of a system can be used to predict future states of the system.<br>Big Idea 4 - Conservation: Changes that occur because of interactions are constrained by conservation laws. |
| **Learning Goal(s):**<br>*Students will be able to use their learning to:* | 10.1.A Describe the electric force that results from the interactions between charged objects or systems.<br>10.2.A Compare the electric forces and gravitational forces that result from interactions between charged objects with mass.<br>10.3.A Describe the behavior of a system using the law of conservation of charge. |

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| | 10.4.A Describe the electric field produced by a charged object or configuration of point charges.<br>10.4.B Describe the electric field generated by charged conductors or uniformly charged solid objects.<br>10.5.A Describe the electric permittivity of a material or medium.<br>10.6.A Describe the electric potential energy of a system.<br>10.7.A Describe the electric potential due to a configuration of charged objects.<br>10.7.B Describe the relationship between electric potential and electric field.<br>10.8.A Describe the physical properties of a parallel plate capacitor.<br>10.9.A Describe changes in energy in a system due to a difference in electric potential between two locations. |

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| **Unit Number and Title:** | Unit 3: Electric Circuits |
| **Duration:** | Approximately 4 weeks |
| **Resource(s):** | *In Review for Proposal Textbook: Knight, Randall D., Brian Jones, and Stuart Field. 2023. College Physics: A Strategic Approach. 4e ed., AP® ed. Boston: Pearson* |
| **Unit Overview:** | Unit 3 delves into the behavior of charged particles, to deepen students' understanding of the law of conservation of energy and how it's applied to electric circuits. This unit will ask students to do more than calculate for the current, resistance, and voltage in a simple circuit; it will challenge them to draw connections between the interactions of systems and the changes that result from those interactions. For example, students will need to be able to articulate the impact of a light bulb being removed on a circuit consisting of several light bulbs. They will also need to design an experiment to test if a light bulb is ohmic or justify how changing the spacing of a capacitor will affect its capacitance. Using models and representations to analyze physical situations, as well as using mathematical relationships to justify claims, are critically important science practices in this unit. Unit 3 will also compel students to discover and understand the relationship between the conservation of total energy and the conservation of total electric charge in circuits. It will encourage them to use Kirchhoff's rules to describe both energy conservation and charge conservation. Simultaneously, students will also have more opportunities in Unit 3 to expand their data collection and analysis abilities to include writing clear, concise procedural paragraphs in addition to revising their reasoning based on new data. |
| **Learning Goals** | |
| **Standard(s):** | 11.1: Electric Current<br>11.2: Simple Circuits<br>11.3: Resistance, Resistivity, and Ohm's Law<br>11.4: Electric Power<br>11.5: Compound Direct Current (DC) Circuits<br>11.6: Kirchhoff's Loop Rule<br>11.7: Kirchhoff's Junction Rule<br>11.8: Resistor-Capacitor (RC) Circuits |

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| | Science Practices:<br>● Science Practice 1: Creating Representations Create representations that depict physical phenomena<br>● Science Practice 2: Mathematical Routines Conduct analyses to derive, calculate, estimate, or predict physical phenomena.<br>● Science Practice 3: Scientific Questioning & Argumentation Describe experimental procedures and methods, interpret their results, and scientifically support claims. |
| **Essential Questions:** | ● How do Kirchhoff's Laws represent conservation of energy and charge in a circuit?<br>● How do capacitors affect a circuit? |
| **Enduring Understandings:** | Big Idea 1 - Systems: A physical system is a portion of the physical universe chosen for analysis.<br>Big Idea 3 - Change: Changes in the properties of a system can be used to predict future states of the system.<br>Big Idea 4 - Conservation: Changes that occur because of interactions are constrained by conservation laws. |
| **Learning Goal(s):**<br>*Students will be able to use their learning to:* | 11.1.A Describe the movement of electric charges through a medium.<br>11.2.A Describe the behavior of a circuit.<br>11.3.A Describe the resistance of an object using physical properties of that object.<br>11.3.A Describe the electrical characteristics of elements within a circuit.<br>11.4.A* Describe the transfer of energy into, out of, or within an electric circuit, in terms of power.<br>11.5.A Describe the equivalent resistance of multiple resistors connected in a circuit.<br>11.5.B Describe a circuit with resistive wires and a battery with internal resistance.<br>11.5.C Describe the measurement of current and potential difference within a circuit.<br>11.6.A Describe a circuit or elements within a circuit by applying Kirchhoff's Loop rule.<br>11.7.A Describe a circuit or elements within a circuit by applying Kirchhoff's Junction rule.<br>11.8.A Describe the equivalent capacitance of multiple capacitors.<br>11.8.B Describe the behavior of a circuit containing combinations of resistors and capacitors. |

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| **Unit Number and Title:** | Unit 4:  Magnetism and Electromagnetism |
| **Duration:** | Approximately 4 weeks |
| **Resource(s):** | *Proposed Textbook: Knight, Randall D., Brian Jones, and Stuart Field. 2023. College Physics: A Strategic Approach. 4e ed., AP® ed. Boston: Pearson* |
| **Unit Overview:** | In Units 2 and 3, students investigated electrostatic forces and fields and how free charges can be moved through electric fields to produce currents. In Unit 4, students will supplement that knowledge by exploring the relationships between moving charges and the magnetic forces and fields they generate. Students will discover the natural symmetry between electricity and magnetism and make connections between electromagnetic induction and the underlying principles behind most of the technology in modern society, including telephones, television, computers, and the Internet. This unit will also build on the representations presented in the previous two units by introducing the magnetic field diagram to illustrate the effects of static and dynamic magnetic fields. |
| **Learning Goals** | |
| **Standard(s):** | 12.1: Magnetic Fields<br>12.2: Magnetic Dipoles<br>12.3: Magnetic Permeability<br>12.4: Magnetism and Moving Charges<br>12.5: Magnetism and Current-Carrying Wires<br>12.6: Electromagnetic Induction and Faraday's Law<br><br>Science Practices:<br>● Science Practice 1: Creating Representations Create representations that depict physical phenomena<br>● Science Practice 2: Mathematical Routines Conduct analyses to derive, calculate, estimate, or predict physical phenomena. |

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| | ● Science Practice 3: Scientific Questioning & Argumentation Describe experimental procedures and methods, interpret their results, and scientifically support claims. |
| **Essential Questions:** | ● What causes a magnetic field?<br>● What objects are affected by a magnetic field?<br>● What is a magnetic dipole?<br>● What is a ferromagnetic material?<br>● How does changing magnetic flux create an electric field? |
| **Enduring Understandings:** | Big Idea 1 - Systems: A physical system is a portion of the physical universe chosen for analysis.<br>Big Idea 2 - Interactions: Objects and system interactions can be described using concepts such as force and energy.<br>Big Idea 3 - Change: Changes in the properties of a system can be used to predict future states of the system. |
| **Learning Goal(s):**<br>*Students will be able to use their learning to:* | 12.1.A Describe the properties of a magnetic field.<br>12.2.A Describe the magnetic behavior of material as a result of the configuration of magnetic dipoles within the material.<br>12.3.A Describe the magnetic permeability of a material.<br>12.4.A Describe the magnetic field produced by moving charged objects.<br>12.4.B Describe the force exerted on moving charged objects by a magnetic field.<br>12.5.A* Describe the magnetic field produced by a current-carrying wire.<br>12.5.B* Describe the force exerted on moving charged objects by a current carrying wire.<br>12.6.A Describe the induced electric potential difference resulting from a change in magnetic flux. |

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| **Unit Number and Title:** | Unit 5: Waves, Sound, and Physical Optics |
| **Duration:** | Approximately 4 weeks |
| **Resource(s):** | *In Review for Proposal Textbook: Knight, Randall D., Brian Jones, and Stuart Field. 2023. College Physics: A Strategic Approach. 4e ed., AP® ed. Boston: Pearson* |
| **Unit Overview:** | Although the nature of oscillating electric and magnetic fields, explored in Unit 4, sets the foundation for this unit's fundamental topic—electromagnetic waves, or light—Units 5 and 6 demonstrate another distinct shift in both content and the models/representations used to analyze physical scenarios. In this unit, students will be introduced to the different ways of thinking about and modeling light, including ray, wave front, and interference diagrams. Students learn how to create and use these diagrams to help answer questions and to use as evidence for claims. A more complete understanding of the different ways of thinking about and modeling light will help students analyze data more effectively; they can then apply this science practice to design a process of data analysis that will help them determine if the experimental design needs to be altered to produce the needed data to justify claims. |
| **Learning Goals** | |
| **Standard(s):** | 13.1: Properties of Wave Pulses and Waves<br>13.2: Periodic Waves<br>13.3: Boundary Behavior of Waves and Polarization<br>13.4: Electromagnetic Waves<br>13.5: The Doppler Effect<br>13.6: Wave Interference<br>13.7: Diffraction<br>13.8: Double-Slit Interference and Diffraction Gratings<br><br>Science Practices:<br>● Science Practice 1: Creating Representations Create representations that depict physical phenomena<br>● Science Practice 2: Mathematical Routines Conduct analyses to derive, calculate, estimate, or predict physical phenomena. |

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| | ● Science Practice 3: Scientific Questioning & Argumentation Describe experimental procedures and methods, interpret their results, and scientifically support claims. |
| **Essential Questions:** | ● How do waves interact with each other?<br>● How are the principles of wave behavior and interactions with matter used to transmit and capture information and energy?<br>● How can electromagnetic radiation be modeled as a wave?<br>● How does electromagnetic radiation transfer energy? |
| **Enduring Understandings:** | Big Idea 1 - Systems: A physical system is a portion of the physical universe chosen for analysis.<br>Big Idea 3 - Change: Changes in the properties of a system can be used to predict future states of the system. |
| **Learning Goal(s):**<br>*Students will be able to use their learning to:* | 13.1.A Describe the physical properties of waves and wave pulses.<br>13.2.A Describe the physical properties of a periodic wave.<br>13.3.A Describe the interaction between a wave and a boundary.<br>13.4.A Describe the properties of an electromagnetic wave.<br>13.5.A Describe the properties of a wave based on the relative motion between the source of the wave and the observer of the wave.<br>13.6.A Describe the net disturbance that occurs when two or more wave pulses or waves overlap.<br>13.7.A Describe the behavior of a wave and the resulting diffraction pattern resulting from a wave passing through a single opening.<br>13.8.A Describe the behavior of a wave and the resulting diffraction pattern resulting from a wave passing through multiple openings. |

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| **Unit Number and Title:** | Unit 6: Geometric Optics |
| **Duration:** | Approximately 4 weeks |
| **Resource(s):** | *In Review for Proposal Textbook: Knight, Randall D., Brian Jones, and Stuart Field. 2023. College Physics: A Strategic Approach. 4e ed., AP® ed. Boston: Pearson* |
| **Unit Overview:** | In Unit 6, students investigate applications of wave behavior like reflection and refraction through experiments in image formation in mirrors and lenses. Students will develop understanding that waves can transfer energy and momentum from one location to another without the permanent transfer of mass and serve as a mathematical model for the description of other phenomena. |
| **Learning Goals** | |
| **Standard(s):** | 14.1: Modeling Light as a Ray<br>14.2: Reflection<br>14.3: Images formed by Mirrors<br>14.4: Refraction<br>14.5: Images formed by Lenses<br>14.6: Thin-Film Interference<br><br>Science Practices:<br>● Science Practice 1: Creating Representations Create representations that depict physical phenomena<br>● Science Practice 2: Mathematical Routines Conduct analyses to derive, calculate, estimate, or predict physical phenomena.<br>● Science Practice 3: Scientific Questioning & Argumentation Describe experimental procedures and methods, interpret their results, and scientifically support claims. |

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| **Essential Questions:** | ● What are the differences between real and virtual images?<br>● How can images be produced by a mirror?<br>● How can images be produced by a lens? |
| **Enduring Understandings:** | Big Idea 1 - Systems: A physical system is a portion of the physical universe chosen for analysis.<br>Big Idea 2 - Interactions: Objects and system interactions can be described using concepts such as force and energy. |
| **Learning Goal(s):**<br>*Students will be able to use their learning to:* | 14.1.A Describe light as a ray.<br>14.2.B Describe the reflection of light from a surface.<br>14.3.A Describe the image formed by a mirror.<br>14.4.A Describe the refraction of light between two media.<br>14.5.A Describe the image formed by a lens.<br>14.6.A Describe the behavior of light that interacts with a thin film. |

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| **Unit Number and Title:** | Unit 7: Modern Physics |
| **Duration:** | Approximately 4 weeks |
| **Resource(s):** | *In Review for Proposal Textbook: Knight, Randall D., Brian Jones, and Stuart Field. 2023. College Physics: A Strategic Approach. 4e ed., AP® ed. Boston: Pearson* |
| **Unit Overview:** | Unit 7 lays the groundwork for the study of modern physics by resolving the conflicts and questions that were left unanswered by Newtonian mechanics. While new models and representations are introduced in Unit 7 (such as the electron level diagram), students will be able to make connections between the content of this unit and the fundamental principles of physics, principles of conservation, and models and representations used earlier in the course. These connections will help students make predictions about a variety of phenomena—including the rate of radioactive decay or the type of nuclear reaction — in addition to making and justifying claims with evidence about such phenomena. |
| **Learning Goals** | |
| **Standard(s):** | 15.1: Quantum Theory and Wave-Particle Duality<br>15.2: The Bohr Model of Atomic Structure<br>15.3: Emission and Absorption Spectra<br>15.4: Blackbody Radiation<br>15.5: The Photoelectric Effect<br>15.6: Compton Scattering<br>15.7: Fission, Fusion, and Nuclear Decay<br>15.8: Types of Radioactive Decay<br><br>Science Practices:<br>● Science Practice 1: Creating Representations Create representations that depict physical phenomena<br>● Science Practice 2: Mathematical Routines Conduct analyses to derive, calculate, estimate, or predict physical phenomena. |

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| | ● Science Practice 3: Scientific Questioning & Argumentation Describe experimental procedures and methods, interpret their results, and scientifically support claims. |
| **Essential Questions:** | ● How is electromagnetic radiation related to photons?<br>● How do scientists determine whether to model light as a particle or as a wave?<br>● How do scientists determine whether to model matter as a particle or as a wave?<br>● How can matter be modeled by a wave function? How does that function describe its motion and interactions?<br>● What forces exist inside an atom?<br>● What evidence is there for Einstein's Theory of Special Relativity? Theory of General Relativity?<br>● Under what circumstances can mass be converted to energy? Energy to mass?<br>● Under what circumstances do space and time become not absolute?<br>● What is nuclear radiation? What different forms exist?<br>● How does nuclear radiation follow the Law of Conservation of Charge? Law of Conservation of Energy? Law of Conservation of Nucleon Number? |
| **Enduring Understandings:** | Big Idea 1 - Systems: A physical system is a portion of the physical universe chosen for analysis.<br>Big Idea 2 - Interactions: Objects and system interactions can be described using concepts such as force and energy.<br>Big Idea 3 - Change: Changes in the properties of a system can be used to predict future states of the system.<br>Big Idea 4 - Conservation: Changes that occur because of interactions are constrained by conservation laws. |
| **Learning Goal(s):**<br>*Students will be able to use their learning to:* | 15.1.A Describe the properties and behavior of an object that exhibits both particle and wave behavior.<br>15.2.A Describe the properties of an atom.<br>15.3.A Describe the emission or absorption of photons by atoms.<br>15.4.A Describe the electromagnetic radiation emitted by an object due to its temperature.<br>15.5.A Describe an interaction between photons and matter using the photoelectric effect. |

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| | 15.6.A Describe the interaction between photons and matter using the Compton effect.<br>15.7.A Describe the physical properties that constrain the behavior of interacting nuclei, subatomic particles, and nucleons.<br>15.7.B Describe the radioactive decay of a given sample of material consisting of a finite number of nuclei.<br>15.8.A Describe the processes by which individual nuclei decay. |

FAIRFIELD PUBLIC SCHOOLS

# Course Information

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| **Grade(s):** | 11 /12 |
| **Discipline/Course:** | Science / Physics |
| **Course Title:** | Physics |
| **Prerequisite(s):** | Successful completion of or concurrently enrolled in 10th grade Chemistry, Environmental Chemistry, or AP Chemistry and Algebra 1. |
| **Course Description:** *Program of Studies* | **Physics** is a year-long, laboratory-based, college preparatory course that integrates Physics, Engineering, and Earth Science concepts and meets the expectations of the Next Generation Science Standards. Students will be asked to use evidence, evaluate claims, and develop models to interpret the seen and unseen and design solutions to real world problems. Each unit begins with a phenomena or design challenge to develop understandings of core science ideas. Topics include: Forces and Motion, Momentum and Energy Conservation; Energy and Forces in the Geosphere; Gravity, Orbits & Planetary Formation; Waves and Information Transfer Technologies; and Stars and the Origin of the Universe |
| **Course Essential Questions:** | How can we explain and predict interactions between objects and within systems of objects?<br><br>How do observations of patterns in systems at all scales provide evidence towards the composition of planets, stars, and the universe? |
| **Course Enduring Understandings:** | The total momentum of a system of objects is conserved when there is no net force on the system.<br><br>Energy is understood as a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system, and the total change of energy in any system is always equal to the total energy transferred into or out of the system. |

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| | The energy associated with the configuration of particles can be thought of as stored in fields.<br><br>Wave properties and the interactions of electromagnetic radiation with matter can transfer information across long distances as well as store information |
| **Duration:** | Full year/1.0 credit |
| **Course Materials/ Resources:** | There is no textbook associated with this course.<br><br>Student and teacher materials will be compiled using a variety of primary scientific resources including but not limited to: NASA, National Oceanic and Atmospheric Administration, (NOAA), United States Geologic Society (USGS), American Association for the Advancement of Science (AAAS) |
| **FPS Course Academic Expectation(s):** | Synthesizing and Evaluating<br>Creating and Constructing |

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| **Unit Number and Title:** | Unit 1: Designing Flying Machines: Newton's Laws of Motion and Momentum |
| **Duration:** | Approximately 6 weeks |
| **Resource(s):** | N/A |
| **Unit Overview:** | Students will examine a variety of flying machines to determine how their structure matches their function. They will evaluate this through a lens of kinematics & forces, and then use their observations to design & construct their own flying machine using the engineering design process. |
| **Learning Goals** | |
| **Standard(s):** | **Scientific and Engineering Practices: (Highlighted Practices are Priority)**<br>Asking Questions, Engaging in Argument from Evidence, **Construction Explanations & Designing Solutions**, **Developing & Using Models**, Obtaining, Evaluating & Communicating Information, **Analyzing & Interpreting Data**, **Using Mathematics and Computational Thinking, Planning and Carrying Out Investigations**<br><br>**Disciplinary Core Ideas:**<br>**HS.ETS1.A: Defining and Delimiting Engineering Problems**<br>Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (HS-ETS1-1)<br>**HS.ETS1.B: Developing Possible Solutions**<br>When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3)<br>**HS.PS2.A: Forces and Motion**<br>Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1) |

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| | **Crosscutting Concepts: Cause and Effect, Systems and System Models, Scale, Proportion, and Quantity, Structure and Function** |
| **Essential Question(s):** | How do flying machines take off? |
| **Enduring Understanding(s):** | To change the motion of an object, the object must experience unbalanced forces. The resulting motion will be dependent upon the magnitude and direction of the forces as well as the mass of the object.<br><br>The engineering design process requires defining and prioritizing criteria and constraints surrounding the intended purpose of the solution. This process is iterative, requiring testing of prototypes, documentation and analysis of results, and redesign until criteria and constraints are satisfactorily met. |
| **Learning Goal(s):**<br>*Students will be able to use their learning to:* | **During this unit, students will meet the following NGSS Performance Expectations:**<br>**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.<br><br>**During this unit, students will be working towards the following NGSS Performance Expectations:**<br>**HS-ETS1-3:** Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics<br><br>*In addition to the learning goals above, Honors students will be able to use their learning to:*<br>● Explore additional topics<br>● Engage in greater quantitative analysis including projectile motion in two dimensions, which involves applying trigonometry, including decomposing vectors, to solve problems |

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| **Unit Number and Title:** | Unit 2: Rocket Design: Energy, Momentum, and Conservation |
| **Duration:** | Approximately 6 weeks |
| **Resource(s):** | N/A |
| **Unit Overview:** | Students will build on their engineering design skills and their understanding of forces and motion as they investigate the role of momentum and energy in rocket launches and landings. Students will create computational models then utilize the engineering process to build rockets with payloads that must land safely. |
| **Learning Goals** | |
| **Standard(s):** | **Scientific and Engineering Practices: (Highlighted Practices are Priority)**<br>Asking Questions, **Planning and Carrying Out Investigations**, Engaging in Argument from Evidence, **Construction Explanations & Designing Solutions**, **Developing & Using Models**, Obtaining, Evaluating & Communicating Information, Analyzing & Interpreting Data<br><br>**Disciplinary Core Ideas:**<br>**HS.PS2.A: Forces and Motion**<br>Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. (HS-PS2-2)<br>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 objects outside the system. (HS-PS2-2),(HS-PS2-3)<br><br>**HS.PS3.D Energy in Chemical Processes and Everyday Life**<br>Alth energy cannot be destroyed, it can be converted to less useful forms- for example, to thermal energy in the surrounding environment. (HS-PS3-3), (HS-PS3-4) |

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| | **ESS3.A Natural Resources**<br>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 regulations can change the balance of these factors. (HS-ESS3-2)<br><br>**PS3.B Conservation of Energy and Energy Transfer**<br>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)<br>The availability of energy limits what can occur in any system. (HS-PS3-1)<br>Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1),(HS-PS3-4)<br><br>**PS3.A Definitions of Energy**<br>Energy is a quantitative property of a system that depends on the motion and 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. (HS-PS3-1),(HS-PS3-2)<br><br>**Crosscutting Concepts: Patterns; Energy & Matter; Systems & System Models; Scale, Proportion, and Quantity** |
| **Essential Question(s):** | How do we launch someone into space and bring them back safely?<br>How do we create computational models?<br>How do we utilize the engineering design process to create a model to test a complex system? |
| **Enduring Understanding(s):** | Momentum is conserved during collisions and interactions between objects. |

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| | Energy cannot be created nor destroyed, it only moves between one place and another place, between objects and/or fields, or between systems.<br><br>Mathematical models can be utilized to evaluate design solutions. |
| **Learning Goal(s):**<br>*Students will be able to use their learning to:* | **During this unit, students will meet the following NGSS Performance Expectations:**<br>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. (Energy and Matter)<br>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.<br>HS-PS2-3. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.<br>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 components and energy flows in and out of the system are known.<br><br>**During this unit, students will be working towards the following NGSS Performance Expectations:**<br>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 motion of particles (objects) and energy associated with the relative positions of particles (objects).<br>HS-ESS3-3: Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on csst-benefit ratios.<br><br>*In addition to the learning goals above, Honors students will be able to use their learning to:*<br>● Evaluate two dimensional systems with multi-step calculations, which involves applying trigonometry, including decomposing vectors, to solve problems |

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| **Unit Number and Title:** | Unit 3: The Solar System: Gravity, Orbits, and Planetary Formation |
| **Duration:** | Approximately 6 weeks |
| **Resource(s):** | N/A |
| **Unit Overview:** | Planets have a specific place in the solar system, but why? Newton's Laws of Gravitation explain Kepler's observations of planetary motion, and now are cited to describe the formation of planets. This unit will require students to analyze astronomical data to construct explanations regarding the origins of the inner planets. |
| **Learning Goals** | |
| **Standard(s):** | **Scientific and Engineering Practices: (Highlighted Practices are Priority)**<br>Asking Questions, Engaging in Argument from Evidence, **Construction Explanations & Designing Solutions**, **Developing & Using Models**, Obtaining, Evaluating & Communicating Information, Analyzing & Interpreting Data, **Using Mathematics and Computational Thinking**<br><br>**Disciplinary Core Ideas:**<br>**PS2.B: Types of Interactions**<br>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)<br>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)<br><br>**PS3.C Relationship Between Energy and Forces**<br>When two objects interacting through a field change relative position, the energy stored in the field is changed. (HS-PS3-5) |

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| | **ESS1.B: Earth and the Solar System**<br>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)<br><br>**ESS1.C: The History of Planet Earth**<br>Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on 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's formation and early history . (HS-ESS1-6)<br><br>**Crosscutting Concepts:** Patterns; Stability and Change; and Scale, Proportion, and Quantity |
| **Essential Question(s):** | Why are planets found around stars? |
| **Enduring Understanding(s):** | Newton's law of universal gravitation provides the mathematical model to describe and predict the effects of gravitational fields between distant objects.<br>Gravitational forces can explain the formation of planetary bodies and their resulting orbital motion. |
| **Learning Goal(s):**<br>*Students will be able to use their learning to:* | **During this unit, students will be working towards the following NGSS Performance Expectations:**<br>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.<br>HS-ESS1-4. Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.<br>HS-ESS1-6. Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history. |

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| | *In addition to the learning goals above, Honors students will be able to use their learning to:*<br>● Explore additional topics related to planetary formation<br>● Solve related problems involving complex work functions, including air resistance<br>● Apply Kepler's Laws and articulate mathematically and verbally how they confirm Newton's Law of Universal Gravitation |

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| **Unit Number and Title:** | Unit 4: The Inner Planets: Waves and Plate Tectonics |
| **Duration:** | Approximately 6 weeks |
| **Resource(s):** | N/A |
| **Unit Overview:** | In this unit, students will investigate the geologic processes of the inner planets over their lifespans. As planets age, their internal energy dissipates. Each planet's energy dissipates at different rates, leading to some planets that still maintain tectonic activity as evidenced by their changing surface and seismic activity. Other planets who have lost too much energy will have a static surface. Students will investigate the role of waves in collecting this data. |
| **Learning Goals** | |
| **Standard(s):** | **Scientific and Engineering Practices: (Highlighted Practices are Priority)**<br>Asking Questions, **Engaging in Argument from Evidence**, Construction Explanations & Designing Solutions, **Developing & Using Models**, **Obtaining, Evaluating & Communicating Information,** Analyzing & Interpreting Data, Using Mathematics and Computational Thinking<br><br>**Disciplinary Core Ideas:**<br>**HS.ESS1.C: The History of Planet Earth**<br>Continental rocks, which can be older than 4 billion years, are generally much older than the rocks of the ocean floor, which are less than 200 million years old. (HS-ESS1-5)<br><br>**HS.ESS2.A: Earth Materials and Systems**<br>Evidence from deep probes and seismic waves, reconstructions of historical changes in Earth's surface and its magnetics 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 the Earth's interior and the gravitational movement of denser materials |

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| | towards the interior. (HS-ESS2-3)<br><br>**HS.ESS2.B: Plate Tectonics and Large-Scale System Interactions**<br>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. Plate movements are responsible for most continental and ocean-floor features and for the distribution of most rocks and minerals within Earth's crust. (HS-ESS1-5, HS-ESS2-1)<br><br>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 be viewed as the surface expression of mantle convection. (HS-ESS2-3)<br><br>Plate movements are responsible for most continental and ocean-floor features and for the distribution of rocks and minerals within Earth's crust. (HS-ESS2-1)<br><br>**HS.PS3.B: Conservation of Energy and Energy Transfer**<br>Uncontrolled systems always evolve toward more stable states - that is, toward more uniform energy distribution (e.g., water flows downhill, objects hotter than their surrounding environment cool down). (HS-PS3-4)<br><br>**HS.PS4.A: Wave Properties**<br>The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. (HS-PS4-1)<br>Geologists use seismic waves to probe structures deep in the planet.<br><br>**Crosscutting Concepts:** Cause and Effect, Energy and Matter, Systems and System Models, Stability and Change, |

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| **Essential Question(s):** | Why are some planets still active while others are inert? |
| **Enduring Understanding(s):** | Planetary surfaces are sculpted by plate tectonics, which are driven by thermal convection occurring under a planet's surface layer. Some planets are more tectonically active than others.<br>The interior of planetary bodies can be modeled utilizing data from seismic activity.<br><br>Mechanical waves are energy transmitted through a medium. The speed of a wave is dependent on what medium it travels through, while its wavelength and frequency are inversely proportional. |
| **Learning Goal(s):**<br>*Students will be able to use their learning to:* | **During this unit, students will meet the following NGSS Performance Expectations:**<br>HS-PS4-1: Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.<br>HS-ESS2-3: Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.<br>HS-ESS2-1: Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.<br>HS-ESS1-5: Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.<br><br>**During this unit, students will be working towards the following NGSS Performance Expectations:**<br>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).<br><br>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. |

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| | *In addition to the learning goals above, Honors students will be able to use their learning to:*<br>● Explore additional topics related to the following: historical scientific discoveries and current scientific models of Earth's internal structure; the formation of Earth's magnetic field; the absence or presence of magnetic fields around the inner planets<br>● Apply the mathematical relation between energy density dissipation and surface area in this context. |

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| **Unit Number and Title:** | Unit 5: Where is the best place to look for life around other stars? Energy from Stars |
| **Duration:** | Approximately 6 weeks |
| **Resource(s):** | N/A |
| **Unit Overview:** | In this unit, students will investigate how the activity of our sun can impact life on Earth. Students will learn about the sun's lifespan and the processes that drive these changes. Focus will be on stars' emission of electromagnetic radiation during nuclear fusion and how that radiation interacts with our planet. |
| **Learning Goals** | |
| **Standard(s):** | **Scientific and Engineering Practices: (Highlighted Practices are Priority)**<br>Asking Questions, **Engaging in Argument from Evidence**, Construction Explanations & Designing Solutions, Developing & Using Models, **Obtaining, Evaluating & Communicating Information**, **Analyzing & Interpreting Data**, Using Mathematics and Computational Thinking<br><br>**Disciplinary Core Ideas:**<br>HS.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. The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode.<br><br>HS.PS3.A Definitions of Energy: Energy is a quantitative property of a system that depends on the motion and 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. At |

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| | a macroscopic scale, energy manifests itself in multiple ways, such as motion, sound, light, and thermal energy. "Electrical Energy" may mean energy stored in a battery or energy transmitted by electric currents.<br><br>HS.PS3.B Conservation of Energy and Energy Transfer: Mathematical expressions, which quantify how the stored energy in a system 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.<br><br>HS.PS2.B Types of Interactions: 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.<br><br>HS.PS1.C Nuclear Processes: Nuclear processes, including fission, fusion, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process.<br><br>HS.PS4.B Electromagnetic Radiation: When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells.<br><br>HS.PS3.D Energy in Chemical Processes and Everyday Life: Nuclear Fusion processes in the center of the sun release the energy that ultimately reaches the Earth as radiation.<br><br>**Crosscutting Concepts:** Energy and Matter, Systems and System Models, Stability and Change, Scale, Proportion, and Quantity |

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| **Essential Question(s):** | Where is the best place to look for life around stars? |
| **Enduring Understanding(s):** | Stars have life cycles that vary depending on the type of star.<br>Stars are fueled by nuclear fusion which emits electromagnetic radiation and causes the formation of many elements.<br>Stars have internal processes that lead to instability and emission of bursts of electromagnetic radiation in the form of solar storms and solar flares.<br>Electromagnetic radiation can be modeled as a wave or a particle and does not require a medium to travel.<br>Electromagnetic radiation can interact with the planet's magnetic field, causing Auroras. |
| **Learning Goal(s):**<br>*Students will be able to use their learning to:* | **During this unit, students will meet the following NGSS Performance Expectations:**<br>HS-ESS1-3: Communicates scientific ideas about the way stars, over their life cycle, produce elements.<br><br>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.<br><br>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.<br><br>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 position of particles (objects).<br><br>HS-PS4-4: Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.<br><br>HS-PS1-8: Develop models to illustrate the changes in the composition of the nucleus of the atom and |

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| | the energy released during the processes of fission, fusion, and radioactive decay.<br><br>*In addition to the learning goals above, Honors students will be able to use their learning to:*<br>● Explore additional topics related to the following: Stellar formation (atomic and subatomic processes) and evolution, Neutron Stars, Supernovae, and Black Holes<br>● Apply the mathematical relation between energy density dissipation and surface area in this context. |

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| **Unit Number and Title:** | Unit 6: Exploring The Universe: Technology |
| **Duration:** | Approximately 6 weeks |
| **Resource(s):** | N/A |
| **Unit Overview:** | Space, the final frontier.<br><br>“Space is big. Really big. You just won't believe how vastly hugely mind-bogglingly big it is.”<br>-Douglas Adams<br><br>In this unit, students will interpret the giganticness of the vacuum of space that really cannot be understood by the human brain. Then we’ll learn about how scientists figure out the chemicals and behaviors that make up stars and planets that are super duper far. Students will be able to understand how telescopes and analytical tools are utilized to create our image of the universe.<br>● The Big Bang<br>● EM-Light<br>● Data Transmission Technology |
| **Learning Goals** | |
| **Standard(s):** | **Scientific and Engineering Practices: (Highlighted Practices are Priority)**<br>Asking Questions, Engaging in Argument from Evidence, Construction Explanations & Designing Solutions, **Developing & Using Models**, **Obtaining, Evaluating & Communicating Information**, **Analyzing & Interpreting Data**, Using Mathematics and Computational Thinking<br><br>**Disciplinary Core Ideas:**<br>**PS3.A: Definitions of Energy**<br>These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases |

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| | the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. (HS-PS3-2)<br><br>**PS4.A: Wave Properties**<br>Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (HS-PS4-3)<br><br>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 sent over long distances as a series of wave pulses. (HS-PS4-2),(HSPS4-5)<br><br>**PS4.B: Electromagnetic Radiation**<br>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)<br>Photoelectric materials emit electrons when they absorb light of a high-enough frequency. (HS-PS4-5)<br>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)<br><br>**PS4.C: Information Technologies and Instrumentation**<br>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) |

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| | **ESS1.A The Universe and Its Stars**<br>The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gasses, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe. (HS-ESS1-2)<br><br>**Crosscutting Concepts:** Energy and Matter, Systems and System Models, Cause and Effect, and Patterns |
| **Essential Question(s):** | How do we know what we know about the Universe?<br>How would we know if there is other life in the Universe? |
| **Enduring Understanding(s):** | Scientists gather and analyze astronomical data in order to explain the formation of the universe and make predictions about the future of the universe.<br><br>The properties of atoms within stars and exoplanets can create identifiable markers called spectra that allow their composition to be determined using modern technology.<br><br>Advances in digital technologies over the past century have enabled more detailed and sophisticated data to be collected and then processed with increasing speed. |
| **Learning Goal(s):**<br>*Students will be able to use their learning to:* | **During this unit, students will meet the following NGSS Performance Expectations:**<br>HS-ESS1-2. Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.<br>HS-PS4-2. Evaluate questions about the advantages of using a digital transmission and storage of information.<br>HS-PS4-3. Evaluate the claims, evidence, and reasoning 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.<br>HS-PS4-5. Communicate technical information about how some technological devices use the |

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| | principles of wave behavior and wave interactions with matter to transmit and capture information and energy.*<br><br>**During this unit, students will be working towards the following NGSS Performance Expectations:**<br>HS-PS4-3. Evaluate the claims, evidence, and reasoning 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.<br>HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.<br><br>*In addition to the learning goals above, Honors students will be able to use their learning to:*<br>● Apply the special theory of relativity<br>● Explore alternative interpretations of spacetime, including block vs. growing block universe views |

Enclosure No. 5
October 11, 2022

# FAIRFIELD BOARD OF EDUCATION
# AGENDA ITEM

**For Consideration by the Board of Education at the Meeting of**: October 11, 2022

**Prepared By:** Dr. James Zavodjancik, Chief Academic Officer

**Presented By:** Mrs. Justine LaSala, Program Director for Secondary Science and STEAM

**Attachments:** (a) The Physics of Music Course Curriculum Proposal; (b) The Physics of Music Course Presentation; (c) Science enrollment memo - Physics and electives; (d) Science course requests 2022-2023

**Subject:** Proposed Course Proposal - The Physics of Music

**Relation to District Improvement Plan:** N/A

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**Background:**
During the 2021-2022 school year, the Science Department, in collaboration with the instructional department and high school leadership, designed a new course for proposal to the Fairfield Board of Education.

The Physics of Music will be an elective course offered to students desiring to enroll in additional science courses on specific topics. The faculty and administration will present this new course, its standards, content, skills, and resource allocation during the October 11 Board of Education meeting.

A three year science course enrollment report is provided by science course, section, and school. In addition, the 22-23 science course requests are provided by each comprehensive high school. These documents may be helpful in determining programming needs. Enrollment versus request class numbers may vary slightly due to the dynamic nature of scheduling. The request report only includes actual requests by students through the scheduling software. If a student requests a course in conference with a school counselor, that request will not be identified on the included report.

**RECOMMENDATION:**
First Reading of The Physics of Music to the Fairfield Board of Education

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**Recommended by the Superintendent:** Steve Tracy

**Agenda Item #** 4B

# Fairfield Public Schools

## New Course Proposal

10/11/2022


# Science Department

## Physics of Music

# Course's Purpose and Vision

***Course Description:***

**Physics of Music** explores the science behind sound and music, from wave generation, to acoustics, to harmonies and instrumentations. Students will examine the production of sound by a variety of musical instruments, how the resulting sound is propagated, and how it can be measured and analyzed. Additional topics to be covered include an analysis of musical scales, the physics and physiology of hearing, and the technology of sound reproduction, including analog and digital recording. Students will engage in hands-on laboratory work pertaining to sound, music, and waves.

***Additional Course Information:***

- ❏ Semester-long, .5 credit, science elective course
- ❏ Open to 11th and 12th grade students
- ❏ *Prerequisites*: completion of Algebra 1

***Course Rationale:*** The Physics of Music will be an elective course offered to students desiring to take an additional science course focused on the science concepts associated with sound production and perception, musical instrumentation, acoustics, and recording.

# Course Overview

| Unit | Overview | Content |
|---|---|---|
| *1* | ***Introduction to Mechanical Waves & Sound*** | *Mechanical Waves*<br>- *Wave Generation (energy transfer)*<br>- *Doppler Effect*<br>- *Reflection, Refraction, Interference*<br>- *Frequency, wavelength, speed and applications to sound*<br>- *Pitch, loudness (decibels), harmonies* |
| *2* | ***Instrumental Structure*** | *Structure & function of instruments, including vocal cords*<br>- *Harmonics*<br>- *Scales, Resonance, & Dissonance*<br>- *Timbre*<br>- *Vocals and Vocal Cords*<br>*End of Quarter Project: Analyze a family of instruments, explain & present on how they produce the noise that they do.* |
| *3* | ***Recording, Hearing, and Acoustics*** | *Physics of hearing*<br>- *Structure of the ear and energy/wave transfer during hearing*<br>- *Hearing loss*<br>- *Analog and Digital Recording*<br>- *Microphones, speakers, electric instruments*<br>- *Acoustics* |
| *4* | ***Final Project - Engineering*** | *End of Course Project: Create an instrument, analyze the sounds it creates, then perform a piece and explain how the acoustics of the location could be improved.* |

# Student Learning Expectations

*By the end of the course, students will be able to use their learning to:*

- ❏ Develop models using computational thinking to demonstrate the relationship between frequency, wavelength, and speed of a wave, as well as the impacts of two or more sound waves interfering.
- ❏ Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
- ❏ Utilize concepts of wave behavior to create questions and predict the impact of the environment on a sound wave's generation and transmission.
- ❏ Obtain, evaluate, and communicate information analyzing a family of instruments and their specific sound properties.
- ❏ Determine if a space is suitable for recording or performance and construct an explanation as to why utilizing their observations of patterns in acoustical spaces.
- ❏ Model and explain the process of sound entering the ear through its interpretation as sound.
- ❏ Compare and contrast digital and analog recordings, create their own recordings, and describe each process.
- ❏ Create an instrument, analyze the sounds it creates, then perform a piece and explain how the acoustics of the location could be improved.

# Resource Allocation

***Course Costs:***

- ❏ Estimated curriculum development cost: $1400
- ❏ No additional material costs beyond normal instructional supply spending
- ❏ No additional staffing needs


*Physics of Music*

# Questions and Comments

FAIRFIELD PUBLIC SCHOOLS

## Course Information

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| **Grade(s):** | 11, 12 |
| **Discipline/Course:** | Science/Physics of Music |
| **Course Title:** | Physics of Music |
| **Prerequisite(s):** | Algebra 1 |
| **Course Description:** *Program of Studies* | This course explores the science behind sound and music, from wave generation, to acoustics, to harmonies and instrumentations. As a final project, students will be tasked with creating their own instruments and composing music, then interpreting the sounds heard by an audience due to the acoustics of an area. Digital and analog recording and hearing will also be investigated. |
| **Course Essential Questions:** | How are specific sounds created by one or more instruments?<br>How does an environment manipulate the way sounds are heard by an observer?<br>How are sounds recorded and replayed? |
| **Course Enduring Understandings:** | Sound is a mechanical wave that occurs due to energy passing through mediums as vibrations, the frequency and amount of energy in the wave determine the pitch and loudness.<br><br>Waves can interfere or complement one another to create dissonance and harmony, and the acoustics of a space can cause waves to dissipate or reflect.<br><br>Recordings can be digital or analog, which vary in sound quality. |
| **Duration:** | Half year/0.5 credit |
| **Course Materials/ Resources:** | N/A |

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| **FPS Course Academic Expectation(s):** | Creating and Constructing<br>Using Communication (Media) Tools |

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| **Unit Number and Title:** | Unit 1: *Introduction to Mechanical Waves & Sound* |
| **Duration:** | Approximately 5-6 weeks |
| **Resource(s):** | N/A |
| **Unit Overview:** | This unit will investigate mechanical waves and their properties (wavelength, frequency, speed, pitch and loudness) along with how waves are generated through energy transfer. Wave phenomena in the context of music will also be explored with concepts including doppler effect, reflection, refraction, interference and harmonies. |
| **Learning Goals** | |
| **Standard(s):** | **Scientific and Engineering Practices: (Highlighted Practices are Priority)**<br>**Asking Questions**, Engaging in Argument from Evidence, Construction Explanations & Designing Solutions, **Developing & Using Models**, Obtaining, Evaluating & Communicating Information, Analyzing & Interpreting Data, **Using Mathematics and Computational Thinking**<br><br>**Disciplinary Core Ideas:**<br>**PS3.A: Definitions of Energy**<br>Energy is a quantitative property of a system that depends on the motion and 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. (HS-PS3-2)<br>At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy.<br><br>**HS.PS4.A: Wave Properties**<br>The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. (HS-PS4-1) |

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| | Crosscutting Concepts:<br>Patterns, Cause and Effect, Structure and Function, |
| **Essential Question(s):** | How do mechanical waves form and behave?<br>How does our interpretation of sound originate in mechanical waves? |
| **Enduring Understanding(s):** | Mechanical waves are energy moving through a medium in the form of vibrations which can be interpreted as sound.<br>Frequency of a wave determines pitch, which is unaffected by medium.<br>Waves can be generated to create different tones and pitches depending on the instrument used to propagate the wave.<br>An instrument is considered in tune when there is an absence of audible beats compared to a known tone. |
| **Learning Goal(s):**<br>*Students will be able to use their learning to:* | **During this unit, students will meet the following Performance Expectations:**<br>Develop models using computational thinking to demonstrate the relationship between frequency, wavelength, and speed of a wave, as well as the impacts of two or more sound waves interfering.<br><br>HS-PS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.<br><br>Utilize concepts of wave behavior to create questions and predict the impact of the environment on a sound wave's generation and transmission.<br><br>**During this unit, students will be working towards the following NGSS Performance Expectations:**<br>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 motion of particles (objects) and energy associated with the relative positions of particles (objects). |

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| **Unit Number and Title:** | Unit 2: *Instrumental Structure* |
| **Duration:** | Approximately 5-6 weeks |
| **Resource(s):** | N/A |
| **Unit Overview:** | This unit will explore how the structure of instruments match their function. Instruments explored will include string instruments, vocal chords, open-ended pipes, and closed-ended pipes. Harmonics, scales, resonance, dissonance, and timbre (why the same note will sound different on different instruments) for each type of instrument will be researched. |
| **Learning Goals** | |
| **Standard(s):** | **Scientific and Engineering Practices: (Highlighted Practices are Priority)**<br>Asking Questions, **Planning and Carrying Out Investigations**, **Engaging in Argument from Evidence**, Construction Explanations & Designing Solutions, Developing & Using Models, **Obtaining, Evaluating & Communicating Information**, Analyzing & Interpreting Data<br><br>**Disciplinary Core Ideas:**<br>**HS.PS4.A: Wave Properties**<br>Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (Boundary: The discussion at this grade level is qualitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.) (HS-PS4-3)<br><br>**CCCs: Patterns; Structure and Function; Scale, Proportion, and Quantity** |
| **Essential Question(s):** | How do instruments make a variety of sounds and how are those sounds described?<br>How do combinations of instruments create harmonies? |

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| **Enduring Understanding(s):** | Timbre allows instruments playing the same note to be differentiated from one another.<br>Instruments create harmonies by utilizing notes that complement one another's frequencies. |
| **Learning Goal(s):**<br>*Students will be able to use their learning to:* | **During this unit, students will meet the following Performance Expectations:**<br>Students will obtain, evaluate, and communicate information analyzing a family of instruments and their specific sound properties. |

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| **Unit Number and Title:** | Unit 3: *Recording, Hearing, and Acoustics* |
| **Duration:** | Approximately 5-6 weeks |
| **Resource(s):** | N/A |
| **Unit Overview:** | How do we hear music? This unit will cover the physics of hearing, the structure of the ear, and how hearing loss can occur. Recording music will also be covered, including how music is recorded via analog and digital means, how microphones, speakers, and electric instruments operate, and how acoustics can be utilized for a more pleasant recording/listening experience.<br><br>Physics of hearing<br>○ Structure of the ear and energy/wave transfer during hearing<br>○ Hearing loss<br>○ Analog and Digital Recording<br>○ Microphones, speakers, electric instruments<br>○ Acoustics |
| **Learning Goals** | |
| **Standard(s):** | **Scientific and Engineering Practices: (Highlighted Practices are Priority)**<br>Asking Questions, **Planning and Carrying Out Investigations**, **Engaging in Argument from Evidence**, **Construction Explanations & Designing Solutions**, **Developing & Using Models**, **Obtaining, Evaluating & Communicating Information**, Analyzing & Interpreting Data<br><br>**Disciplinary Core Ideas:**<br>**PS3.C: Relationship Between Energy and Forces**<br>When two objects interacting through a field change relative position, the energy stored in the field is changed. (HS-PS3-5) |

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| | **PS4.A**<br>Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (Boundary: The discussion at this grade level is qualitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.)<br>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)<br><br>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 sent over long distances as a series of wave pulses. (HS-PS4-2),(HSPS4-5)<br><br>**CCCs: Patterns; Structure and Function; Scale, Proportion, and Quantity** |
| **Essential Question(s):** | How do we hear music?<br>How do we record music?<br>How do acoustics of a space impact sound quality? |
| **Enduring Understanding(s):** | The inner ear utilizes the energy in waves to create electrical signals in our brains that we interpret as sounds.<br><br>Recorded music can be done in either analog or digital, with digital technologies utilizing computational functions that are now close to their smoother analog counterparts.<br><br>The materials and shape of materials have a direct impact on sound wave behavior, creating beneficial or detrimental results in terms of sound quality. |

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| **Learning Goal(s):**<br>*Students will be able to use their learning to:* | **During this unit, students will meet the following Performance Expectations:**<br><br>Students will be able to determine if a space is suitable for recording or performance and construct an explanation as to why utilizing their observations of patterns in acoustical spaces.<br><br>Students will be able to explain the process of sound entering the ear through its interpretation as sound.<br><br>Students will compare digital and analog recordings, create their own recordings, and describe each process.<br><br>**During this unit, students will be working towards the following NGSS Performance Expectations:**<br>**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.<br><br>**HS-PS4-2**: Evaluate questions about the advantages of using digital transmission and storage of information.<br><br>**HS-PS4-5.** Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy. |

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| **Unit Number and Title:** | Unit 4: *Culminating Experience & Final Project* |
| **Duration:** | Approximately 2 weeks |
| **Resource(s):** | N/A |
| **Unit Overview:** | Create an instrument, analyze the sounds it creates, then perform a piece and explain how the acoustics of the location could be improved. |
| **Learning Goals** | |
| **Standard(s):** | **Scientific and Engineering Practices: (Highlighted Practices are Priority)**<br>Asking Questions, **Planning and Carrying Out Investigations**, Engaging in Argument from Evidence, **Construction Explanations & Designing Solutions**, **Developing & Using Models**, **Obtaining, Evaluating & Communicating Information, Analyzing & Interpreting Data**<br><br>**Disciplinary Core Ideas:**<br>**ETS1.A:** Defining and Delimiting Engineering Problems Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (HS-ETS1-1)<br><br>**ETS1.B:** Developing Possible Solutions When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3)<br><br>**PS4.A:** Wave Properties<br>The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. (HS-PS4-1) |

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| | Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other<br><br>**CCCs: Patterns; Structure and Function; Scale, Proportion, and Quantity** |
| **Essential Question(s):** | How are instruments created and improved upon? |
| **Enduring Understanding(s):** | Sound is a mechanical wave that occurs due to energy passing through mediums as vibrations, the frequency and amount of energy in the wave determine the pitch and loudness.<br><br>Waves can interfere or complement one another to create dissonance and harmony, and the acoustics of a space can cause waves to dissipate or reflect.<br><br>Recordings can be digital or analog, which vary in sound quality |
| **Learning Goal(s):**<br>*Students will be able to use their learning to:* | **During this unit, students will meet the following NGSS Performance Expectations:**<br>Demonstrate mastery of previous performance expectations through a culminating engineering and analysis task.<br><br>Students will create an instrument, analyze the sounds it creates, then perform a piece and explain how the acoustics of the location could be improved. |

Enclosure No. 7
October 11, 2022

**Course Enrollment 3 Year Period**

| Course | 2020-2021 | | | | | 2021-2022 | | | | | 2022-2023 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Section | FLHS | FWHS | WFC | Total | Section | FLHS | FWHS | WFC | Total | Section | FLHS | FWHS | WFC | Total |
| **AP Physics I** | 1 | 22 | 24 | | | 1 | 20 | 16 | | | 1 | 23 | 21 | | |
| | 2 | 14 | 16 | | | 2 | 16 | 22 | | 139 | 2 | 17 | 12 | | 134 |
| | 3 | 22 | 21 | | 189 | 3 | 11 | 10 | | | 3 | 24 | 20 | | |
| | 4 | 23 | 13 | | | 4 | 21 | 23 | | | 4 | | 17 | | |
| | 5 | | 17 | | | | | | | | | | | | |
| | 6 | | 17 | | | | | | | | | | | | |
| **AP Physics II** | 1 | 19 | 23 | | 42 | 1 | 5 | 9 | | 14 | Course not offered 22-23 | | | | 0 |
| **Physics** | 1 | 22 | 19 | | | 1 | 18 | 23 | | | 1 | 12 | 24 | | |
| | 2 | 19 | 22 | | | 2 | 19 | 22 | | | 2 | 21 | 23 | | |
| | 3 | 20 | 23 | | | 3 | 20 | 20 | | 227 | 3 | 19 | 21 | | 228 |
| | 4 | 23 | 19 | | 229 | 4 | 23 | 20 | | | 4 | 23 | 23 | | |
| | 5 | 19 | 19 | | | 5 | 24 | 18 | | | 5 | 20 | 22 | | |
| | 6 | | 13 | | | 6 | | 20 | | | 6 | | 20 | | |
| | 7 | | 11 | | | | | | | | | | | | |
| **AP Physics C** | Class Not in the Program of Studies | | | | | | | | | | 1 | 14 | 16 | | 30 |
| **Chemistry of Medicine** | 1 | 9 | 5 | | | 1 | 16 | 14 | | 30 | 1 | 23 | 16 | | |
| | 2 | 9 | 5 | | 28 | | | | | | 2 | | 13 | | 52 |
| **Earth - Dangerous Planet** | 1 | 23 | 18 | | | 1 | 20 | 22 | | | 1 | 15 | 18 | 16 | |
| | 2 | 10 | 15 | | | 2 | 20 | 20 | | | 2 | 19 | 18 | | 109 |
| | 3 | 14 | 20 | | 153 | 3 | 12 | 24 | | 206 | 3 | 23 | | | |
| | 4 | 22 | 10 | | | 4 | 22 | 24 | | | | | | | |
| | 5 | | 21 | | | 5 | 23 | 19 | | | | | | | |
| **Earth - Dynamic Environment** | 1 | 18 | 20 | 9 | | 1 | 20 | 23 | 10 | | | | | | |
| | 2 | 21 | 24 | 8 | 104 | 2 | 16 | 16 | 10 | 142 | Class not offered 22-23 | | | | |
| | 3 | | | 4 | | 3 | 23 | 24 | | | | | | | |
| **Forensics: Without a Trace** | 1 | 21 | 24 | 10 | | 1 | 22 | 24 | 7 | | 1 | 24 | 24 | 7 | |
| | 2 | 23 | 22 | 7 | | 2 | 24 | 23 | 9 | | 2 | 16 | 23 | | |
| | 3 | 21 | 20 | 10 | | 3 | 16 | 22 | | | 3 | 22 | 24 | | |
| | 4 | 17 | 15 | | | 4 | 15 | 23 | | | 4 | 23 | 14 | | |
| | 5 | 20 | | | 251 | 5 | 24 | 21 | | 316 | 5 | 24 | 24 | | 289 |
| | 6 | 18 | | | | 6 | 21 | 21 | | | 6 | 24 | 18 | | |
| | 7 | 23 | | | | 7 | 22 | 1 | | | 7 | 22 | | | |
| | | | | | | 8 | 21 | | | | | | | | |

| Course | 2020-2021 | | | | | 2021-2022 | | | | | 2022-2023 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Section | FLHS | FWHS | WFC | Total | Section | FLHS | FWHS | WFC | Total | Section | FLHS | FWHS | WFC | Total |
| **Forensics II: Fake the Prints** | 1 | 24 | 22 | 1 | | 1 | 24 | 23 | 6 | | 1 | 24 | 24 | 3 | |
| | 2 | 23 | 18 | | | 2 | 23 | 22 | 11 | | 2 | 23 | 22 | | |
| | 3 | 21 | 22 | | 171 | 3 | 20 | 20 | | 252 | 3 | 24 | 22 | | 212 |
| | 4 | 22 | 16 | | | 4 | 23 | 21 | | | 4 | 24 | 22 | | |
| | 5 | 1 | | | | 5 | 16 | 18 | | | 5 | | 24 | | |
| | 6 | 1 | | | | 6 | 23 | 2 | | | | | | | |
| **Human A&P: Blood & Guts** | 1 | 24 | 22 | | | 1 | 24 | 13 | | | 1 | 17 | 19 | | |
| | 2 | 20 | 19 | | 85 | 2 | 10 | 15 | | 101 | 2 | 24 | 21 | | 125 |
| | | | | | | 3 | 23 | 16 | | | 3 | 22 | 22 | | |
| **Human A&P: Brains and Bones** | 1 | 18 | 23 | | | 1 | 21 | 23 | | | 1 | 19 | 23 | | |
| | 2 | 17 | 24 | | 96 | 2 | 23 | 22 | | 136 | 2 | 19 | 19 | | 124 |
| | 3 | 14 | | | | 3 | 19 | 13 | | | 3 | 20 | 24 | | |
| | | | | | | 4 | | 15 | | | | | | | |
| **Marine Science of LI Sound** | 1 | 24 | 23 | | | 1 | 13 | 15 | | | 1 | 24 | 15 | 11 | |
| | 2 | 14 | 20 | | 108 | 2 | 22 | 23 | | 73 | 2 | 21 | 17 | 11 | 99 |
| | 3 | 10 | | | | | | | | | | | | | |
| | 4 | 17 | | | | | | | | | | | | | |
| **Nutritional Chemistry** | 1 | 20 | 23 | | | 1 | 10 | 23 | 3 | | 1 | 16 | 17 | | |
| | 2 | 16 | | | 59 | 2 | 16 | | | 52 | 2 | 24 | 14 | | 94 |
| | | | | | | | | | | | 3 | 23 | | | |
| **Science of the Cosmos** | 1 | 22 | 22 | | | 1 | 21 | 24 | | | 1 | 12 | 19 | | |
| | 2 | 23 | 21 | | | 2 | 18 | 24 | | | 2 | 21 | 22 | | |
| | 3 | 20 | 23 | | 172 | 3 | 17 | 22 | | 212 | 3 | 20 | 12 | | 153 |
| | 4 | 17 | 24 | | | 4 | 23 | 23 | | | 4 | 23 | 24 | | |
| | | | | | | 5 | 16 | 24 | | | | | | | |
| **The Planet's Oceans** | Course not offered in 21-22 | | | | | 1 | 9 | 21 | | | 1 | 15 | 20 | | |
| | | | | | | 2 | 17 | 24 | | 111 | 2 | 7 | | | 62 |
| | | | | | | 3 | 18 | 22 | | | 3 | 20 | | | |
| **AP Biology** | 1 | 15 | 20 | | | 1 | 22 | 18 | | | 1 | 24 | 15 | | |
| | 2 | 8 | 20 | | | 2 | 17 | 18 | | | 2 | 23 | 22 | | |
| | 3 | 9 | | | 95 | 3 | 21 | 13 | | 109 | 3 | 19 | 16 | | 119 |
| | 4 | 23 | | | | | | | | | | | | | |

| Course | 2020-2021 | | | | | 2021-2022 | | | | | 2022-2023 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Section | FLHS | FWHS | WFC | Total | Section | FLHS | FWHS | WFC | Total | Section | FLHS | FWHS | WFC | Total |
| **AP Chemistry** | 1 | 16 | 11 | | 84 | 1 | 20 | 10 | | 65 | 1 | 22 | 14 | | 77 |
| | 2 | 23 | | | | 2 | 19 | | | | 2 | 21 | | | |
| | 3 | 12 | | | | 3 | 16 | | | | 3 | 20 | | | |
| | 4 | 22 | | | | | | | | | | | | | |
| **AP Environmental Science** | 1 | 20 | 22 | | 180 | 1 | 18 | 24 | | 180 | 1 | 21 | 23 | 13 | 259 |
| | 2 | 24 | 14 | | | 2 | 21 | 15 | | | 2 | 24 | 18 | | |
| | 3 | 21 | 20 | | | 3 | 22 | 22 | | | 3 | 23 | 23 | | |
| | 4 | 18 | 17 | | | 4 | 22 | 14 | | | 4 | 22 | 23 | | |
| | 5 | | 24 | | | 5 | 22 | | | | 5 | 24 | 23 | | |
| | | | | | | | | | | | 6 | 22 | | | |
| **Environmental Chemistry** | Class not in Program of Studies | | | | | | | | | | 1 | 23 | 15 | | 205 |
| | | | | | | | | | | | 2 | 20 | 17 | | |
| | | | | | | | | | | | 3 | 20 | 18 | | |
| | | | | | | | | | | | 4 | 23 | 18 | | |
| | | | | | | | | | | | 5 | 20 | 16 | | |
| | | | | | | | | | | | 6 | | 15 | | |
| **Environmental Chemistry H** | Class not in Program of Studies | | | | | | | | | | 1 | 18 | 17 | | 138 |
| | | | | | | | | | | | 2 | 23 | 15 | | |
| | | | | | | | | | | | 3 | 22 | 20 | | |
| | | | | | | | | | | | 4 | | 23 | | |
| **Biology** | 1 | 22 | 14 | 6 | 469 | 1 | 21 | 12 | 4 | 402 | 1 | 21 | 11 | 4 | 442 |
| | 2 | 22 | 15 | | | 2 | 16 | 15 | | | 2 | 23 | 17 | | |
| | 3 | 21 | 15 | | | 3 | 23 | 19 | | | 3 | 24 | 17 | | |
| | 4 | 14 | 14 | | | 4 | 17 | 11 | | | 4 | 18 | 15 | | |
| | 5 | 12 | 17 | | | 5 | 16 | 11 | | | 5 | 15 | 23 | | |
| | 6 | 18 | 18 | | | 6 | 14 | 24 | | | 6 | 20 | 13 | | |
| | 7 | 18 | 15 | | | 7 | 12 | 15 | | | 7 | 20 | 20 | | |
| | 8 | 24 | 14 | | | 8 | 24 | 18 | | | 8 | 23 | 15 | | |
| | 9 | 24 | 17 | | | 9 | 21 | 15 | | | 9 | 19 | 21 | | |
| | 10 | 24 | 17 | | | 10 | 14 | 19 | | | 10 | 14 | 14 | | |
| | 11 | 23 | 15 | | | 11 | 16 | 12 | | | 11 | 16 | 19 | | |
| | 12 | | 16 | | | 12 | 1 | 16 | | | 12 | 20 | 20 | | |
| | 13 | | 19 | | | 13 | | 16 | | | | | | | |
| | 14 | | 17 | | | | | | | | | | | | |

| Course | 2020-2021 | | | | | 2021-2022 | | | | | 2022-2023 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Section | FLHS | FWHS | WFC | Total | Section | FLHS | FWHS | WFC | Total | Section | FLHS | FWHS | WFC | Total |
| | 15 | | 18 | | | | | | | | | | | | |
| | 1 | 22 | 24 | | | 1 | 24 | 15 | | | 1 | 19 | 20 | | |
| | 2 | 21 | 22 | | | 2 | 20 | 8 | | | 2 | 18 | 16 | | |
| | 3 | 21 | 20 | | | 3 | 19 | 20 | | | 3 | 20 | 22 | | |
| | 4 | 24 | 19 | | | 4 | 20 | 9 | | | 4 | 18 | 23 | | |
| **Biology H** | 5 | 22 | 24 | | 347 | 5 | 24 | 23 | | 284 | 5 | 20 | 24 | | 286 |
| | 6 | 21 | 21 | | | 6 | 14 | 17 | | | 6 | 23 | 20 | | |
| | 7 | 22 | 21 | | | 7 | 24 | 24 | | | 7 | 19 | 24 | | |
| | 8 | 22 | | | | 8 | 23 | | | | | | | | |
| | 9 | 21 | | | | | | | | | | | | | |
| | 1 | 15 | 20 | | | 1 | 19 | 19 | | | 1 | 16 | 19 | | |
| | 2 | 13 | 20 | | | 2 | 21 | 18 | | | 2 | 18 | 19 | | |
| | 3 | 22 | 15 | | | 3 | 19 | 16 | | | 3 | 19 | 22 | | |
| | 4 | 24 | 13 | | | 4 | 22 | 14 | | | 4 | 22 | 16 | | |
| | 5 | 21 | 22 | | | 5 | 13 | 21 | | | 5 | 16 | 19 | | |
| **Chemistry** | 6 | 22 | 18 | | 383 | 6 | 21 | 13 | | 356 | | | | | 186 |
| | 7 | 21 | 16 | | | 7 | 14 | 12 | | | | | | | |
| | 8 | 12 | 15 | | | 8 | 21 | 12 | | | | | | | |
| | 9 | 19 | 19 | | | 9 | 22 | 15 | | | | | | | |
| | 10 | 22 | 20 | | | 10 | | 20 | | | | | | | |
| | 11 | | 14 | | | 11 | | 24 | | | | | | | |
| | 1 | 12 | 23 | | | 1 | 19 | 20 | | | 1 | 20 | 16 | | |
| | 2 | 23 | 18 | | | 2 | 23 | 15 | | | 2 | 15 | 23 | | |
| | 3 | 23 | 24 | | | 3 | 19 | 17 | | | 3 | 24 | 23 | | |
| | 4 | 16 | 19 | | | 4 | 21 | 24 | | | 4 | 20 | 21 | | |
| **Chemistry H** | 5 | 16 | 22 | | 330 | 5 | 18 | 11 | | 304 | 5 | 24 | | | 203 |
| | 6 | 16 | 17 | | | 6 | 22 | 15 | | | 6 | 17 | | | |
| | 7 | 21 | 24 | | | 7 | 24 | 17 | | | | | | | |
| | 8 | 18 | 17 | | | 8 | 24 | 15 | | | | | | | |
| | 9 | 21 | | | | | | | | | | | | | |

| Course | Course Requests - Fairfield Ludlowe High School 2022-2023 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 9 | | | 10 | | | 11 | | | 12 | | | Total | | |
| | Rostered | REQ | ALT | Rostered | REQ | ALT | Rostered | REQ | ALT | Rostered | REQ | ALT | Rostered | REQ | ALT |
| **AP Biology** | 0 | 0 | 0 | 0 | 0 | 0 | 44 | 49 | 8 | 22 | 23 | 2 | 66 | 72 | 10 |
| **AP Chemistry** | 0 | 0 | 0 | 16 | 17 | 1 | 31 | 32 | 3 | 18 | 19 | 1 | 65 | 68 | 5 |
| **AP Environmental Science** | 0 | 0 | 0 | 0 | 0 | 0 | 76 | 85 | 3 | 61 | 63 | 3 | 137 | 148 | 6 |
| **AP Physics C** | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 14 | 14 | 1 | 15 | 15 | 1 |
| **AP Physics I** | 0 | 0 | 0 | 3 | 3 | 0 | 48 | 50 | 7 | 16 | 16 | 3 | 67 | 69 | 10 |
| **Biology** | 230 | 231 | 2 | 7 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 237 | 238 | 2 |
| **Biology H** | 144 | 145 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 145 | 146 | 1 |
| **Chemistry** | 0 | 0 | 1 | 68 | 72 | 2 | 23 | 24 | 1 | 3 | 3 | 0 | 94 | 99 | 4 |
| **Chemistry H** | 0 | 0 | 0 | 116 | 119 | 2 | 5 | 5 | 2 | 0 | 0 | 0 | 121 | 124 | 4 |
| **Chemistry of Medicines** | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 9 | 6 | 15 | 17 | 8 | 23 | 26 | 14 |
| **Earth - Dangerous Planet** | 0 | 0 | 0 | 5 | 6 | 5 | 19 | 23 | 9 | 34 | 37 | 11 | 58 | 66 | 25 |
| **Environmental Chemistry** | 0 | 0 | 0 | 88 | 89 | 2 | 19 | 20 | 0 | 2 | 2 | 0 | 109 | 111 | 2 |
| **Environmental Chemistry H** | 0 | 0 | 0 | 58 | 62 | 4 | 6 | 6 | 0 | 0 | 0 | 0 | 64 | 68 | 4 |
| **Forensics I: Without a Trace** | 0 | 0 | 0 | 1 | 1 | 0 | 87 | 94 | 14 | 70 | 72 | 20 | 158 | 167 | 34 |
| **Forensics II: Fake the Prints** | 0 | 0 | 0 | 0 | 0 | 0 | 51 | 61 | 5 | 44 | 50 | 15 | 95 | 111 | 20 |
| **Human A&P: Blood** | 0 | 0 | 0 | 0 | 0 | 0 | 22 | 23 | 7 | 41 | 43 | 14 | 63 | 66 | 21 |
| **Human A&P: Brains** | 0 | 0 | 0 | 0 | 0 | 0 | 24 | 25 | 7 | 36 | 41 | 16 | 60 | 66 | 23 |
| **Marine Science of LI Sound** | 0 | 0 | 0 | 3 | 3 | 1 | 13 | 14 | 6 | 29 | 33 | 8 | 45 | 50 | 15 |
| **Nutritional Chemistry** | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 8 | 4 | 57 | 57 | 18 | 65 | 65 | 22 |
| **Physics** | 0 | 0 | 0 | 1 | 1 | 0 | 64 | 65 | 9 | 33 | 35 | 5 | 98 | 101 | 14 |
| **Science of the Cosmos** | 0 | 0 | 0 | 15 | 16 | 8 | 22 | 23 | 13 | 41 | 42 | 10 | 78 | 81 | 31 |
| **The Planet's Oceans** | 0 | 0 | 0 | 4 | 5 | 6 | 12 | 13 | 11 | 27 | 32 | 7 | 43 | 50 | 24 |

**Rostered -** Number of students enrolled in the course
**REQ -** Number of students who have requested the course
**ALT -** Number of students who have requested the course as an alternative if a first choice was not available
**Note: Numbers may vary depending on how a course is enrolled (i.e., a student may not request but be enrolled or request and not be enrolled.*

| Course | Course Requests - Fairfield Warde High School 2022-2023 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 9 | | | 10 | | | 11 | | | 12 | | | Total | | |
| | Rostered | REQ | ALT | Rostered | REQ | ALT | Rostered | REQ | ALT | Rostered | REQ | ALT | Rostered | REQ | ALT |
| **AP Biology** | 0 | 0 | 0 | 0 | 0 | 0 | 32 | 32 | 1 | 23 | 23 | 1 | 55 | 55 | 2 |
| **AP Chemistry** | 0 | 0 | 0 | 1 | 2 | 1 | 8 | 8 | 2 | 5 | 10 | 0 | 14 | 20 | 3 |
| **AP Environmental Science** | 0 | 0 | 0 | 0 | 0 | 0 | 48 | 51 | 5 | 65 | 68 | 6 | 113 | 119 | 11 |
| **AP Physics C** | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 1 | 14 | 13 | 1 | 16 | 15 | 2 |
| **AP Physics I** | 0 | 0 | 0 | 5 | 6 | 1 | 54 | 60 | 3 | 11 | 13 | 0 | 70 | 79 | 4 |
| **Biology** | 202 | 206 | 2 | 3 | 3 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 206 | 211 | 2 |
| **Biology H** | 149 | 149 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 150 | 150 | 1 |
| **Chemistry** | 0 | 0 | 0 | 71 | 75 | 1 | 21 | 22 | 0 | 3 | 4 | 0 | 95 | 101 | 1 |
| **Chemistry H** | 1 | 1 | 0 | 82 | 88 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 84 | 90 | 3 |
| **Chemistry of Medicines** | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 20 | 12 | 14 | 21 | 3 | 29 | 41 | 15 |
| **Earth - Dangerous Planet** | 0 | 0 | 0 | 6 | 7 | 1 | 10 | 12 | 3 | 20 | 28 | 1 | 36 | 47 | 5 |
| **Environmental Chemistry** | 2 | 4 | 0 | 71 | 82 | 1 | 24 | 27 | 0 | 3 | 5 | 0 | 100 | 118 | 1 |
| **Environmental Chemistry H** | 0 | 0 | 0 | 73 | 75 | 1 | 4 | 4 | 0 | 1 | 1 | 0 | 78 | 80 | 1 |
| **Forensics I: Without a Trace** | 0 | 0 | 0 | 2 | 4 | 0 | 68 | 74 | 27 | 59 | 65 | 11 | 129 | 143 | 38 |
| **Forensics II: Fake the Prints** | 0 | 0 | 0 | 3 | 4 | 0 | 51 | 62 | 10 | 60 | 68 | 5 | 114 | 134 | 15 |
| **Human A&P: Blood** | 0 | 0 | 0 | 0 | 0 | 1 | 18 | 24 | 13 | 44 | 49 | 14 | 62 | 73 | 28 |
| **Human A&P: Brains** | 0 | 0 | 0 | 1 | 2 | 0 | 20 | 27 | 11 | 45 | 53 | 12 | 66 | 82 | 23 |
| **Marine Science of LI Sound** | 0 | 0 | 0 | 0 | 4 | 0 | 7 | 15 | 10 | 25 | 26 | 7 | 32 | 45 | 17 |
| **Nutritional Chemistry** | 0 | 0 | 1 | 1 | 1 | 0 | 15 | 17 | 10 | 15 | 28 | 4 | 31 | 46 | 15 |
| **Physics** | 0 | 0 | 0 | 2 | 2 | 1 | 84 | 90 | 6 | 50 | 53 | 0 | 136 | 145 | 7 |
| **Science of the Cosmos** | 0 | 0 | 0 | 20 | 23 | 4 | 18 | 21 | 5 | 41 | 47 | 18 | 79 | 91 | 27 |
| **The Planet's Oceans** | 0 | 0 | 0 | 0 | 4 | 2 | 5 | 11 | 6 | 15 | 23 | 7 | 20 | 38 | 15 |

**Rostered -** Number of students enrolled in the course
**REQ -** Number of students who have requested the course
**ALT -** Number of students who have requested the course as an alternative if a first choice was not available
**Note: Numbers may vary depending on how a course is enrolled (i.e., a student may not request but be enrolled or request and not be enrolled.*

Enclosure No. 8
October 11, 2022

# FAIRFIELD BOARD OF EDUCATION
# AGENDA ITEM

**For Consideration by the Board of Education at the Meeting of**: October 11, 2022

**Prepared By:** Dr. Zakia Parrish, Deputy Superintendent

**Presented By:** Mary Dolan-Collette and Peter Shanazu, Summer BOOST Program Principals

**Attachments:** Summer BOOST Program Presentation

**Subject:** Summer BOOST Program

**Relation to District Improvement Plan:** Supports academic strategic initiative

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**Background:** Students who were in kindergarten through grade 8 during the 2021-2022 school year were recommended by their school teams to participate in the FPS Summer BOOST Program in order to receive additional instruction in literacy and math. Transportation was provided to and from the student's districted elementary school, at no cost to families.

This learning opportunity included daily instruction by certified teachers in literacy and math as well as experiences that incorporate interdisciplinary project-based learning. The program ran for 17 days from July 5th - July 29th, from 8:30 until 12:30. The elementary program includes students who were in grades K-4 during the 2021-2022 school year and Mary Dolan-Collette served as the program principal. The secondary program includes students who were in grades 5-8 during the 2021-2022 school year and Peter Shanazu served as the program principal. Fall assessment data for students who participated in the Summer BOOST program will be included in the October 25th Student Achievement Data Review.

**RECOMMENDATION:** For information only.

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**Recommended by the Superintendent:** Steve Tracy

**Agenda Item #** 4C

# Summer Boost 2022

Grades K-8

# Goals of Program

The Summer Boost Program aimed to boost a specific group of students toward success in their subsequent year of school.  This group of students may have struggled during distance learning or hybrid models during the pandemic.  This program was for students who were passing but were below grade level for any number of reasons.  The program was also designed to help quell the “summer slide” often evident in students - especially those below grade level.

# Program Design

- The boost program was designed first by identifying the subset of the FPS students that would benefit most from this type of program
- Then identifying curricula that should be used to help those students meet the goals of the program.
- The Boost Team designed engaging and project-based interdisciplinary curricula unique for each grade-level.
- As we examined the curricula before implementation, a necessity for specific math interventions - both related to the project-based, interdisciplinary curriculum, as well as the summer math packets - was identified for the middle school.

# Elementary Boost

The students attending the elementary boost program engaged in reading, writing, math, and STEAM lessons that would strengthen current skills while exposing them to new skills.

The students also had SEL instruction 2 sessions a week provided by a school social worker.  These lessons focused on mindfulness  following the Mind-Up curriculum.

This year, in addition to a Language Arts Specialist, we also had a Math Specialist.  These teachers were able to plan and co-teach with the Boost Teachers.

# Curricula

Kindergarten -Dinosaurs

1st Grade - Light and Sound

2nd Grade - Pollinators

3rd Grade - Bridges

4th Grade - Playground Design

5th Grade - Create a Solar Oven while Learning About Space

6th Grade - Design a Middle School

7th Grade - Create a Summer Camp

8th Grade - Create a Website About Yourself/Your Identity

# Exemplar Projects

K -Research and Design a Dinosaur Habitat

1 - Sound Waves-Design a Musical Instrument

2 - Research and Design a Pollinator Field Guide

3 - Research and Build a Bridge

4 - Research, Design and Build a Playground

5 - Solar Oven Photo

6 - WestView Middle School

7 - Camp Tiki Waka

8 - Identity Websites

# Math Lead Teacher, ELA Lead Teacher and ELL Teacher

# Elementary Photos

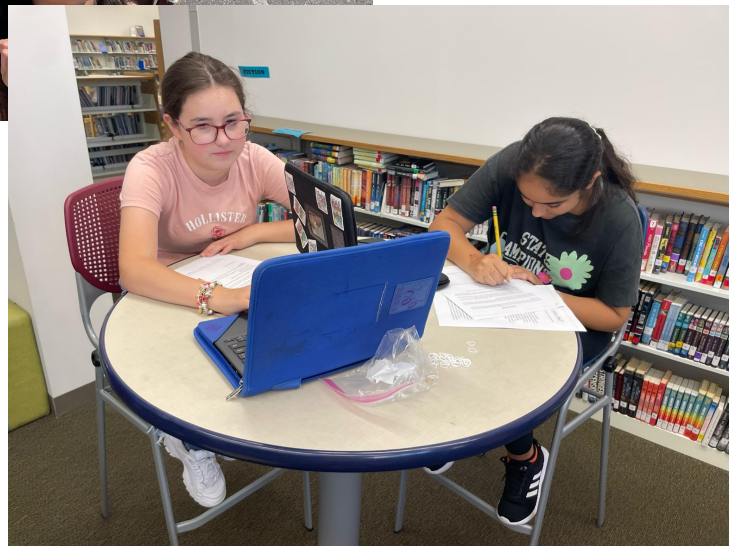
# Elementary Photos

# Elementary Photos (continued)

# Elementary Photos (continued)

# Middle School Photos

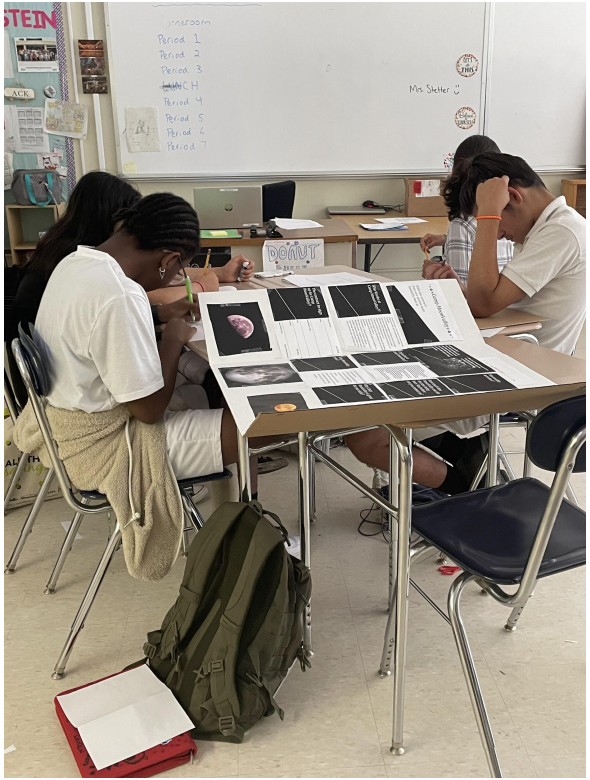

5th graders using solar glasses

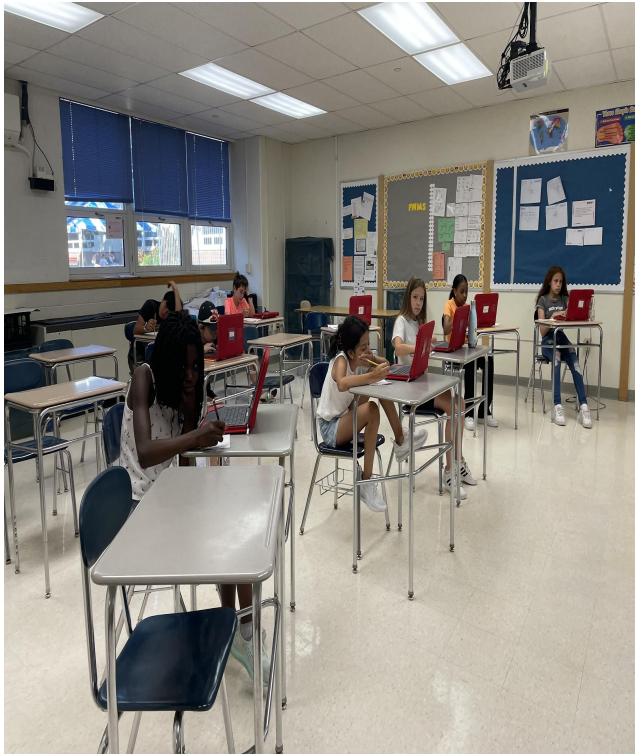


Left and Right: 6th and 7th Graders working on their projects

# More Middle School Photos

Left: 8th graders creating identity pictures
Center: 7th graders working on their Camp posters
Right: 5th graders in math class



# Some Quotes from Middle School Teachers

- We developed positive strong bonds and I think if you asked them, they would agree that even though it was school, they were positive about the time they spent.
- I do feel the program was successful, students did think critically about important issues, and were engaged in reading writing and thinking every day.
- I do feel the Boost program was successful this year because the majority of the students seemed very happy to be there indicated by the smiles on their faces and the energy they brought to Boost with them.
- I do feel it is a great program. Kids are learning and working on their skills that make them better students. I saw new friendships created (kids were exchanging numbers and planned to keep in touch once class ended).
- Participation in this program helped students avoid summer slide. I don't have access to student's fall STAR scores. But, I would put a bet on it that they don't have the normal fall dip as in the past.

# Enrollment and Attendance

Grades K-4 Attendance: 141 total students with an 85.61% average daily attendance.

- Covid
- Family trips
- Field trips–Recreation Playground Camp

Grades 5-8 Attendance:  50 total students with 92.69% average daily attendance

# Conclusion

**Elementary School:** The learning environment remained rigorous with the focus on student growth and agency. The students engaged in daily theme activities such as 80's day, PJ day, and beach day. Parents were invited to celebrate the students projects on the last day of Boost. The students were able to showcase their projects and present their learning in oral and written form. The attendance this year at Boost was lower than expected. This was due in part to some students missing due to Covid while other students were missing days due to family vacations. Overall, those students who attended the program with fidelity were engaged and happy making new friends and strengthening their academic skills. The parents were very appreciative of the program and the attention their children received from the teachers.

**Middle School:** The learning environment was much more rigorous than last summer. The kids said it felt much more like school than camp. Some kids did not buy in and the attendance of those kids were reflective of that. With enrollment being lower (especially in some classes) I was reluctant to remove kids due to attendance issues. Overall, I believe that the program was a success, but with any endeavor I would make some changes (stricter attendance, modify daily schedule, tweak curricula) if it were to run again. On that note, if the program is to run again, I think gearing it towards the elementary level would be best. The middle school program was much more rigorous, which aided the students' learning, also aided in a more school-like feel. Due to this, the older kids did not buy into the program as much. I think the elementary school kids would buy-in to a more school-like setting.

Enclosure No. 9
October 11, 2022

# FAIRFIELD BOARD OF EDUCATION
# AGENDA ITEM

**For Consideration by the Board of Education at the Meeting of**: October 11, 2022

**Prepared By:** Dr. James Zavodjancik, Chief Academic Officer

**Presented By:** N/A

**Attachments:** N/A

**Subject:** Proposed Physical Education Course for 23-24 (Yoga, Mindfulness, and Personal Fitness II)

**Relation to District Improvement Plan:** N/A

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**Background:**
During the regular Fairfield Board of Education (BoE) meeting on September 29, 2022, Ms. Mayeran presented and proposed *Yoga, Mindfulness, and Personal Fitness II* as a new course for inclusion in the 23-24 high school program of studies.

**RECOMMENDATION:**
Approval of Yoga, Mindfulness, and Personal Fitness II course for inclusion in the 23-24 Fairfield Program of Studies.

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**Recommended by the Superintendent:** Steve Tracy

**Agenda Item #** 5C

Enclosure No. 10
October 11, 2022

# FAIRFIELD BOARD OF EDUCATION
# AGENDA ITEM

**For Consideration by the Board of Education at the Meeting of**: October 11, 2022

**Prepared By:** Dr. James Zavodjancik, Chief Academic Officer

**Presented By:** N/A

**Attachments:** N/A

**Subject:** Proposed Course and Curriculum Approval for Advanced Pottery and Advanced Sculpture

**Relation to District Improvement Plan:** N/A

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**Background:**
During the regular Fairfield Board of Education (BoE) meeting on September 29, 2022, Mrs. Hermsen presented and proposed *Advanced Sculpture* and *Advanced Pottery* as two new courses for inclusion in the 23-24 high school program of studies.

Approval of courses will also indicate the removal of the current course, Advanced Pottery and Sculpture, beginning in the 23-24 school year. The current Advanced Placement 3-D Art and Design (76305) course prerequisites will be amended to include Advanced Pottery or Advanced Sculpture to enroll.

**RECOMMENDATION:**
Approval of Advanced Pottery course for inclusion in the 23-24 High School Program of Studies.

Approval of Advanced Sculpture course for inclusion in the 23-24 High School Program of Studies

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**Recommended by the Superintendent:** Steve Tracy

**Agenda Item #** 5D and 5E

Enclosure No. 11
October 11, 2022

# EDUCATIONAL SPECIFICATIONS

## Fairfield Warde High School

## Fairfield Public Schools

## Fairfield, CT 06824

## Steve Tracy, Ed.D.

## Interim Superintendent of Schools

***Approved by BOE XX/XX/XXXX***

# RATIONALE FOR THE PROJECT

**BACKGROUND**:

On September 28, 2021 the Fairfield Board of Education adopted the "Capital Waterfall Schedule." The primary purpose of this schedule was to produce a spending outline for meeting the facilities needs of the school district over the next ten years. The replacement of the aged and deficient RTUs at Fairfield Warde High School Fitts House wing was a priority of the schedule.

**LONG RANGE EDUCATIONAL PLAN:**

On March 11, 2014 the Fairfield Board of Education approved the following policies which outline the long range educational plan of the district.

**MISSION** **Policy Number 0100**

The mission of the Fairfield Public Schools, in partnership with families and community, is to ensure that every student acquires the knowledge and skills needed to be a lifelong learner, responsible citizen, and successful participant in an ever changing global society through a comprehensive educational program.

**LONG-TERM GOAL** **Policy Number 0110**

Fairfield Public Schools will ensure that every student is engaged in a rigorous learning experience that recognizes and values the individual and challenges each student to achieve academic progress including expressive, personal, physical, civic, and social development. Students will be respectful, ethical, and responsible citizens with an appreciation and understanding of global issues. Student achievement and performance shall rank among the best in the state and the nation.

On June 28, 2022, the Board of Education approved a District Improvement Plan that details the specific actions to be implemented over the next five years to achieve the Mission.

**THE PROJECT**

In conjunction with the Capital Waterfall Schedule, the Board proposes a mechanical replacement project at Fairfield Warde High School Fitts House wing that includes:

- Replacement of three Fitts House rooftop units – RTU-F-1, RTU-F-2 and RTU-F-4 including the addition of structural access platforms
- Addition of a structural access platform to RTU-F-3 which was recently replaced
- Upgrade of the building's building management system as necessary to support the new equipment

## ENROLLMENT DATA

| FAIRFIELD WARDE HIGH SCHOOL | YEAR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 22-23 | 23-24 | 24-25 | 25-26 | 26-27 | 27-28 | 28-29 | 29-30 | 30-31 |
| Enrollment | 1422* | 1373 | 1294 | 1279 | 1213 | 1217 | 1215 | 1193 | 1237 |

*August 29 actual enrollment

## INTERIOR BUILDING ENVIRONMENT:

### Mechanical Systems

- Separate independent commissioning of Mechanical/Electrical/Plumbing (MEP) systems to include an air flow balancing contractor hired directly by the building committee (not the construction manager or design team) and reporting directly to the building committee and the Fairfield Public Schools Central Office
- Low voltage systems to be designed to district standards
- Proper shutoff and backflow valves located to provide easy and quick access

### Code

- Abate any hazardous material – encapsulation is not acceptable (exception: PCB impacted substrates)
- ILSM – Interim Life Safety Measures for working in an occupied building

(Also see OSCG&R Filing Requirements)

## CDAS OSCG&R FILING REQUIREMENTS (for Reimbursement):

This project shall be designed so that it can be filed with the Connecticut Department of Administrative Services – Office of School Construction Grants and Review.

## COMMUNITY USES:

Fairfield Warde High School does not contain or host space(s) for other town departments or outside firms. The building is used exclusively as a high school. The building facilities are available to the public on a reservation basis when the building is not in use (nights and weekends). Some of these uses include among others:

- Parent Teacher Association (PTA) meetings and events
- Various school clubs
- Civic group meetings

*Draft*

**Regular Meeting Minutes**
**Fairfield BoE, September 13, 2022, 7:30 PM**

**NOTICE: A full meeting recording can be obtained from Fairfield Public Schools. Please call 203-255-8371 for more information and/or see the FPS website (under Board Meeting Minutes) for a link to FAIRTV and FPS YouTube.**

# Voting Summary

## Call to order of the Regular Meeting of the Board of Education and Roll Call

Chairman Christine Vitale called the Regular meeting to order at 7:31PM. Present were members Bonnie Rotelli, Jennifer Jacobsen, Carol Guernsey, Jessica Gerber, Christine Vitale, Nick Aysseh, Jennifer Maxon-Kennelly, Jeff Peterson and Crissy Kelly. Others present were Acting Superintendent Steve Tracy, members of the central office leadership team and two members of the public.

## New Business

*Adoption of Policy 5141.21, Students: Administration of Medication in the Schools*

Mrs. Maxon-Kennelly moved/Mr. Peterson seconded the recommended motion "that the Board of Education adopt Policy 5141.21, Students: Administration of Medications in the Schools."

Motion passed 9-0.

## Approval of Minutes

Mrs. Guernsey moved/Mrs. Gerber seconded the recommended motion "that the Board of Education approve the 8-30-2022 BoE Special meeting minutes."

Motion passed 9-0.

## Adjournment

Mr. Peterson moved/Mr. Aysseh seconded the recommended motion "that this Regular Meeting of the Board of Education adjourn."

Motion passed 9-0.
Meeting adjourned at 10:30PM.

# Detailed Minutes

## Presentation: Athletic Financial Report

Mr. Parness and Ms. DiGiacomo presented the Athletic Financial Report. FPS offers 40 sports; 27 are sanctioned by the CIAC. Students are not required to pay to participate in athletic programs. Allocations and expenditures of school and district level athletic accounts were reviewed. School-based ticket revenue covers mandated police coverage with excess funds used for the needs of the athletic department. Ticket sales in 21-22 totaled $27K for each high school. Sports expenditures for each season included a breakdown of game workers, equipment, fees, reconditioning, coaches, uniforms, rental and transport. Athletic accomplishments in 2021-2022 included 69 All-FCIAC recipients at Warde and 84 All-FCIAC recipients at Ludlowe. Next steps for the athletic program include streamlining accounts for athletic expenditures, collaborating with central office to ensure facility upgrades and maintaining an extension of spending deadlines.

Mr. Parness, Ms. DiGiacomo and Ms. LeBorious responded to Board questions:

- An arbiter account is a separate account and requires bank reconciliation; the practice is to return surplus funds to the Board.
- Rugby is covered by the school for insurance purposes and field access, but is not yet supported financially. Information is being collected on needs of the sport.
- Rental rates were higher during COVID. The SHU ice rink may be an option in the near future.
- A vendor collects, launders, reconditions and inventories uniforms.
- Ticket sale monies remain in a district account and is accounted for. Ms. LeBorious will provide more detailed information on this account. Mr. Aysseh asked whether extra monies from this account could have been spent on uniforms. Mr. Peterson said he wanted to ensure the account is closed out at the end of the year.
- Due to the increase in participants, there may be a need to budget for two separate boys' hockey teams.
- The contracting company used for trainers has been having a problem finding a trainer for Warde. Currently Warde is paying per diem rates to ensure 40 hours per week coverage which is not conducive to building a relationship or having continuity. The district may want to explore hiring in-house, full-time trainers at each high school.
- In the coming year, Mr. Parness said he would like to see facility upgrades at Ludlowe including a concession stand and scoreboard completion. Ms. DiGiacomo said Warde could always use more turf fields.
- Mr. Parness said fall sports are fully staffed. It has become more challenging each year to find coaches; many are underpaid for their work and effort. Coaches aren't paid a stipend during the off season.
- Mr. Aysseh requested the Board be kept informed of all district athletic needs in order to keep all teams as top notch as possible. Parents should be made aware of ongoing discussions related to their concerns, such as the Ludlowe weight room. Ms. DiGiacomo welcomed the Board to tour Warde's facilities, similar to the recent tour at Ludlowe.

*Capital Waterfall Update*

Mr. Papageorge reported that he is working with the Town's Facilities Committee on a joint effort towards a 5-year facilities plan. The town is also working on a cash-flow chart to show overall town spending, with $12.5M allotted to Fairfield Public Schools annually for projects that require bonding. In order to accommodate priority A/C projects, the waterfall chart has shifted several projects around. The Dwight and Jennings projects are currently both scheduled in 2029 as a placeholder year.

Mrs. Vitale said the town is approaching capital planning differently this year. Instead of one meeting, there will be several working groups. The BoE will continue to discuss capital planning projects for budget purposes. Mr. Aysseh noted that the BoE was not previously given a maximum yearly bonding amount.

Mr. Papageorge responded to Board questions:

- Allowing additional A/C units at Dwight would require an additional $255K, excluding electrical upgrades of approximately $200K. Split units do not provide fresh air and cause condensation on hallway floors. Dr. Tracy said a letter was recently sent to parents about the Dwight A/C issue. Mrs. Maxon-Kennelly said the A/C expense would be much higher if other schools were also considered and included.
- Mr. Aysseh said Dwight and Jennings were not included for A/C projects as it is assumed those schools will be renovated.
- The increase in the NSS vestibule cost is due to a reevaluation of numbers and is not a change in scope.

- State reimbursement should be included for Fairfield Ludlowe and Fairfield Warde; that error will be corrected.
- The price of a project escalates whenever the timeline is pushed back.

Mrs. Vitale said the Town is expecting the Board to make some tough decisions and commit to plans for Dwight and Jennings. Mr. Peterson said decisions can't be made outside of redistricting. Mr. Aysseh agreed and said as the Facilities Chair, he wants the full Board to have a say and does not want to rehash committee work at Board meetings. Mr. Aysseh said SLAM may be able to outline the resulting implications for taking a school offline.

The Board continued discussion on the location of ECC, CPP, anticipated SPED spaces, projected residential growth, new developments, and school facility utilization rates.

Mrs. Jacobsen advocated for public access to all meetings regarding the town waterfall, and asked that previous versions of FPS waterfalls remain on the FPS website.

Mrs. Vitale requested Priority 1 and 2 projects in advance of budget discussions.

## New Business

*2021-2022 Financial Review and 4th Quarter Report*

Ms. LeBorious reported a 2021-2022 fiscal year-end balance of $540K and reviewed the adopted vs. actual budget financials for personnel services, fixed charges, pupil personnel expenses, school expenses, support expenses, maintenance/operations/transportation, and capital outlay. The $1.4M actual balance in personnel services and $1.1M actual balance in fixed charges are anomalies due to the large number of retirements, and the inability to fill vacancies. SPED had a challenging year due to the timing of excess cost reimbursement and settlement agreements. The transportation surplus was due to fewer drivers and running fewer buses. As approved in June, uniforms and IT equipment were purchased; the remaining $540K surplus was returned to the Town. Newly created real-time reports to track special education and transportation costs will be closely monitored this year.

Ms. LeBorious and Mr. Mancusi responded to Board questions:

- SPED settlement agreements are trending close to budget.
- Mr. Peterson questioned the apparent communication disconnect between Finance and Transportation, given the surplus swing from June's reported projections to actual end-of-year. Ms. LeBorious said while it is the Transportation Director's responsibility to manage contracts, she will improve the monitoring process to include real-time reporting to the Board and projection refinement.
- Some downsides to the overall budget surplus were longer bus rides and fewer paraeducators.
- Ms. Kelly questioned whether the actual surplus was closer to $1.2M, including the spend out as approved in June. Ms. LeBorious said yes and no; the spend out is a normal year-end occurrence within the appropriate categories, but it could also be termed as monies that were not available in the original budget.
- Next year's budget book will provide comparisons including actuals and budget to budget.
- Several items such as textbooks and HVAC were removed from the operating budget and paid out through a grant.
- 21-22 surplus monies have been effectively transferred to the town.

Ms. Kelly said she hopes that special education remains on budget and requested updated vacancy information in order to budget accurately for next year.

Mrs. Vitale said it may be challenging to make budget comparisons to the previous two years; the surplus from staffing shortages is not a positive and is not in the best educational interests of our students.

*Adoption of Policy 5141.21, Students: Administration of Medication in the Schools*
Mrs. Maxon-Kennelly moved, Mr. Peterson seconded that the Board of Education adopt Policy 5141.21, Students: Administration of Medications in the Schools.

Mrs. Maxon-Kennelly said an updated enclosure has been provided at the table. The policy is pertinent to one of the district's fall athletes.

**Motion Passed: 9-0**

*First Reading of 6148, Instruction: Policy to Improve Completion Rates of the Free Application for Federal Student Aid (FAFSA)*

Mrs. Maxon-Kennelly said policy is aimed at informing families about FAFSA. The final sentence is statutory language. FPS Pupil Services already provides information through college nights.

## Approval of Minutes

Mrs. Guernsey moved, Mrs. Gerber seconded that the Board of Education approve the 8-30-2022 BoE Special meeting minutes.

**Motion Passed: 9-0**

## Superintendent Report

*School Opening Review*

- Generally positive reports have been received on the first few days of school. Transportation challenges include full routes with long bus rides. Vacancies remain, and the district is filling paraeducator positions through an agency. Hot days have made schools uncomfortable; Mr. Papageorge has responded to the Dwight community regarding the split units.
- Pins marking 25-years of service have been hand-delivered to those who were not acknowledged in-person during Convocation.
- Middle school principals are reporting that the new block schedule is going very well. Warde held its first Open House in a very long time.

*Sped Outplacements*

- Mr. Mancusi said students continue to struggle with learning loss and mental health. A report on emergency placements will be provided. Ms. Kelly requested pre-pandemic historical data that would provide some context.
- The same number of SPED referrals is anticipated this year and there may be some after-hours staff support for evaluations.
- Ms. Kelly said contracting with agencies to provide paraeducators will be an additional budget expense that bears watching. Dr. Tracy said savings from open positions may be able to cover the extra expense.
- Ms. LeBorious said the district will be reimbursed for excess cost at 70%.

*Remote Learning Support*
There are 57 students home with positive Covid test results. The district is determining the support needs for students in isolation as outlined in Policy 6999.

*Racial Balance Plan*
CSDE has acknowledged receipt of the FPS Racial Balance plan. CSDE attorney Laura Anastasio requested a presentation on the redistricting plan; FPS will appear to the CT BoE to present the plan on October 12.

## Committee/Liaison Reports

*Mrs. Rotelli reported for SEPTA*: Mr. Mancusi will be at the September 28 meeting to introduce sped coordinators.

*Mrs. Gerber reported for PTAC:* The first PTAC meeting was held this morning and it was nice to have a virtual option. The next meeting is at Sherman on October 12.

*Mr. Aysseh reported for the Facilities Committee*: The committee meets next week.

*Mr. Peterson reported for the Finance Committee:* The financial impacts of closing a school and fundraising were recent topics.

*Mr. Peterson reported for the Board of Finance:* Capital maintenance projects were discussed at the most recent meeting.

## Open Board Comment

*Mr. Aysseh* said he had an awesome Open House experience and it was nice to be back in person and visiting the school. *Mrs. Vitale* thanked Dr. Tracy for being invited to the District Leadership Team meeting and for also inviting incoming Superintendent Mike Testani.

## Public Comment

*David Krasnoff, Fairfield Parent:* As a realtor and parent, requests more transparency from SLAM Collaborative. The student population is growing as older people move out of town and younger families move in.

*Katie Flynn, PTAC President*: Requests that BoE committee meetings be more accessible to the public. Requested a web page tab devoted to redistricting. Encouraged the BoE to adopt a public forum. Felt the A/C letter to the Dwight community should have been sent district-wide.

Dr. Tracy said the Dwight letter was sent to all principals and all parents should be receiving it shortly.

Mrs. Vitale said she will begin populating a redistricting tab on the website.

## Adjournment

Mr. Peterson moved, Mr. Aysseh seconded that this Regular Meeting of the Board of Education adjourn.

**Motion Passed: 9-0**
Meeting adjourned at 10:30PM.

*Respectfully submitted by,*
*Jessica Gerber*
*Fairfield Board of Education, Secretary*