Barrington School District	Haddon Heights School District	Lawnside School District	Merchantville School District

Course Name: Science
Grade: Fourth Grade
Board Approved:

*All curriculum is aligned with the NJSLS in accordance with the Department's curriculum implementation timeline and includes all required components (NJ.A.C.6A:8).
**Resource and activity lists are compiled from all four districts and may not necessarily be reflected in each district or school.

Introduction

New Jersey Student Learning Standards for Science

Michael Heinz, Coordinator

Science, engineering, and technology influence and permeate every aspect of modern life. Some knowledge of science and engineering is required to engage with the major public policy issues of today as well as to make informed everyday decisions, such as selecting among alternative medical treatments or determining how to invest public funds for water supply options. In addition, understanding science and the extraordinary insights it has produced can be meaningful and relevant on a personal level, opening new worlds to explore and offering lifelong opportunities for enriching people's lives. In these contexts, learning science is important for everyone, even those who eventually choose careers in fields other than science or engineering.

Mission: Scientifically literate individuals possess the knowledge and understanding of scientific concepts and processes required for personal decision-making, participation in civic and cultural affairs, and economic productivity.

Vision: The science standards are designed to help realize a vision for education in the sciences and engineering in which students, over multiple years of school, actively engage in scientific and engineering practices and apply crosscutting concepts to deepen their understanding of the core ideas in these fields. The learning experiences provided for students should engage them with fundamental questions about the world and with how scientists have investigated and found answers to those questions. Throughout grades K-12, students should have the opportunity to carry out scientific investigations and engineering design projects related to the disciplinary core ideas (pp. 8-9, NRC, 2012).

<table>
<tr><td colspan="3">STANDARD:
4-PS3 - Energy
3-5 ETS1 - Engineering Design</td></tr>
<tr><td colspan="3">Unit 7: Using Engineering Design with Force and Motion Systems</td></tr>
<tr><td>ESTABLISHED GOALS (INDICATOR #)</td><td colspan="2">TRANSFER (How will this apply to their lives?)</td></tr>
<tr><td rowspan="3">4-PS3-4 - Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

3-5-ETS1-1 - Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2 - Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3-5-ETS1-3 - Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.</td><td colspan="2">Students will be able to independently use their knowledge to…
● Demonstrate how energy can be converted from one form to another using the design process.</td></tr>
<tr><td colspan="2">MEANING</td></tr>
<tr><td>UNDERSTANDINGS:

● Science affects everyday life.
● Most scientists and engineers work in teams.
● Engineers improve existing technologies or develop new ones.
● People’s needs and wants change over time, as do their demands for new and improved technologies.
● Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.
● Energy can be transferred in various ways and between objects.
● Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy.
● The expression “produce energy” typically refers to the conversion of stored energy into a desired form for practical use.
● Possible solutions to a problem are limited by available materials and resources (constraints).</td><td>ESSENTIAL QUESTIONS:

● How can scientific ideas be applied to design, test, and refine a device that converts energy from one form to another?</td></tr>
</table>

	- The success of a designed solution is determined by considering the desired features of a solution (criteria). - Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. - Research on a problem should be carried out before beginning to design a solution. - Testing a solution involves investigating how well it performs under a range of likely conditions. - At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. - Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. - Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.	

Unit 7: Grade 4 - Lessons

Note: In the prior unit of study, students observed objects in motion in order to understand the relationship between the speed of an object and its energy, and they investigated the transfer of energy from one object to another, as well as from one form to another. In this unit, students will apply scientific ideas about force, motion, and energy in order to design, test, and refine a device that converts energy from one form to another. Through this process, students will learn that science affects everyday life and that engineers often work in teams, using scientific ideas, in order to meet people's needs for new or improved technologies. To begin the engineering design process, students must be presented with the problem of designing a device that converts energy from one form to another. This process should include the following steps:

As a class, students should create a list of all the concepts that they have learned about force, motion, and energy.

- The faster a given object is moving, the more energy it possesses.
- Energy is present whenever there are moving objects, sound, light, or heat.
- Energy can be transferred in various ways and between objects.
- Energy can be moved from place to place by moving objects or through sound, light, or electric currents.
- When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically

- also transferred to the surrounding air; as a result, the air gets heated and sound is produced.
- When objects collide, the contact forces transfer energy so as to change the objects' motions.

Have students brainstorm examples of simple devices that convert energy from one form to another. As students give examples, the teacher should have one or two and have students describe how each device converts energy from one form to another. Next, the teacher can present a "Design Challenge" to students: Design and build a simple device that converts energy from one form to another. Please note that teachers should limit the devices to those that convert motion energy to electric energy or that use stored energy to cause motion or produce light or sound. Small groups of students should conduct research, using several sources of information, to build understanding of "stored energy." Students can look for examples of objects that have stored energy. Stretched rubber bands, compressed springs, wound or twisted rubber bands, batteries, wind-up toys, and objects at the top of a ramp or held at a height above the ground all have stored energy. As a class, determine criteria and possible constraints on the design solutions. For example, the devices are only required to perform a single energy conversion (i.e., transfer energy from one form to another), and devices must transfer stored energy to motion, light, or sound. Constraints could include the use of materials readily available in the classroom or provided by the teacher. (An assortment of materials can be provided, including batteries, wires, bulbs,buzzers, springs, string, tape, cardboard, balls, rubber tubing, suction cups, rubber bands of various sizes, construction paper, craft sticks, wooden dowels or skewers, buttons, spools, glue, brads, paper clips, plastic cups, paper plates, plastic spoons, straws, Styrofoam, and cloth.) A time constraint could also be set, if desired. All criteria and constraints should be posted on chart paper so that groups can refer to them as needed.

Students should work in small, collaborative groups to design and build their devices. Examples of possible devices could include:

- A simple rubber band car that converts the stored energy in a twisted rubber band into motion energy.
- A simple roller coaster that converts the stored energy in a marble held at the top of the roller coaster into motion energy.
- A whirly bird that converts stored energy (in a student's muscles) into motion energy.
- A ball launcher that converts stored energy in a compressed spring, compressed suction cup, or stretched rubber band into motion energy when the ball is launched.

Students should create a poster that includes a diagram of the device and a description of how the device transfers energy from one form to another. Every group should have the opportunity to present their device and explain how it works. As a class, students compare each of the design solutions based on how well they meet the criteria and constraints, giving evidence to support their thinking. When giving feedback to the groups, students should identify which criteria were/were not met, and how the design might be improved. Small groups should then have the opportunity to refine their designs based on the feedback from the class. At every stage, communicating with peers is an important part of the design process, because shared ideas can lead to improved designs. It is also important that students describe the ways in which energy is transferred between objects and from one form to another.

Suggested Lessons:

Lesson 1: Introduction to the Engineering Design Process

Lesson 2: Discuss the evolution of a flashlight (examples: portable lights, torches, candles, etc.)

Lesson 3: Discuss and Identify Problem Based Learning (Using Slides 1-6)

Lesson 4: What's My Game? Problem Based Learning Practice (Formative Assessment)

Lesson 5: Real World Problems- Climate Change (Formative Assessment)

Lesson 6: The Boy Who Harnessed the Wind

"The Boy Who Harnessed the Wind" Resource for Lesson 6 (Optional Performance Task)

Lesson 7: STEAM Tank Prototypes (Performance Task)

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting concepts
Constructing Explanations and Designing Solutions • Apply scientific ideas to solve design problems. (4-PS3-4) • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. (3-5-ETS1-2) Asking Questions and Defining Problems • Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. (3-5-ETS1-1) Planning and Carrying Out Investigations • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3-5-ETS1-3)	PS3.B: Conservation of Energy and Energy Transfer • Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. (4-PS3-4) PS3.C: Relationship Between Energy and Forces • When objects collide, the contact forces transfer energy so as to change the object's' motions. (4-PS3-3) PS3.D: Energy in Chemical Processes and Everyday Life • The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use. (4-PS3-4) ETS1.A: Defining and Delimiting Engineering Problems • Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-5-ETS1-1) ETS1.B: Developing Possible Solutions • Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it	Energy and Matter • Energy can be transferred in various ways and between objects. (4-PS3-4) - Connections to Engineering, Technology, and Applications of Science Influence of Engineering, Technology, and Science on Society and the Natural World • Engineers improve existing technologies or develop new ones. (4-PS3-4) - Connections to Nature of Science Science is a Human Endeavor • Most scientists and engineers work in teams. (4-PS3-4) • Science affects everyday life. (4-PS3-4) Influence of Science, Engineering, and Technology on Society and the Natural World • People's needs and wants change over time, as do their demands for new and improved technologies. (3-5-ETS1-1) • Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (3-5-ETS1-2)

	performs under a range of likely conditions. (3-5-ETS1-2) • At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-5-ETS1-2) • Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5- ETS1-3) ETS1.C: Optimizing the Design Solution • Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5-ETS1-3)	

District/School Formative Assessment Plan	District/School Summative Assessment Plan
Students who understand the concepts are able to: Describe the various ways that energy can be transferred between objects. • Apply scientific ideas to solve design problems. • Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. (Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.) • Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound or passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device. • Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. • Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. • Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. • Plan and conduct an investigation collaboratively to produce data to serve as the basis for	*Summative assessment is an opportunity for students to demonstrate mastery of the skills taught during a particular unit.*

evidence, using fair tests in which variables are controlled and the number of trials considered. • Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved. Lesson 4: What's My Game? Problem Based Learning Practice (Formative Assessment) Lesson 5: Real World Problems- Climate Change (Formative Assessment)	

Alternative Assessments	
Evaluative Criteria	**Assessment Evidence**
Suggested Performance Rubric: Use the following or similar rubric to evaluate students' performance on lesson assessments:	Suggested Performance Tasks include but are not limited to: Wind Turbine Prototype from Lesson 6 STEAM Tank Prototypes: Lesson 7: STEAM Tank Prototypes

4 - Innovating:	Advanced understanding and application of the standard
3 - Applying:	Consistently applies skills independently
2 - Developing:	Progressing towards independent application of skills
1 - Beginning:	Early stages of development, need assistance

District/School Texts	District/School Supplementary Resources
Haddon Heights - Unit Kits for Science Labs and References Lawnside - Houghton Mifflin Harcourt : Science Fusion Merchantville- Exploring Science (National Geographic Learning)	**-Scholastic News** **-Brain POP** **-NewsELA** **-Read Works**

Interdisciplinary Connections		
ELA ● Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-PS3-4) W.4.7 ● Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-PS3-4) W.4.8 ● Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (3-5-ETS1-2) RI.5.1 ● Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (3-5-ETS1-2) RI.5.1 ● Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (3-5-ETS1-2) RI.5.9 ● Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (3-5-ETS1-1),(3-5-ETS1-3) W.5.7 ● Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (3-5-ETS1-1),(3-5-ETS1-3) W.5.8 ● Draw evidence from literary or informational texts to support analysis,	**Math** Solve multistep word problems posed with whole numbers and having whole number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. ● Assess the reasonableness of answers using mental computation and estimation strategies including rounding. (4-PS3-4) 4.OA.A.3 ● Mathematics - Operations and Algebraic Thinking (3-ETS1-1),(3-ETS1-2) 3. ● OA Reason abstractly and quantitatively. (3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3) MP.2 ● Model with mathematics. (3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3) MP.4 ● Use appropriate tools strategically. (3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3) MP.5 ● Operations and Algebraic Thinking (3-ETS1-1),(3-ETS1-2) 3-5.OA	**21st Century Skills/Career Education** CRP2. Apply appropriate academic and technical skills. CRP4. Communicate clearly and effectively and with reason CRP11. Use technology to enhance productivity.

reflection, and research. (3-5-ETS1-1),(3-5-ETS1-3) W.5.9		
Technology 8.2.5.C.2 Explain how specifications and limitations can be used to direct a product's development. 8.2.5.C.4 Collaborate and brainstorm with peers to solve a problem evaluating all solutions to provide the best results with supporting sketches or models.		
Modifications and Accommodations		
Special Education Students Small group Direct instruction restate/rephrase graphic organizers modified assignments chunking leveled text intentional grouping read text extended time breaks Teacher records/ student dictates	**English Language Learners** Labels word banks visuals student friendly definitions extended time chunking intentional grouping	**Students at Risk of School Failure** leveled text graphic organizers modified assignments kinesthetic activities restate/rephrase chunking intentional grouping
Gifted and Talented extension project leveled text leadership roles intentional grouping Targeted learning from assessment	**Students with 504 Plans** breaks chunking preferential seating visual reminders restate/rephrase check-in/check-out system visual time Teacher records/ student dictates	
Unit Duration:		
15 days		