Phoenixville Area School District Understanding by Design (UbD) Science Template

Grade Level 4 **Unit Name: Energy** **Authors: L. Freeman (PAMS)**

Stage 1 Desired Results

Overarching NGSS & PA Standards:

3.2.4.A
Use evidence to construct an explanation relating the speed of an object to the energy of that object.

3.2.4.B
Make and communicate observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

3.2.4.C
Ask questions and predict outcomes about the changes in energy that

Transfer

Students will be able to independently use their learning to…

1. Ask questions and/or define problems
2. Develop and/or use models
3. Plan and/or carry out investigations
4. Analyze and interpret data using computational thinking
5. Obtain, evaluate, and communicate information (supported by evidence)
6. Construct explanations and design solutions

Meaning-Making

Students will understand that…

- Energy is evident whenever there is motion, electric current, sound, light, or heat
- Energy can transfer from place to place.
- Magnets interact with each other and with some other materials
- The magnetic force acting between magnets declines as the distance between them increases
- Earth has a magnetic field
- Waves are a repeating pattern of motion that transfer energy from place to place

ESSENTIAL QUESTIONS
Students will keep considering...

- How does energy transfer in a complete circuit?
- What affects magnetic force?
- What causes electromagnetism?
- How can we use electromagnetism to transfer energy?
- How does energy transfer between objects or systems?
- What do waves have to do with energy?

Knowledge and Skills Acquisition

occur when objects collide.

3.2.4.D Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

3.2.4.D Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.

3.2.4.E Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.

3.2.4.F Develop a model to

UNDERSTANDINGS

Students will know…

- An electric circuit is a system that includes a complete pathway through which electric current flows from an energy source to its components
- Conductors are materials through which electric current can flow; all metals are conductors
- Magnets are surrounded by an invisible magnetic field, which acts through space and through most materials
- All magnets have two poles, a north pole at one end (side) and a south pole at the other end (side). Like poles of magnets repel each other, and opposite poles attract
- When an iron object enters a magnetic field, the field induces magnetism in the iron object, and the object becomes a temporary magnet
- The magnetic field produced by a current-carrying wire can induce magnetism in a piece of iron or steel
- An electromagnet is made by sending electric current through an insulated wire wrapped around an iron core (more current = stronger magnetism).
- When objects collide, energy can transfer from one object to another, thereby changing their motion
- The faster a given object is moving, the more kinetic energy it has.
- There are sound waves, light waves, radio waves, microwaves, and ocean waves.
- Light travels in straight lines and can reflect (bounce) off surfaces.
- Matter can absorb light
- An object is seen only when light from that object enters and is detected by an eye
- White light is a mixture of all colors (wavelengths) of visible light
- Solar cells are designed technologies to transfer visible light into electricity

KEY VOCABULARY

Energy Amplitude Reflect Transmit Vibrate Visible	Conductor Magnet Magnetic Field Electromagnetic Wavelength Waves

Students will be skilled at…

- Formulating and justifying predictions, based on observations of electricity transferring energy to produce light and motion
- Exploring the variables that influence the strength of the magnetism produced by electromagnets
- Determining the strength of the force of attraction between two magnets and other objects
- Differentiating between potential and kinetic energy
- Exploring variables of mass and release-position to find out how these variables affect energy transfer
- Identifying the properties of waves (amplitude, wave length, and frequency)
- Developing a conceptual model about how light travels and explaining this model
- Designing series and parallel solar cell circuits and observe the effect on the speed of a motor

describe that light reflecting from objects and entering the eye allows objects to be seen. **3.2.4.G** Generate and compare multiple solutions that use patterns to transfer information **3.3.4.D** Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. **Which branch(es) of science apply:** PS, E&SS		• Differentiating between cells in a series and cells in parallel circuit • Determining humans impact the environment by using natural resources to produce energy
Stage 2 – Evidence		
Evaluative Criteria	***Assessment Evidence***	
	PERFORMANCE TASK(S): Investigations:	Differentiation Considerations:

What criteria will be used in each assessment to evaluate attainment of the desired results? Rubrics related to each will be developed.	I. **Task(s):** Students investigate the phenomenon of electric current in circuits, the pathways through which electricity flows. They work with a variety of components—D-cells, lightbulbs, motors, switches, and wires—and explore conductors and insulators. They explore series and parallel circuits and compare the functioning of the components in each circuit. They formulate and justify their predictions, based on their observations of electricity transferring energy to produce light and motion. **Assessment**: Investigation 1 I-Check II. **Task(s):** Students investigate the phenomenon of magnets and their interactions with materials and each other. Students go outdoors to find objects in the environment that are attracted to magnets. They conduct an investigation to determine if like or opposite poles of a magnet attract. They construct a simple compass and use it to detect magnetic effects. They also discover that magnetism can be induced in a piece of iron. They investigate the strength of the force of attraction between two magnets by graphing data to look for patterns of interaction. The first two investigations provide the foundation for students to develop an understanding of electromagnetism in the next investigation. **Assessment**: Investigation 2 I-Check III. **Task(s):** Students investigate the phenomenon of electromagnetism. Students learn how to use electricity to make an electromagnet. They explore the variables that influence the strength of the magnetism produced by their electromagnets. Students use all the concepts they have learned to engineer a simple telegraph system and communicate using a click code. **Assessment**: Investigation 3 I-Check IV. **Task(s):** Students observe the phenomenon of energy transfer that results in heat, light, sound, and motion. Students are introduced to sources of energy and components that store energy (potential energy of position or condition). They conduct structured investigations with steel balls and ramps to discover how the variable of starting position on the ramp affects the speed of the rolling ball. Using controlled experiments involving the transfer of potential energy into kinetic energy, students test the variables of mass and release position to find out how these variables affect energy transfer. **Assessment**: Investigation 4 I-Check V. **Task(s):** Students experience the phenomenon of waves through firsthand experiences using ropes, demonstrations with waves in water, spring toys, and a sound generator. They also use videos, animations, and readings to gather information. Through these experiences, students learn that waves are repeating patterns of motion that transfer energy from place to place. They analyze compression waves (sound waves) to learn the general properties of waves—amplitude, wavelength, and frequency.	For labs, some students may wish to: • Explain verbally instead of in a written format • Draw their responses • Write in their first language If challenges arise with the complexity of the task(s), some students may need: • Additional incremental steps • An alternative activity Other considerations: • When grouping students' various skills sets and strengths will be considered • When asking students to describe a model, opportunities to draw or write it, as well. • Teacher can scribe written responses for students

	Students use mirrors to experience reflecting light. They start by using mirrors outdoors to see objects behind them and to reflect a bright image of the Sun onto walls. In the classroom, they determine that a mirror can be used to reflect light. Students then use flashlights, mirrors, and water to observe light in numerous ways, reinforcing the idea that light can reflect and refract. Students build a conceptual model about how light travels. Students use light wave energy to design series and parallel solar cell circuits and observe the effect on the speed of a motor. They observe that cells in series make the motor run faster, but cells in parallel do not deliver additional power to the motor. They read about alternative energy sources. **Assessment**: Investigation 5 I-Check	
What criteria will be used in each assessment to evaluate attainment of the desired results? Rubrics related to each will be developed.	OTHER EVIDENCE: • Checklists of collaborative behaviors in labs and activities • Checklists of collaborative behaviors in class discussions • Daily journal entries • Self-Assessment Rubrics for all performance tasks • Science Notebook • TO CONSIDER FOR LATER: UNIT TEST(S)	Differentiation Considerations: For journal entries, consider that some students may wish to: • draw instead of write entries • write in their first language • record verbally instead of in a written format annotated notes/slides