Subject: Conceptual Physics Grade: 8th Unit #: 1 Title: Energy of Matter

UNIT OVERVIEW

<table>
<tr><th colspan="3">STAGE ONE: Identify Desired Results</th></tr>
<tr><td rowspan="6">Established Goals/ Standards

Standards found within P.I. 3.1 “Properties of materials” from the NYS Intermediate Level Science Standards

Standards found within 3.2 and 3.3 “Chemical & Physical changes” from the NYS Intermediate Level Science Standards</td><td colspan="2">Long-Term Transfer Goal</td></tr>
<tr><td colspan="2">At the end of this unit, scholars will use what they have learned to independently…
The year long big-idea for this conceptual physics course is building an understanding of “what is energy?”. This unit will serve as the foundation for this big idea by allowing students to examine the overarching essential question “What is matter and how does energy transform matter? Do these transformations happen in space?”. This unit serves to introduce students to the idea of energy by connecting it to the matter that makes up their physical environment (the foundation understanding of the “physical world”). Explain the properties and characteristics of the physical world around them.

Students will be able to create evidence arguments explaining how matter can be transformed by matter.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>Enduring Understandings
Students will understand that…

All things are made out of particles which have energy. This is called matter.

Matter can be transformed by energy. This is often reflected in differences in density.

Properties of a material are determined by the energy of its particles.

Models can be used to explain explain changes in states of matter.

Elements/matter can be organized based on similar properties and this organizational scheme is the Periodic Table.

Engineering practices help solve problems and to every engineering solution has its pros and cons that need to be considered before taking action.</td><td>Essential Questions
Students will consider such questions as…
● Matter, what is it good for?
● How are matter and energy different
● What makes up all this stuff?
● What is energy?
● What are our initial ideas about energy and how is matter transformed by energy?
● How does energy change stuff?
● Why are there so many different kinds of matter and how are they organized?
● Why does my door jam in the summer? What type of matter would make the perfect door at any “energy level”?</td></tr>
<tr><td colspan="2">Acquisition</td></tr>
<tr><td>What knowledge will students learn as part of this unit?
● Substances have characteristic properties. Some of these properties include color, odor, phase at room temperature, density,</td><td>What skills will students learn as part of this unit?
● Measure the mass of an object.</td></tr>
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	solubility, heat and electrical conductivity, hardness, and boiling and freezing points. ● The motion of particles helps to explain the phases (states) of matter as well as changes from one phase to another. The phase in which matter exists depends on the attractive forces among its particles. ● Temperature is a direct measurement of the average kinetic energy of the particles in a sample of material. It should be noted that temperature is not a measurement of heat. ● Gases have neither a determined shape nor a definite volume. Gases assume the shape and volume of a closed container. ● A liquid has a definite volume, but takes the shape of a container. ● A solid has a definite shape and volume. Particles resist a change in position. ● Density can be described as the amount of matter that is in a given amount of space. If two objects have equal volume, but one has more mass, the one with more mass is denser. ● During a physical change a substance keeps its chemical composition and properties. Examples of physical changes include freezing, melting, condensation, boiling, evaporation, tearing, and crushing. ● All matter is made up of atoms. Atoms are far too small to see with a light microscope. ● Atoms and molecules are perpetually in motion. The greater the temperature, the greater the motion. ● Atoms may join together in well-defined molecules or may be arranged in regular geometric patterns. ● Interactions among atoms and/or molecules result in chemical reactions. ● The atoms of any one element are different from the atoms of other elements. ● There are more than 100 elements. Elements combine in a multitude of ways to produce compounds that account for all living and nonliving substances. Few elements are found in their pure form. ● The periodic table is one useful model for classifying elements. The periodic table can be used to predict properties of elements (metals, nonmetals, noble gases).	● Measure the volume of regularly shaped objects using a ruler and V = WxLxH ● Measure the volume of an irregularly shaped objects using the water displacement method. ● Read volume measurements using a graduated cylinder. ● Use particle diagrams to describe the differences between liquids, solids, and gases. ● Identify materials based on physical and chemical properties. ● Identify like/unlike material properties based on periodic table. ● Classify materials based on properties. ● Craft small and large scale evidence based science explanations based on the attached rubric. ● Design engineering solution to the door problem. ● Comparing and contrasting the pros and cons of engineering solutions.

STAGE TWO: Determine Acceptable Evidence	
	Assessment Evidence

Criteria to assess understanding: *(This is used to build the scoring tool.)* -Definition of matter & the states of matter -Explanation of how matter is organized on P.T. -Create particle diagram for each state of matter. -Definition of density. -Properties of metals, nonmetals, and gases. -Distinguish between elements, compounds, and molecules. For a specific compound/element: -Identify family/group of element(s). -Describe following properties: Density, color, luster, boiling/freezing points, insulation, conduction, state at room temp, malleability, expansion/contraction, atomic number & mass, properties unique to material. -Create atomic model including protons, neutrons, & electrons in appropriate locations with appropriate charges. -Calculate mass based on density and volume. -Calculate cost. Makes claim citing	**Performance Task focused on Transfer:** The curriculum embedded task for this unit has students construct large-evidence based explanations (Thompson et al., 2009) based on their answer to the question "Why won't my door just stay shut?! What is matter and how is it transformed by energy?" This large scale explanation will serve as an engineering proposal (combining both engineering and science practices and content) for a door most resistant to changes in energy. Students will receive different material and weigh both the engineering and scientific pros and cons of the material for making the ideal door that won't "get stuck" in the summer. Following these proposals students will pick one material that they determine to be "best" from the class (in terms of both engineering and science) and design a proposal to send the material to the International Space Station to allow NASA astronauts to perform student designed experiments on the material to see if it behaves the same when in the presences of varying energy in zero gravity. **Other Assessment Evidence:** Unit ILST style quiz Daily Bridge Daily Summary/Closure Questions Daily Extended learning Activities Investigations & writeups Teacher observations

appropriate evidence with key vocabulary. -include pros and cons of both unseen and seen properties of both materials.	

T, M, A *(Code for Transfer, Meaning Making and Acquisition)*	**STAGE THREE: Plan Learning Experiences**
A: Acquisition M: Meaning Making T: Transfer	Daily Evidence of learning: *(formative assessment)* Summary + Closure at end of each lesson utilizing the “Workshop Model”. Investigation reports if applicable.
1. A, M 2. A, M 3. A, M 4. A,M 5. A,M 6. T 7. A,M 8. A,M 9. M 10. A, M 11. A,M,T 12. A,M 13. A, M 14. A,M 15. T 16. T 17. T 18. T 19. T 20. T	Learning Events: 1. Day 1: Project introduction a. Matter, what is it good for? (absolutely everything) b. Classify matter vs. nonmatter given a list of terms. 2. Day 2 & 3: What makes up all this stuff? (**definition of matter: volume, mass and density**) a. Matter has mass and takes up space i. Review of mass, volume, and density. Work in small groups describing how one object is physically different from another object (it’s bigger, heavier, etc) in scientific terms w/ scientific tools (TBB, ruler). ii. Particle diagram + atom overview. What is this “stuff” that some things have more of than others. Atom Brainpop, practice drawing particle diagrams for different classroom/household objects. 3. Day 4, 5, 6, 7 What are our initial ideas about energy and how is matter transformed by energy? (**matter and energy**) a. Day 4: Acquisition/Meaning Making: Matter has energy i. What is energy? Where do we see it in matter? ii. Stations with different examples of energy (spring, ramp, monster energy drink, light bulb, hot plate, exothermic reaction). Students identify where they see energy in station, construct own definition of energy based on experiences at stations. b. Day 5: Acquisition/Meaning Making: Heat energy:How does heat affect the properties of matter? **(Particle diagrams hot v. cold)** i. Ball and ring demo. (Why does ball not fit through ring until ring is heated) and other experiences of heating/cooling matter causing it to expand/contract with particle diagrams. c. Day 6: Transfer: Heat energy cont. i. Creating an explanation of the ball and ring demo. d. Day 7: Acquisition / Meaning Making: States/Phases of matter: What causes matter to change states? (**Particle diagrams solid v. gas v. liquid)** i. Foldable notes with Motion/energy of particles, particle diagrams, state change vocab (condensation, boiling point, etc)

	ii. Phase change investigation (add heat to substance, see what happens to phase and properties). Find a liquid that expands when heated (alternate option: creating a thermometer). 4. Day 8 and 9: Everything is made of atoms, what are atoms made of? (**Structure of the atom**) a. Day 8: Acquisition / Meaning Making: PHET simulation model of the atom (protons, etc. & location) i. Atomic # -> different elements b. Day 9: Meaning Making: Dif configurations give dif properties 5. Day 10-12: Organizing matter: how do i quickly tell the (general) properties of some matter? How can I apply my knowledge of one type of matter's properties to another? **(Periodic Table trends and properties of different types of matter: metals, non-metals, gasses).** a. Day 10: Acquisition / Meaning Making: Periodic table of "cupcakes" investigation. Students create classification system for cupcakes based on properties (frosting, sprinkles, etc) b. Day 11: Acquisition / Meaning Making / Transfer: Periodic table of elements notes i. Groups + families ii. metals/nonmetals/gases c. Day 12: Acquisition / Meaning Making: Investigation observing and categorizing general properties of metals/nonmetals/gases 1. color/luster 2. boiling/freezing 3. State at room temp 4. Malleability 5. Thermal expand/contract 6. Electric + thermal conductivity 6. Day 13-14: Complexity of matter: combining atoms changes matter's properties. What happens when atoms synergize? **(elements vs compounds and how properties change)** a. Day 13: Chemical energy to bind atoms (exothermic & endothermic demos: why is does it get hot/cold?) b. Day 14: Molecules & compounds investigation i. Why are two versions of same element different? Graphite vs. diamond: same element, different properties ii. More changed properties (comparing/contrasting tin/copper vs. bronze, iron/carbon vs. steel, oxygen/hydrogen vs. water) 7. Day 15-19: Transfer: Answering Overarching Essential Question (Door and performance assessment on the impact of energy on matter.) **(calculate cost, pros/cons, and other engineering practices)**. a. Create overview of matter poster in pair b. Given two materials per pair

	c. Research properties (1 person each) d. Create material poster (1 per person) e. Unite for claim poster f. Presentation g. Reflection on science & engineering practices 8. Day 20: Transfer: Extension to space: Applying the findings of the door performance assessment to space and writing a protocol to see if our findings would be similar in "zero gravity".