	ARTS IN MOTION CHARTER SCHOOL| 10th Grade Physics CURRICULUM MAP				
Projects	**Essential Questions**	**Enduring Understandings**	**Cognitive Skills**	**CCSS**	**Final Product**
Energy Models	• What is the nature of sound? • How are Evidence and Analysis used to Support a Claim?	• Sound is the result of the transmission of waves.	• Identifying Patterns and Relationships • Modeling • Norms / Active Listening • Theme/Central Idea	• NGSS.HS-PS4-1 • NGSS.HS-PS4-2 • NGSS.HS-PS4-3 NGSS.HS-PS4-4 • NGSS.HS-PS4-5	• Group Work Norms • Performance Task
EM Wave Applications Research Video	• How can you interpret information and use it to form a strong thesis? • How can you communicate and justify your thesis to others in a comprehensive way? • How can multimedia tools be used to make an engaging presentation?	• Using research to become informed on a topic is an essential skill that extends far beyond the classroom. • It is also essential to be able to interpret and present this research to effectively communicate a point of view to others.	• Informational/Explanatory Thesis • Multimedia in Oral Presentation • Narrative • Norms / Active Listening • Precision • Selecting Relevant Sources • Style and Language (Tone, Academic Language, Syntax) • Synthesizing Multiple Sources	• NGSS.HS-PS3-1 • NGSS.HS-PS3-2 • NGSS.HS-PS3-3 • NGSS.HS-PS3-4 • NGSS.HS-PS3-5 • NGSS.HS-PS4-1 • NGSS.HS-PS4-2 • NGSS.HS-PS4-3 • NGSS.HS-PS4-4 • NGSS.HS-PS4-5	• Performance Task
Electric House	• What is electricity, how does it work, and how do we measure it? • What materials, knowledge and skills are required to properly and efficiently wire a house?	• Designing, modeling and evaluating a house wired for electricity develops a student's understanding of real world applications of electrical properties such as voltage, current, and resistance.	• Comparing/ Contrasting • Designing Processes and Procedures • Hypothesizing • Identifying Patterns and Relationships • Justifying / Constructing an Explanation • Modeling • Precision	• NGSS.HS-PS3-1 • NGSS.HS-PS3-2 • NGSS.HS-PS3-3 • NGSS.HS-PS3-4 • NGSS.HS-PS3-5	• Circuit Lab Findings and Conclusions • Building Proposal • House Construction • Final Evaluation
Design your own Physics Experiment	• How does an explanation/understanding become scientifically valid? • How can you add to the body of scientific research?	• Scientists follow a specific, uniform method to understand the natural world. All processes must be clear, precise, and able to be replicated by other scientists. • Peer review is used to analyze the validity of research and scientific claims. This scientific process allows us to identify dependable patterns and make accurate predictions in a changing world.	• Asking questions • Conventions • Critiquing the Reasoning of Others • Designing Processes and Procedures • Explanation of Evidence • Hypothesizing • Identifying Patterns and Relationships • Interpreting Data/Info • Introduction and	• NGSS.HS-PS2-1 • NGSS.HS-PS2-2 • NGSS.HS-PS2-3 • NGSS.HS-PS2-4 • NGSS.HS-PS2-5 • NGSS.HS-PS2-6 • NGSS.HS-PS3-1 • NGSS.HS-PS3-2 • NGSS.HS-PS3-3 • NGSS.HS-PS3-4	• Performance Tasks

			Conclusion		
Safety First	• How does safety equipment (helmets, seat belts, padding) keep you safe? • How does the engineering design cycle work to produce the best product for consumers?	• Students will understand the role of force in collisions and explore how changing variables can increase or reduce force. • Students will understand the process of engineering and design and develop tools to prioritize design decisions. • Students will experience the connection between research science and engineering and understand the cyclical nature of the engineering process.	• Designing Processes and Procedures • Hypothesizing • Justifying / Constructing an Explanation • Modeling • Multimedia in Oral Presentation • Norms / Active Listening • Oral Presentation • Style and Language (Tone, Academic Language, Syntax) • Theme/Central Idea	• NGSS.HS-ETS1-1 • NGSS.HS-ETS1-2 • NGSS.HS-ETS1-3 • NGSS.HS-ETS1-4 • NGSS.HS-PS2-1 • NGSS.HS-PS2-2 • NGSS.HS-PS2-3 • NGSS.HS-PS2-4 • NGSS.HS-PS2-5 • NGSS.HS-PS2-6	• Performance Task

Project	Energy Models
Suggested Time	● 6 Weeks
Essential Questions	● What is the nature of sound? ● How are Evidence and Analysis used to Support a Claim?
Enduring Understandings	● Sound is the result of the transmission of waves.
Cognitive Skills	● Identifying Patterns and Relationships ● Modeling ● Norms / Active Listening ● Theme/Central Idea
Focus Areas	● Water Basics
CCSS	● NGSS.HS-PS4-1 ● NGSS.HS-PS4-2 ● NGSS.HS-PS4-3 NGSS.HS-PS4-4 ● NGSS.HS-PS4-5
Checkpoints	● Skate Park Physics: Energy Summary ● Energy Experiments ● Energy Models
Final Product	● Group Work Norms ● Performance Task (See attached Sample)

ARTS IN MOTION CHARTER SCHOOL| 10th Grade Physics LESSON PLAN					
Project	Energy Models	**Essential Questions**	● What is the nature of sound? ● How are Evidence and Analysis used to Support a Claim?	**Final Product**	● Group Work Norms ● Performance Task

Checkpoint	● Skate Park Physics: Energy Summary
Cognitive Skills	● Theme/Central Idea
Objective	● In this checkpoint, you will summarize what you learned about energy from the Energy Skate Park. A deep understanding about energy will enable you to make sense of the other checkpoints in this project. This is also your opportunity to get feedback on the cog skill "Theme/Central Idea" before you are graded on it in the final project.
Activities	● Energy Skate Park CER (See attached Sample) ● Energy Skate Park CER Scaffolded
Resources	● Skills Description: Norms/Active Listening (See attached Sample) ● Law of Conservation Slide Show ● Energy Summary Scaffolded
Assessment	● Performance task assessment using cognitive skills (See attached Sample)

Norms/Active Listening

Norms/Active Listening

Each day of the project, you will be assessed on Norms/Active Listening. The purpose of this skill is to practice productive group norms so that we can create an inclusive classroom culture that takes advantage of every minute of class time.

You will get scored each day on this skill and your final score for the project will be the average of those scores.

Norms/Active Listening

3	4	5	6
Generally adheres to established norms for collegial discussions. Follows specific goals & deadlines. Enacts individual roles with help as needed.	Mostly adheres to established norms for collegial discussions. Tracks progress toward specific goals & deadlines. Enacts individual roles independently.	Adheres to teacher-enforced collegial discussion norms. Facilitates progress toward specific goals & deadlines. Attempts to establish individual roles within the group as needed.	Adheres to teacher- and group-enforced collegial discussion norms. Effectively facilitates progress toward specific goals & deadlines. Establishes appropriate individual roles within the group as needed.

Level 5 +/-

Lose Points	5	Gain Points
• Inappropriate use of technology • Interrupting a presentation • Not engaging fully in presentations or group work • Misses group or individual deadlines • Negatively contributes to the classroom environment	**Adheres to teacher-enforced collegial norms** **Facilitates progress toward specific goals & deadlines**	• Assists group members in setting and meeting deadlines • Includes/engages all group members in group work • Positively contributes to the classroom environment

Roles

Facilitator - This person is responsible for making sure that everyone knows what they should be doing and is participating in the activity and discussion.

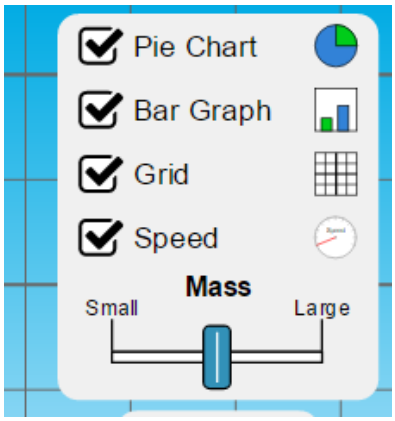
Recorder - This person is responsible for taking notes of the group's discussion in their own PLP document for each step and making sure that everyone else in the group has been shared on these documents.

Liaison- This person is able to ask the teacher questions during work time.

Materials Manager - This person is responsible for collecting needed materials and putting used materials away at the end of class.

Energy Skate Park

Open the Simulation at http://tinyurl.com/EnergySimSkating



Intro

Setup:

- Make sure all the checkboxes are marked every time you load the simulation

Writing Help:

- CLAIM: Answer the question (turn the question into a sentence)
- EVIDENCE: Describe a specific observation ("For example…" "We observed that…"
- ANALYSIS: Explain how that observation proves your claim "This shows that (restate claim) because…"

Questions:

1. How does speed affect the skater's **kinetic energy (KE)**?
   Here are some experiments that may help you figure this out:
   - *Determine at what speed the kinetic energy is 0 (look at pie chart, bar graph, and speedometer).*
   - *Determine at what speed the kinetic energy is the highest and lowest (look at pie chart, bar graph, and speedometer).*

   CLAIM: _____

   _____

   EVIDENCE: _____

   _____

   ANALYSIS: _____

   _____

2. How does height affect the skater's **gravitational potential energy (GPE)**?
   Here are some experiments that may help you figure this out:
   - *Determine at what position the gravitational potential energy is 0 (look at pie chart and bar graph).*
   - *Determine at what position the gravitational potential energy is the highest and the lowest (look at pie chart and bar graph).*
   - *Change the starting height (2, 4, and 6). Observe how that affects Gravitational Potential Energy.*

   CLAIM: _____

   _____

   EVIDENCE: _____

   _____

   ANALYSIS: _____

   _____

3. Why does **total energy (TE)** stay the same as the skater rolls up and down the ramp?
   Here are some experiments that may help you figure this out:

- *Change the starting height of the skater (2, 4, and 6) and observe the effects on KE, PE, and TE*
- *Figure out a way to make the total energy = 0.*
- *Look at the bar graph of the different types of energy at different locations. Think about how the height of the three bars (KE, PE, and TE) may be mathematically related.*
- *Think about why the energy is being depicted as a pie chart and observe how the pie chart changes.*

CLAIM: _____

_____

EVIDENCE: _____

_____

ANALYSIS: _____

_____

Friction

Setup:

- Make sure all the checkboxes are marked every time you load the simulation

4. **Friction** is a force (it is NOT a form of energy). **Friction** is the force resisting the motion when surfaces slide past each other. For now, we can think of **thermal energy (ThE)** as heat. Friction causes **kinetic energy (KE)** to be ***transformed*** into **thermal energy(ThE)**. When there is *more* friction, does this ***transformation*** happen more quickly or more slowly?
   Here are some experiments that may help you figure this out:
   - *Observe how the pie-chart and bar graphs change when there is NO friction versus SOME friction*
   - *Time how long it takes for the skater to come to a stop when there is more friction versus less friction*

   CLAIM: _____

   _____

   EVIDENCE: _____

   _____

   ANALYSIS: _____

   _____

5. Measure the time it takes for the skater to stop moving from each starting height and fill in the table below. How can measuring the time something takes to stop help us measure total energy?

   _____

   _____

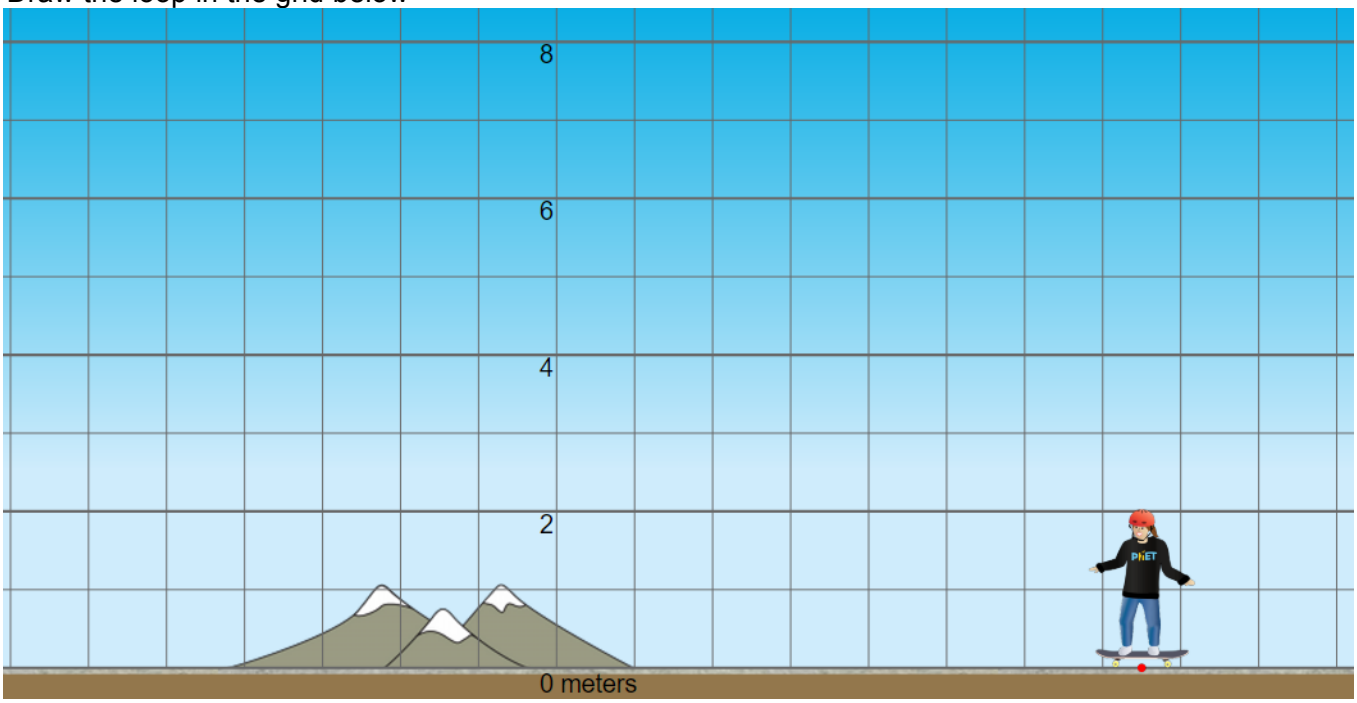
   _____

Height	Time to Stop
2 meters	
4 meters	
6 meters	

OPTIONAL CHALLENGE #1: Playground

Setup:

- Make sure all the checkboxes are marked every time you load the simulation
- Make a loop that you think the skater will be able to skate through
- Draw the loop in the grid below



6. Did the skater make the loop? Explain why or why not. If the skater did not make the loop, keep redesigning the loop until you are successful. Draw and highlight the successful loop on your drawing.

_____

_____

7. What factors matter when designing a loop that a skater can successfully move through?

CLAIM: _____

_____

EVIDENCE #1: _____

_____

ANALYSIS #1:

_____

_____

EVIDENCE #2: _____

_____

ANALYSIS #2:

_____

_____

OPTIONAL CHALLENGE #2: Math = Life

8. *What is the relationship between work, friction, and thermal energy in the skater system? HINT: Review the reading on work!*

9. *The equation for Kinetic Energy (KE) is:*

   $KE = 0.5 \cdot m \cdot v^2$

   m *= mass of object*
   v *= speed of object*

   a. *What is the mathematical relationship between KE and v (linear, quadratic, exponential, etc.)? Explain.*

   b. *Does this equation accurately describe the motion of the skater in the simulation? Why or why not?*

10. *The equation for Gravitational Potential Energy (GPE) is:*

    $GPE = m \cdot g \cdot h$

    m *represents the mass of the object*
    h *represents the height of the object*
    g *represents the gravitational field strength (9.8 N/kg on Earth)*

    a. *What is the mathematical relationship between GPE and h (linear, quadratic, exponential, etc.)? Explain.*

    b. *Does this equation accurately describe the motion of the skater in the simulation? Why or why not?*

Step 1: Energy Summary

Task Card

1. Complete the Skate Park handout
2. Read and take notes on the Conservation of Energy slideshow
3. Write a paragraph explaining what Conservation of Energy is using details (evidence) from both the Skatepark Simulation and the Conservation of Energy slideshow
4. Assess your paragraph on the skill ***"Theme/Central Idea"***

Resources:

Skate Park Handout

Conservation of Energy Slideshow

Energy Paragraph

Explain the main ideas about energy using examples/details from the Skate Park simulation and the Conservation of Energy slideshow. Use the rubric as a guide for your writing.

For a higher score on "Theme/Central Idea" you can incorporate evidence from any of these additional sources:

- ★ Slides
- ★ Reading
- ★ Simulation

Self Assessment: Theme/Central Idea

Definition	Determining central idea(s) and explaining how they develop and interact
Level 3	Identifies a central idea and identifies some details that are relevant to that central idea.
Level 4	Identifies a central idea and provides a limited explanation of how that central idea is developed through specific details.
Level 5	Identifies a major central idea and provides an accurate explanation of how that central idea is developed through specific details. Provides some explanation of how the central idea interacts with supporting ideas or other elements in the text/simulation
Level 6	Identifies multiple central ideas and provides an accurate analysis of their development and interaction with each other and with supporting ideas or other elements in the text/simulation

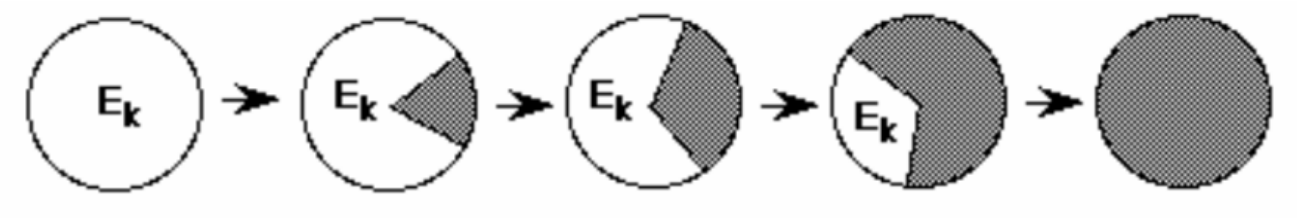
Highlight the level you think your paragraph is demonstrating. Justify your answer using language from the rubric AND examples from your work.

Modeling Assessment

Name: _____
Block: _____

Directions: *This final assessment will test you modeling abilities. In addition to answering the questions, be sure to explain in* ***explicit detail*** *what each aspect of your model represents and why that model can be useful to understand the situation it relates to. You are being assessed on your modeling ability overall, so* ***answer as much as you can*** *and* ***explain all of your thinking****!*

1. What does the following series of energy pie charts tell you about the behavior of the object?



2. A slingshot shoots a pebble up in the air at a 45 degree angle. The pebble arcs through the air and then lands on the ground.
    a. Create a set of energy pie charts to model this situation.

    b. Explain the different types of energy involved in your situation and how your model shows the energy changes. Explain all features of your model.

3. A rubber ball bounces up and down on the floor. Each time the ball bounces up to a lower height until it stops bouncing.

a. Create a set of energy pie charts to model this situation.

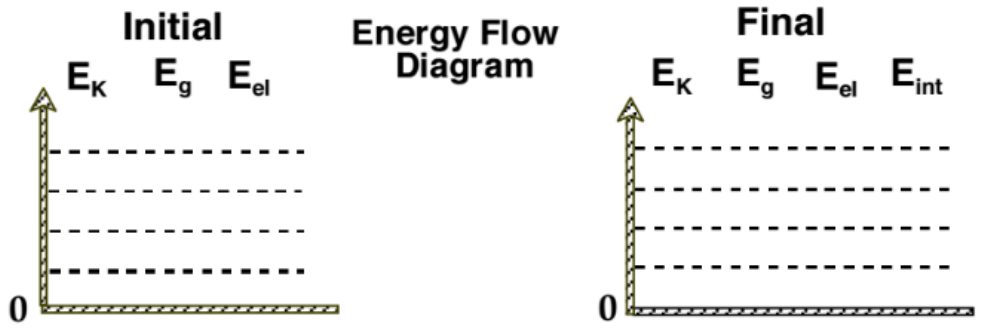
b. Explain the different types of energy involved in your situation and how your model shows the energy changes. Explain all features of your model.

4. A cell phone is used to play music.
   a. Create a set of energy pie charts to model this situation.

   b. Explain the different types of energy involved in your situation and how your model shows the energy changes. Explain all features of your model.

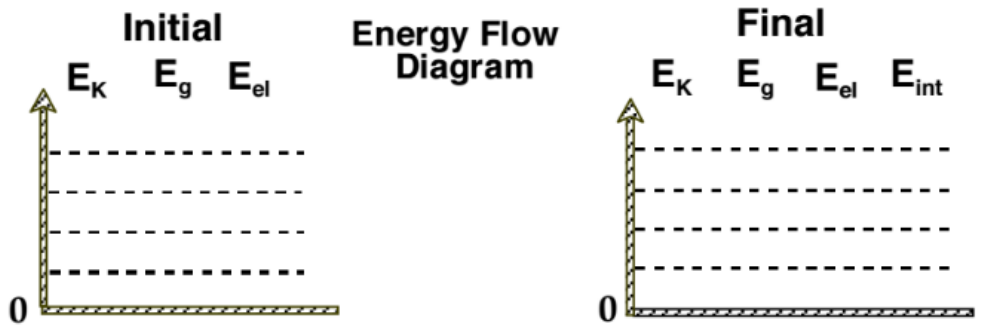
5. You pull a wagon, initially at rest, until it reaches constant velocity, along a level sidewalk.

a. Create an energy bar graph of this situation



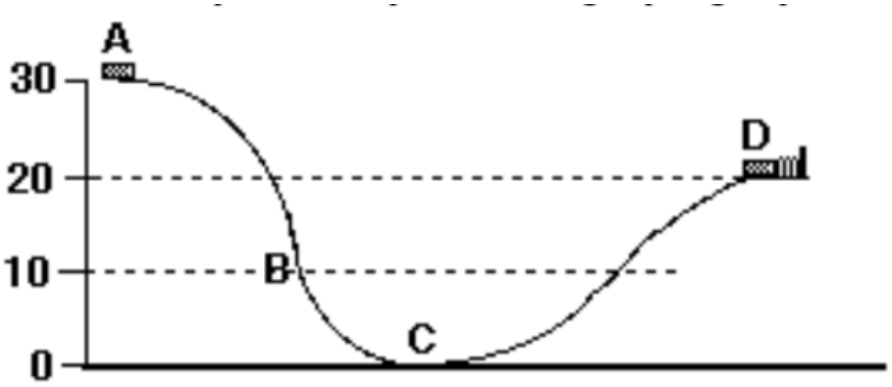
b. Explain how this bar graph models the situation

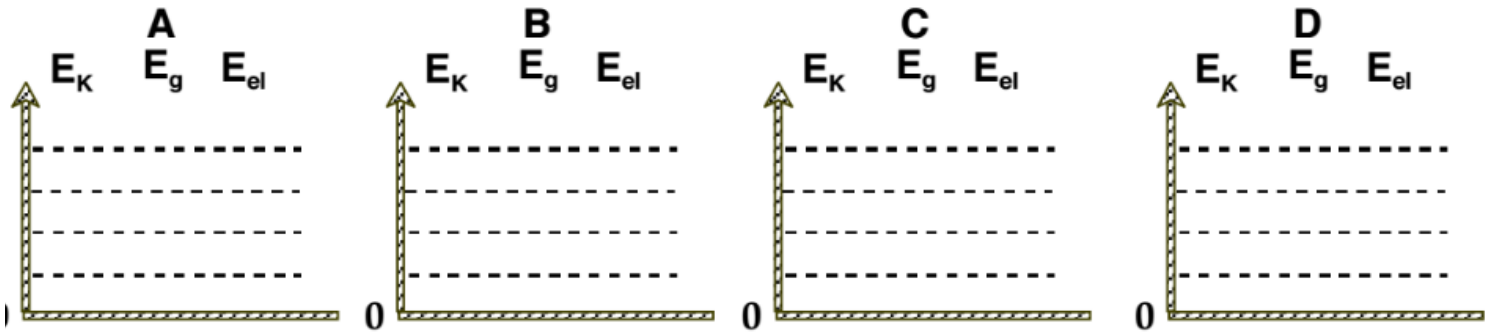
6. A dart gun fires a dart straight up which then sticks to the ceiling
   a. Create an energy bar graph of this situation



   b. Explain how this bar graph models the situation

7. A 100kg car has 30,000J of Potential Energy at point A. It moves down a frictionless track and comes to a stop as it compresses a huge spring at point D.





a. Create energy bar graphs for each point in the car's path.

b. Explain how your model shows the energy throughout this scenario. Explain how the heights of each bar connect to the visual as well as the motion of the car.