Topic: Energy and Simple Machines

Teacher: **Mariano Arce**
Genre: **Science** **Unit: Energy**
Grade Level: **6th Grade** **Duration: 1 unit**

Sub-Groups - SDI - **Variables, Graphing. Simple/Compound Machines, Mass, Volume, Density**

Essential Questions
(Domain 1: Planning and Preparation-Component 1c: Designing Coherent Instruction)

- How can **energy** be **transferred** from one material to another?
- What happens to a material when it receives energy?
- What happens to the energy in a system — where does this energy come from, how is it changed within the system, and where does it ultimately go?
- How does the flow of energy affect the materials in the system?

Background Knowledge

Background Summary:
Students will need to understand that energy can exist in many forms. Energy cannot be created or destroyed, but only changed/transferred from one form into another. Energy can be considered either to kinetic energy, which is energy of motion, or potential energy, which depends on relative position. Students will need to understand potential and kinetic energy through the robot and ramp activity.

Lesson Objective:

- Students will be able to identify the impact of friction on the distance an object can travel
- Identify the types of energy present in the system.
- The students will understand that Models can be used to represent systems and their interactions—such as inputs, processes, and outputs and energy, matter, and information flows within systems.
- Students should be able to explain how changes in motion, perspective, and reference of objects, depend on different variables such as mass, direction of motion, and frame of reference.

Standards:
(Domain 1: Planning and Preparation- Component 1a:Demonstrating Knowledge of Content and Pedagogy)

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New York State Learning Standards for Mathematics, Science, and Technology (MST)

STANDARD 1 – Analysis, Inquiry, and Design Students will use mathematical analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seek answers, and develop solutions.

- M1.1a identify independent and dependent variables
- M1.1b identify relationships among variables including: direct, indirect, cyclic, constant; identify non-related material

STANDARD 2 – Information Systems Students will access, generate, process, and transfer information, using appropriate technologies.

- S2.1 Use conventional techniques and those of their own design to make further observations and refine their explanations, guided by a need for more information.
    - S2.1a demonstrate appropriate safety techniques
    - S2.1b conduct an experiment designed by others
    - S2.1c design and conduct an experiment to test a hypothesis
    - S2.1d use appropriate tools and conventional techniques to solve problems about the natural world, including:
        - Measuring
        - Observing
        - Describing
        - Classifying
        - Sequencing

STANDARD 4 – Students will understand and apply scientific concepts, principles, and theories pertaining to the physical setting and living environment and recognize the historical development of ideas in science.

- PS. Key Idea 4: Energy exists in many forms, and when these forms change, energy is conserved.
- PS. Key Idea 5: Energy and matter interact through forces that result in changes in motion.

NYS Science Standards

- Energy cannot be created or destroyed, but only changed from one form into another. (4.5a)
- Energy can be considered either to be either kinetic energy, which is energy of motion, or potential energy, which depends on relative position. (4.1e)
- Different forms of energy include heat, light, electrical, mechanical, sound, nuclear and chemical energy. (4.1d)
- Most activities in everyday life involve at least one form of energy being transformed into another. For example, the chemical energy in gasoline is transformed into mechanical energy in an automobile engine. Energy, in the form of heat, is almost always one of the products of energy transformations. (4.1c)
- A machine can be made more efficient by reducing friction. Some common ways of reducing friction include lubricating or waxing surfaces. (5.2e)
- Friction is a force that opposes motion. (5.2d)
- A complex machine uses a combination of interacting simple machines. (5.2g)
- Machines transfer mechanical energy from one object to another. (5.2c)
- Machines can change the direction or amount of force, or the distance or speed of force required to do work. (5.2f)

Vocabulary **(Domain I: Planning and Preparation - Component 1e: Demonstrating Knowledge of Students.)**	**Prep Work/Materials** **(Domain 1 Planning and Instruction-Component 1e: Designing Coherent Instruction, Domain 3 Instruction-Component 3c: Instruction Engaging Students in Learning)**	**Cross Curricular Connection** **(Domain I: Planning and Preparation - Component 1a: Demonstrating Knowledge of Content and Pedagogy, Component 1b: Demonstrating Knowledge of Students.)**
• kinetic energy • potential energy • energy transfer • energy • distance • mass • acceleration • gravity • friction • force	• EV3 robot • Touch sensor (port 1) • Large motors (port b and c) • measuring tape • yard stick • tennis ball • sand paper • golf hole o Cardboard square with a hole cut out to catch ball, but allow over shooting For Teachers : Surface 1: Table Surface 2: towel Surface 3: Aluminum Foil Surface 4: Pebbles/gravel Surface 5: sandpaper	• Math • Technology • Engineering

Differentiation
(Domain I Planning and Preparation-Component 1e: Designing Coherent Instruction, Domain 3: Instruction - Component 3b: Using Question and Discussion techniques Domain 3: Instruction - Component 3c: Engaging Students in Learning)

- Bodily kinesthetic learners - Hands on Collision Activity
- Audio and Visual learners – Visual representation of activity in the Do Now. The observations collected throughout the activity.
- ELL/Low reader - Guided notes printed for those who require them
- Technology- Utilizing Lego Mindstorms robot kit and digital program
- Enrichment: Graphing of data collected in activity
- Extended time for those who require it
- Small groups. 2 to 3 students per paraprofessional
- Extended I*ndividual attention from ICT teachers and paraprofessionals*
- Remediation for those who require/Push in services Ms.Murphy Speech

Procedure **(Domain I Planning and Preparation-Component 1e: Designing Coherent Instruction, Domain 3: Instruction - Component 3b: Using Question and Discussion techniques Domain 3: Instruction - Component 3c: Engaging Students in Learning)**	**Student Engagement (Teacher Assessment)**

Day 1: 1) Introduce the problem of the day (how will the power of a robot affect the distance traveled by the ball once impacted?) Watch Brainpop video clip on potential energy. Lead Mini Lesson introducing types of energy (kinetic and potential), t he transfer of energy and Newton's Laws. https://www.brainpop.com/science/energy/potentialenergy/preview.weml 2) **Do Now:** Review valid measurement technique, demonstrate how to adequately measure distance. 4) **Instruct** students on how to find the robot and change the power levels. 6) **Direct** students to develop a hypothesis and reasoning. 7) In **small groups,** direct students to assign roles, conduct experiment, and record data utilizing Student Data Collection Directions. 8) **Circulate and motivate** students to start their data collection. Asking students to describe what they are measuring, and documenting data on worksheet (Workshop Model) 9) After performing this experiment **6 times,** analyze data (Testing Variables) 10) Summative - Students will use the model of this system to label types of energy in diagram on worksheet. 11) Robotics Journal - Literary Support. Students will explain and discuss how energy was transferred in this model. **Student Data Collection Directions:**	

1.Place robot at a set starting point for all trials.
2.Place the ball at a set starting point.
3.Start with power level 10 on the robot, and measure how far the ball travels with measuring tape.
4.Repeat this trial and record data on worksheet until power level 50.

Day 2:

1) Introduce the problem of the day (how will the friction of the surface affect the distance traveled by the ball once impacted by the robot?)

2) Direct students to develop a hypothesis and reasoning based on the experimental setup.

3) In small groups, direct students to assign roles, conduct experiment, and record data utilizing Student Data Collection Directions.

4) Activity: Round Robin - Each table will have a different surface, and students will circulate through each station. Students will get 4 minutes per station.

8) Work it - Work Shop - Teacher will circulate and motivate students to start their data collection. Asking students to describe what they are measuring, and documenting data on worksheet.

9) After performing this experiment, analyze data.

10) Students will use the model of this system to label types of energy in diagram on worksheet.

11) Students will explain and discuss how energy was transferred in this model.

Day 3

1) Students will observe the actual mini golf course as a DO NOW
2) Students must measure the distances of each path to decide which power level they must use to push the ball into each hole. Students must create a data table to record their data.

3) After students create their data table then they may use their robots to complete the challenge. 4) Each run of mini-golf course will be recorded for future analysis 5) Students will be able to reflect on their choices of power levels at the end of the lesson as the reflection section of the activity.	
Assessment *(Formative or Summative)* (Domain 1 Planning and Instruction- Component 1e: Designing Coherent Instruction, Domain 3 Instruction- Component 3c: Engaging Students in Learning, Domain 3 Instruction- Component 3d: Using Assessment in Instruction)	**Student Engagement (Teacher Assessment)**
<u>Formative assessment:</u> ...Each group has designated roles and are fulfilling their responsibilities and collaborating with their group members. ...Students are collecting data and answering the follow up questions accompanied by each activity. **<u>Summative Assessment:</u>** -Students will take a quiz on energy to show understanding of the concepts demonstrated through the activity.	
Additional Resources	
- For lesson 2 and 3, teachers can use other surfaces than the ones mentioned in this lesson. - Pre- and post-assessment: BrainPop video on Kinetic Energy	