Short Performance Assessment: **HS-PS3-2**

Grade Level: **High School**

Adapted from SNAP[1]

Title	**MagLev**		
Designed by	CREATE for STEM at Michigan State University	Course(s)	**High School**

Performance Expectation	**HS-PS3-2**: Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects). **Clarification Statement**: Examples of phenomena at the macroscopic scale could include the conversion of kinetic energy to thermal energy, the energy stored due to position of an object above the earth, and the energy stored between two electrically-charged plates. Examples of models could include diagrams, drawings, descriptions, and computer simulations **Assessment Boundary**: none

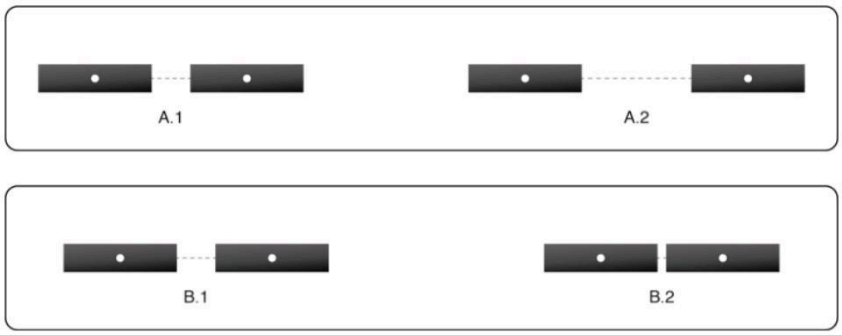
Science and Engineering Practice	**Developing and Using Models** • Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.
Disciplinary Core Ideas	**PS3.A: Definitions of Energy** • Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. • At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. • These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space.
Crosscutting Concept	**Energy and Matter** • Energy cannot be created or destroyed; it only moves between one place and another place, between objects and/or fields, or between systems.

Student Performance	1. Components of the model 2. Relationships 3. Connections

[1] The Short Performance Assessment (SPA) and the Assessment Rubric adapted from the Stanford NGSS Assessment Project http://snapgse.stanford.edu/

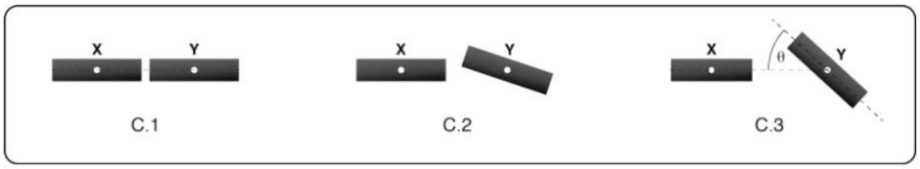
Name_____

Tom found two bar magnets stuck to the fridge. He held the magnets close to one another, let one of them go and observed what happened. He then did that again, only this time flipping one of the magnets. In the first try, the magnets were repelled and in the other, they were attracted (pictures A and B).



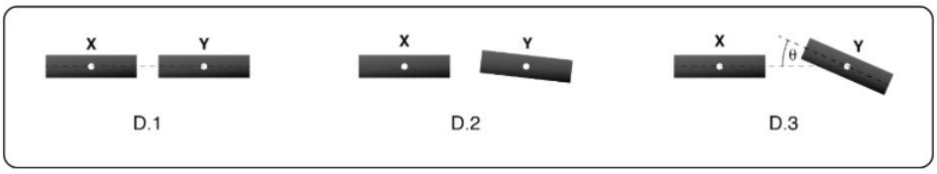
1. Draw a model explaining the difference in the magnetic fields and the forces acting on the magnets. Describe your model.

2. As Tom continued playing with them, he observed something interesting. He took two bar magnets (noted X and Y in the picture) and held them close to each other, as shown in picture C.1. As he let go of magnet Y, he noticed that magnet Y did not only move back but also rotated (pictures C.2 and C.3).



Modify your model of the magnet system you drew in item #1 to explain why the magnet rotated. In your response, label the pole orientation of both magnets, address the magnetic field between the magnets, and label the forces acting in the system. Describe your model.

3. Tom decided to try it again, only this time holding the magnets farther apart before letting go of magnet Y. The result is shown in the figure below. Tom repeated this a few more times, each time changing the initial distance between the magnets and measuring the rotation angle. The results are shown in the table below.



Position	Initial Distance (cm)	Angle of Rotation (θ)
1	0.3	42°
2	0.5	34°
3	0.8	29°
4	1.3	15°

Use the data to explain the force exerted by the magnetic field. Justify your explanation using the pattern in the relationship between the positions of the magnets.

4. Compare data for each position in the data table to explain which position has more energy stored in the system. Justify your explanation using the pattern in the relationship between the positions of the magnets.

Assessment Rubric* - Question 1				
	Emerging	Developing	Approaching Proficiency	Excelling
Description of performance				
Sample student responses				

Assessment Rubric* - Question 2				
	Emerging	Developing	Approaching Proficiency	Excelling
Description of performance				
Sample student responses				

Insert additional Assessment Rubrics (if needed) here.