

Science Performance

Grade- 3

Topic – Force and Motion

Title:
Predicting Motion

NGSS Performance Expectation(s): 3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion. [Clarification Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a see-saw.] [Assessment Boundary: Assessment does not include technical terms such as period and frequency.]

Lesson Performance Expectations: (LESSON)

Carry out investigations to gather and analyze data to provide evidence of patterns of motion.
Use mathematical and computational thinking to compare the motion of objects.
Construct an explanation for how a pattern can be used to predict motion.

Student Science Performance

A. Gathering:

Students in groups of two compare the motion of 2 pendulums of different lengths (provided), and work collaboratively to quantify this comparison. Students develop and use a table to record data.

Hint: Be sure to have lengths of significant difference (i.e., 20 cm and 60 cm).

Hint: Engage students in generating ideas for quantification of measurements] How can we do better than “fast” and “slow”?

Count number of swings per minute, perhaps.

Students record their data in science notebook.

B. Reasoning:

Analyze Data

Student groups analyze their data for the 2 pendulums tested to identify the relationship between pendulum length and pendulum back and forth motions (swings) per minute.

Hint: Students independently record their description of the relationship. Students share their findings with their small group and then have whole group share.

Students will predict the motion of a third pendulum of a different length based on the first 2 pendulums tested. Each group will be given a different length of string to create the 3rd pendulum.

Hint: Provide pendulum lengths that will create a “gap” in the number line created later in the lesson. For example, provide 10 cm, 30 cm, 70 cm, 80 cm, 90 cm – but not 50 cm. This will show an obvious void when the number line (visual model) is constructed.

Hint: Students self-access “How confident are you that your prediction on a scale of 1 – 5?” The purpose of the prediction is not intended to be precise, simply just to estimate relative swings per minute based on pendulum length.

C. Gathering

Students test their predictions.

Hint: Students individually record the data, compare their findings to their predictions, and discuss in groups.

Students create a way to present the whole class data for the range of pendulum lengths.

Hint: Support students in the creation of a visual representation/number line that shows number of swings per minute and encompasses the range. Have each group tape their pendulums on the line. The strings will hang down forming a visual representation.

D. Reasoning

Students analyze the data presented in the visual representation (number line), and note their observations.

Conduct a class discussion and engage students in argument from evidence.

Teacher initiated questions: *(Hint: have groups discuss first and then share with class to encourage more individual student thinking.)*

Q: Describe meaningful relationships and/or patterns in the data.

Q: How does the motion of a 20 cm pendulum compare to a 40 cm pendulum? (have students make other comparisons)

Q: How does a pendulum that swings at 80 swings per minute compare with a pendulum that swings at 50 swings per

minute? (have students make other comparisons)

Q: What would a pendulum that swings at 60 swings per minute look like? Test your prediction.

Q: What do you know that will help you determine a pendulum to fill the “gap” in the number line? Create a pendulum to fill the gap and test your pendulum.

E. Communicating

Students construct a written explanation to communicate how to determine the appropriate pendulum length for a desired pattern. Students include evidence to justify reasoning from the data.

Assessment of Student Learning

Swing on a Tree Branch

Examine the swing hanging from a tree branch as shown. Imagine yourself sitting on this swing; now give yourself a push with your feet. Describe your predicted pattern of motion for the swing. Construct an explanation for your prediction, and be sure to support your explanation using evidence from past investigations.



Photo source: *Yet More Everyday Science Mysteries*, Konicek-Moran, 2011, page 166.

Additional Comments

Hint: One learning experience will not provide adequate learning opportunity for student mastery of any Performance Expectation(s).

Other examples of motion with a predictable pattern could include:

- A toy car rolling down a ramp from various heights.
- A ball dropped from various heights, measuring rebound height.

Science Essentials (Student Performance Expectations From Appendix C, D, E)

Science Practices	
Carrying Out Investigations	<ul style="list-style-type: none"> • Conduct an investigation collaboratively to produce data to serve as the basis for evidence. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. • Analyze and interpret data to make sense of phenomena. • Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. • Organize simple data sets to reveal patterns that suggest relationships. • Use evidence to construct or support an explanation.
Analyzing & Interpreting Data	
Using Mathematical & Computational Thinking	
Constructing Explanations	
Crosscutting Concepts	<ul style="list-style-type: none"> • Patterns of change can be used to make predictions. • Patterns can be used as evidence to support an explanation.
Patterns	
Disciplinary Core Ideas	<ul style="list-style-type: none"> • Patterns of motion can be used to predict future motion.
Forces and Motion	

3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion. [Clarification Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a see-saw.] [Assessment Boundary: Assessment does not include technical terms such as period and frequency.]

Knowledge	Reasoning or Performance Skill	Product
<p>Explain that “patterns” describe a repeating characteristic, and give examples of patterns in the manmade or natural world.*</p> <p>Identify an observed and/or measured pattern, and explain the pattern.</p> <p>Recognize that “observations” and/or “measurements” are data that can support a claim.</p>	<p>Gather and analyze data to provide evidence for patterns of motion.</p> <p>Use mathematical reasoning to compare the motion of objects in order to identify a pattern.</p> <p>Explain how a pattern of motion can be used to predict other motion of an object under similar constraints.</p>	<p>No products.</p>

**(Connection to Nature of Science: Science findings are based on recognizing patterns.)*