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| **Science Performance** |
| **Grade- 3** | **Title:****Predicting Motion** |
| **Topic – Force and 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**1. ***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.* 1. ***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-assess “How confident are you of 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.*1. ***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.*  1. ***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.***1. ***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 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.
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| **Science Essentials (***Student Performance Expectations From Appendix C, D, E)* |
| **Science Practices** | * 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.
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| Carrying Out InvestigationsAnalyzing & Interpreting Data Using Mathematical & Computational ThinkingConstructing Explanations |
| **Crosscutting Concepts** | * Patterns of change can be used to make predictions.
* Patterns can be used as evidence to support an explanation.
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| Patterns |
| **Disciplinary Core Ideas** | * Patterns of motion can be used to predict future motion.
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| Forces and Motion |

(B. Moulding, 2011)