

NAME: \_\_\_\_\_

Other group members: \_\_\_\_\_

### Scenario

You have just graduated from college and have taken a job with the East Lyme Engineering Company. An amusement park owner has come to your company with an idea for a new ride. It involves attaching one to three people to a steel wire, pulling them up and out, and letting them swing like a large pendulum.

He has come to your engineering firm to have you determine whether the mass of the riders or the length of the pendulum affects the time it takes the pendulum to complete a swing. Complete the following package and submit a completed report explaining the effects of these two variables (mass and length). If possible, identify and test any additional variable you think might also have an effect on a pendulum's swing.

Your final report must contain the following pieces:

1. A cover page that includes a title, date, names of group members and at least one illustration.
2. Initial hypotheses about the effect of length and weight of the riders.
3. A clear description of how you constructed your model and collected your data, preferably with a numbered, step-by-step procedure for your experiment.
4. Data charts showing the data collected.
5. Line graphs made using the data collected.
6. Conclusions based on and supported by the data collected.
7. Changes to initial hypotheses.
8. Any additional observations or illustrations that will help the amusement park owner understand your report.

## ***HYPOTHESIZING***

### **1. HOW DOES MASS AFFECT THE SPEED OF A PENDULUM'S SWING?**

Will a heavier pendulum make it swing faster, slower, or about the same as a pendulum that is not as heavy?

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Why do you think your prediction is true?

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### **2. HOW DOES THE LENGTH AFFECT THE SPEED OF A PENDULUM?**

Will a longer pendulum swing faster, slower, or about the same as a shorter pendulum?

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Why do you think your prediction is true?

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### ***PLANNING AND CRITIQUING OF INVESTIGATIONS:***

One of your team members thinks that you can use a piece of string and 20 metal washers to model the ride and collect data. She says that you must keep the length constant while you are changing the number of washers, and you must keep the number of washers constant while you are changing the length.

3. How could you make a model of this ride using a piece of string and 20 washers?

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4. Why is it important to keep the length of the pendulum constant while you are changing the number of washers? What might have happened if you changed the length AND the number of washers?

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5. What are some other variables that you will need to control while you are collecting your data.

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## CONDUCTING INVESTIGATIONS:

You decide to measure each pendulum by counting the number of swings the pendulum makes in 30 seconds. You want to test at least three different masses and at least three different lengths. Use the space below to describe way you will conduct your experiment. Be sure to state the lengths and masses you will use. If you intend to test another variable besides mass and length, describe the steps you will take to collect your data.

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

NAME: \_\_\_\_\_

6. Record the data for changing mass, then graph your data:

Data Chart: CHANGING MASS (length = )

# OF WASHERS	TRIAL #1 (swings)	TRIAL #2 (swings)	TRIAL #3 (swings)	AVERAGE (swings)

TITLE \_\_\_\_\_

# OF SWINGS IN 30 SECONDS


# OF WASHERS

NAME: \_\_\_\_\_

7. Record the data for changing length, then graph your data:

Data Chart: CHANGING LENGTH (# of washers = )

LENGTH (centimeters)	TRIAL #1 (swings)	TRIAL #2 (swings)	TRIAL #3 (swings)	AVERAGE (swings)

***TITLE*** \_\_\_\_\_

***# OF SWINGS IN 30 SECONDS***


***LENGTH (centimeters)***

## ***DEVELOPING AND EVALUATING EXPLANATIONS***

8. What did you discover about the relationship between the mass and the speed of a pendulum? Be sure to use your data to support your answer.

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9. What did you discover about the relationship between the length and the speed of a pendulum? Be sure to use your data to support your answer.

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10. Look back at your original prediction about the effect of mass on the speed of a pendulum. Look at your data. Did your data support your prediction? Use your data to explain your thinking.

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11. Look back at your original prediction about the effect of length on the speed of a pendulum. Look at your data. Did your data support your prediction? Use your data to explain your thinking.

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12. What are some possible sources of error in your data collection?

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13. Predict how long a pendulum would have to be to complete ten full swings in 30 seconds and explain your thinking.

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## **RUBRIC.....INQUIRY SCIENCE TASK.....THE PENDULUM**

### **Items #1 and 2     Point Range: 0–2**

- 2** - Response includes a prediction that is reasonable in terms of available evidence **AND** response includes an explanation that supports the prediction.
- 1** - Response includes a prediction that is reasonable in terms of available evidence but lacks a supporting explanation **OR** response has an explanation but does not include a prediction.
- 0** - Response includes a prediction that is not reasonable in terms of available evidence **AND** response lacks any supporting explanation **AND** response is not relevant to the question being asked.

### **Item #4     Point Range: 0–2**

- 2** - Response indicates the importance of changing only one variable at a time **AND** response explains that results would not be reliable if the pendulum's length and mass were changed.
- 1** - Response indicates the importance of changing one variable at a time.
- 0** - Response does not correctly indicate the importance of changing only one variable at a time **OR** response is not relevant to question being asked.

### **Item #5     Point Range: 0–2**

- 2** - Response indicates at least two additional variables that must be controlled in the experiment.
- 1** - Response indicates one additional variable that must be controlled in the experiment..
- 0** - Response does not correctly any additional variables that must be controlled in the experiment **OR** response is not relevant to question being asked.

### **Items #6 and 7     Point Range: 0–3 (Use same scoring for each of the two graphs.)**

- 3** - Response is a line graph that accurately represents the data (the numbers of swings, lengths and numbers of washers plotted on the graph correspond to the recorded data) **AND** response (graph) includes a scale appropriate to the range of the data collected **AND** response (graph) includes a relevant title.
- 2** - Response is a line graph that accurately represents the data. (The numbers of swings, lengths and numbers of washers plotted on the graph correspond to the recorded data) **AND** response (graph) includes a scale appropriate to the range of the data collected **OR** response (graph) includes a relevant title.
- 1** - Response is a line graph or another representation that displays data but omits required components **OR** response (graph) includes a scale appropriate to the range of the data collected **OR** response (graph) includes a relevant title **OR** response indicates a limited understanding of representing data in a graph.
- 0** - Response does not accurately represent data, uses an incorrect scale, and lacks a relevant title.

**Items #8 and 9     Point Range: 0–3**

- 3** - Response provides a reasonable explanation that accurately reflects the correct relationship between the length (or mass) of a pendulum and the speed of its swing **AND** response includes data to support the explanation.
- 2** - Response provides a reasonable explanation that accurately reflects the correct relationship between the length (or mass) of a pendulum and the speed of its swing **AND** response does not include data to support the explanation.
- 1** - Response includes a more general explanation of the relationship between the length (or mass) of a pendulum and the speed of its swing **AND** response does not include data to support the explanation.
- 0** - Response includes an incorrect explanation of the relationship between the length (or mass) of a pendulum and the speed of its swing **AND** response does not include data to support the explanation.

**Items #10 and 11     Point Range: 0–2**

- 2** - Response correctly indicates whether the data supports the prediction **AND** response includes data to correctly explain the relationship between the prediction and the findings.
- 1** - Response correctly indicates whether the data supports the prediction **OR** response explains the relationship between the prediction and the findings but omits supporting data.
- 0** - Response incorrectly indicates whether the data supports the prediction **AND** response does not include an explanation or includes an explanation that is incorrect or irrelevant **AND** response omits supporting data.

**Item #12     Point Range: 0–3**

- 3** - Response includes at least three (3) possible sources of error in the data collection.
- 2** - Response includes at least two (2) possible sources of error in the data collection.
- 1** - Response includes at least one (1) possible sources of error in the data collection.
- 0** - Response does not include any possible sources of error in the data collection explanation **OR** response is not relevant to the question being asked.

**Item #13     Point Range: 0–2**

- 2** - Response includes a prediction that is reasonable in terms of available evidence **AND** response includes an explanation that supports the prediction.
- 1** - Response includes a prediction that is reasonable in terms of available evidence, but lacks a supporting explanation **OR** response includes an explanation but does not include a prediction.
- 0** - Response includes a prediction that is not reasonable in terms of available evidence **AND** response lacks a supporting explanation **OR** response is not relevant to the question being asked.

EXTRA CREDIT: Record the data for changing angle of release, then graph your data

Data Chart: **CHANGING ANGLE OF RELEASE** (# of washers = ; length = cm)

Angle (degrees)	<b>TRIAL #1</b> (swings)	<b>TRIAL #2</b> (swings)	<b>TRIAL #3</b> (swings)	<b>AVERAGE</b> (swings)

***TITLE***

**# OF SWINGS IN 30 SECONDS**


**ANGLE (degrees)**

**# OF SWINGS IN 30 SECONDS**

	<b>TRIAL #1</b> <b>(swings)</b>	<b>TRIAL #2</b> <b>(swings)</b>	<b>TRIAL #3</b> <b>(swings)</b>	<b>AVERAGE</b> <b>(swings)</b>

**TITLE**A blank 10x10 grid for graphing, consisting of 10 columns and 10 rows of squares.