Super Swing

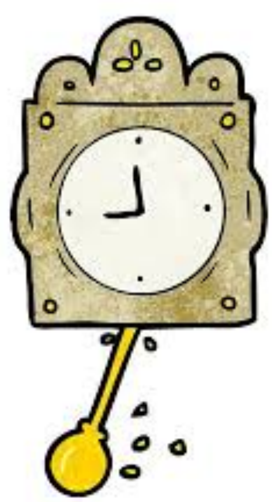
Science Standard

5.PS2.5 Explain how forces can create patterns within a system (moving in one direction, shifting back and forth, or moving in cycles), and describe conditions that affect how fast or slowly these patterns occur.

Math Standards

5.MD.B.2 Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Use operations on fractions for this grade to solve problems involving information presented in line plots. For example, given different measurements of liquid in identical beakers, find the amount of liquid each beaker would contain if the total amount in all the beakers were redistributed equally.

5E Project Prepared by: Audrey Pendola



ENGAGE – FULL ACTIVITY DIRECTIONS AND QUESTIONS TO PROMPT PRIOR KNOWLEDGE

- Teacher will example pendulum swing in front of the class (or if pretty day teacher will take students to playground with swings and demonstrate).

Discussion:

What do you notice about the movement of the pendulum?

Draw the kind of pattern it creates.

What happens to this pattern over time?

What causes the pendulum to move?

EXPLORE – PLANNING FOR MATERIALS, TECHNOLOGY, AND SAFETY

Material/Resources	Technology
Material/Resources: *What do you need for this lesson? Identify, within a bulleted list, the specific materials and resources that you will use. Describe how these materials and resources add value, depth, and extend students' learning.* - Video on smartboard - Pre-made pendulum stand (per group): for the students to create a pendulum - 3 pieces of 18" string (per group): for the students to cut and measure the pendulum - 10 Metal screw-nuts or washers (per group): to attach to the end of the string on the pendulum - 1 pair of scissors (per group): to cut the string - iPpad with flipgrid (per group): to upload findings so that students can compare results - Stopwatch (per group): to time the length of the pendulum swing - Measuring tape (per group): to measure the length of the string and height of pendulum drop - Calculator (per group): to convert time into fractions	**Technology:** *(a) Describe the technology you plan to use in your lesson, (b) How does the identified technology in your lesson improve student learning? If applicable, (c) explain how you will use this technology to support a variety of student needs within the learning environment, and (d) If you used this technology to design and implement formative and/or summative assessments, please explain. Did you use the technology to collect and/or analyze your data to inform instruction? Explain.* The teacher will show the students one video during this lesson. This will be shown through the smartboard. The students will use and iPad with the flipgrid app to record and show off their data to the class. This will make it easier to share and compare the results of all the explore. The teacher will use technology on the iPads as a formative assessment, as the students will upload their findings. Students will use calculator to convert their stopwatch times into fractions.

Management
Management**:** *Explanation of processes and/or procedures, transitions from one activity to another, strategies for gaining attention, motivating students to engage in the lesson and focus on learning (e.g. work boards, posted procedures, modeling, positive feedback, redirection). If management decisions were addressed above, please bold those processes and procedures.* - Showing the class video on smartboard. - Allowing the class to design their own pendulum length and weight. *SCIENCE FOCUS* - *What safety precautions will be used **specific** to any lab activities?* I will make sure that the students are using the scissors properly and will ensure that they only use them when needed.

EXPLORE – FULL ACTIVITY DIRECTIONS AND LAB SHEETS

1. The students will watch a video on pendulum swings and patterns with *no* sound.

Pendulum Video: https://www.britannica.com/video/161914/Changes-energy-pendulum-swings

2. Divide the students into groups of two or three.
3. Tell the students that we are going to build our own pendulum swings and measure the amount of time it takes for them to follow and end their cycle (complete stop).
4. Instruct the students that they will build and measure the swing out of the materials provided.
5. Give the following instructions to the students on the board throughout the design:
    a. Everyone will work in teams.
    b. The pre-made kits with the provided materials will be passed out to the groups.
    c. You will need scissors to cut the string length to tie to the pendulum stand.
    d. You will count how many washers or screw-nuts you attach to the end of the string.
    e. You will need to measure the length of the string with screw-nuts attached.
    f. Measure the height of the drop that you will let the pendulum start its swing at the same point every time.
    g. With the stopwatch, time how long the swing takes until completely still, record data.
    h. Change the height of the string to see if there is a change in time.
    i. Do three runs for this test

Data Collected

Length of string 1:	**Seconds**	**Fraction Conversion**
Swing #1		
Swing #2		
Swing #3		
Length of string 2:	**Seconds**	**Fraction Conversion**
Swing #1		
Swing #2		
Swing #3		
Length of string 3:	**Seconds**	**Fraction Conversion**
Swing #1		
Swing #2		
Swing #3		

EXPLAIN – SCIENCE

Core Ideas:

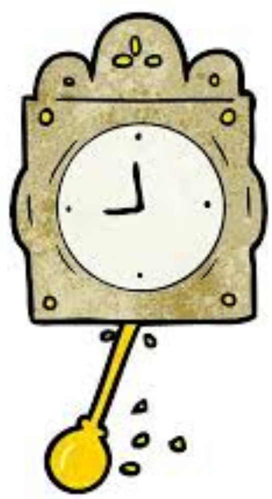
- Cause and effect of forces on objects
- These forces can be caused
- Forces can be measured by their effect on an object, even if the objects do not touch.
- The power of forces on objects can create patterns within systems.

Vocabulary:

- Forces: the push or pull on an object with mass that causes it to change velocity.
- Conditions: a particular mode of being of a person or thing; existing state; situation with respect to circumstances.
- Patterns: Something that repeats in a predictable way.

Misconceptions:

- Force and power are not the same thing.
- All forces need objects to be in contact with to have an effect.
- All patterns are the same.
- Patterns will continue forever.



EXPLAIN – MATH

Line Plot: A line plot is a graph that shows frequency of data along a number line. It is best to use a line plot when comparing fewer than 25 numbers. It is a quick, simple way to organize data.

- Making a line plot
  - Gather the data needed
  - Organize data in numerical order
  - Draw a horizontal line
  - Mark "X" about the horizontal line at ever data occurrence
  - Interpret the data

Data: facts and statistics collected together for reference or analysis.

- Collecting data
  - Keeping time
  - Observations
  - Records
  - Interviews
  - Experiments

Measurements: the size, length, or amount of something, as established by measuring.

- Things to measure:
  - Time
  - Weight
  - Distance
  - Volume

Fractions: A numerical quantity that is not a whole number

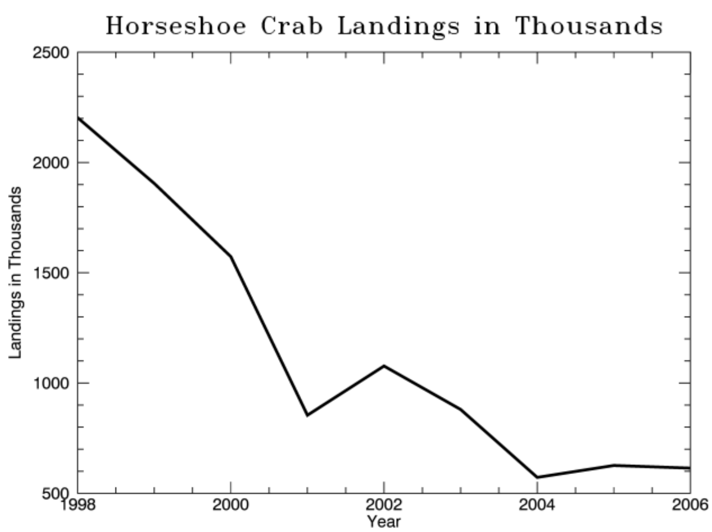
- Examples
  - 1/2
  - 5/8
  - 4/5

Common Misconceptions:

- Line plots and line graphs are the same things
- Fractions are all less than 1
- Data can only be measured in labs
- All data can be shown on graphs

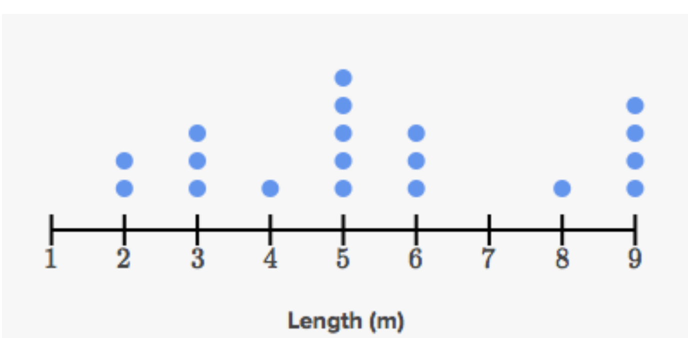
Period: The time for one complete **cycle**, a left swing and a right swing.

Line graph



Data courtesy Dr. L. Niles, NJ DEP and the USFWS

Line (dot) plot



ELABORATE – PLANNING FOR MATERIALS, TECHNOLOGY, AND SAFETY

Material/Resources: *What do you need for this lesson? Identify, within a bulleted list, the specific materials and resources that you will use. Describe how these materials and resources add value, depth, and extend students' learning.*	**Technology:** *(a) Describe the technology you plan to use in your lesson, (b) How does the identified technology in your lesson improve student learning? If applicable, (c) explain how you will use this technology to support a variety of student needs within the learning environment, and (d) If you used this technology to design and implement formative and/or summative assessments, please explain. Did you use the technology to collect and/or analyze your data to inform instruction? Explain.*
- Data from pendulum experiment - Graphing worksheet (1 per student) - Pre-made pendulum stand (per group): for the students to create a pendulum - 3 pieces of 18" string (per group): for the students to cut and measure the pendulum - 10 Metal screw-nuts or washers (per group): to attach to the end of the string on the pendulum - 1 pair of scissors (per group): to cut the string - iPpad with flipgrid (per group): to upload findings so that students can compare results - Stopwatch (per group): to time the length of the pendulum swing - Measuring tape (per group): to measure the length of the string and height of pendulum drop - Calculator (per group): to convert time into fractions	The students will upload data results on flipgrid. The teacher will get the iPad attached to smart board. Teacher will show results of all students work on flipgrid. The students will be able to compare results and see what other groups chose to test.

Management
Management**:** *Explanation of processes and/or procedures, transitions from one activity to another, strategies for gaining attention, motivating students to engage in the lesson and focus on learning (e.g. work boards, posted procedures, modeling, positive feedback, redirection). If management decisions were addressed above, please bold those processes and procedures.* - The students will upload their results to flipgrid using the iPads - The students will compare their line plots with other groups *SCIENCE FOCUS - What safety precautions will be used* ***specific*** *to any lab activities?* I will make sure that the students are using the scissors properly and will ensure that they only use them when needed.

ELABORATE – FULL ACTIVITY DIRECTIONS AND LAB SHEETS

The students will watch a video on pendulum swings and patterns *with* sound.

Pendulum Video: https://www.britannica.com/video/161914/Changes-energy-pendulum-swings
Now the students will retest the pendulum.

1. The students will discuss with group how they are going to change the weights on their pendulums.
2. The groups will use the same length of the string.
3. The group will retest their pendulum swings will change the weights on the pendulum on the string.
4. They will retest these 3 different times.
5. Students will convert the time to fractions using calculator.
6. Students will be given graph paper and will graph the data collected.
7. Students will answer the following questions:

- Did the length of the string effect the time it took the pendulum to finish its swing cycle?
- Why?
- What makes the pattern of the pendulum?
-What keeps the pendulum moving?

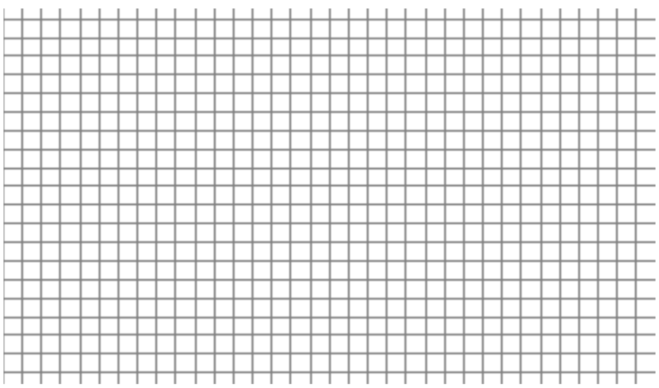
Data Collected

Weight on string 1:	**Seconds**	**Fraction Conversion**
Swing #1		
Swing #2		
Swing #3		
Weight on string 2:	**Seconds**	**Fraction Conversion**
Swing #1		
Swing #2		
Swing #3		
Weight on string 3:	**Seconds**	**Fraction Conversion**
Swing #1		
Swing #2		
Swing #3		

Challenge:

Make a pendulum swing that is 15 seconds long. And create a line plot and prove that it works

Length of string: **Weight of string:**	**Seconds**	**Fraction Conversion**
Swing #1		
Swing #2		
Swing #3		



Graph Paper Templates. (n.d.). Retrieved from
https://www.vertex42.com/ExcelTemplates/graph-paper.html

Example of Data Actually Collected (my experiment):

Weight on string: **5 screw nuts**	**Change in length:**	**Time:**	**Fraction:** **(x/60)** **Fraction in 1/10s**
Length 1	30 inches	34 seconds	5.6/10
Length 2	24 inches	27 seconds	4.5/10
Length 3	18 inches	21 seconds	3.5/10
Length of string: **18 inches**	**Change in Weight**	**Time**	**Fraction:** **(x/60)** **Fraction in 1/10s**
Weight 1	10 screw nuts	21 seconds	3.5/100
Weight 2	5 screw nuts	21 seconds	3;5/100
Weight 3	2 screw nuts	21 seconds	3.5/100

Line (dot) Plot:

```
                              X
                              X
                              X
                              X        X.       X

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     1/10       2/10     3/10      4/10     5/10     6/10     7/10      8/10
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CLAIM, EVIDENCE, AND REASONING FOR KEY CONCEPT(S)

Claim: Write a sentence explaining how forces create patterns within the pendulum.

Target Response

- How long it takes the pendulum to move back and forth depends on the length of the string, not the weight attached to it, or the height of the release.

Evidence: Provide evidence to support your claim. Include evidence from the experiments that support claim.

Target Response

- The average time that it took to the pendulum to complete a whole cycle was around 20 seconds, with a string length of 15 and 28 inches. Changing the height and weight did not affect the time it took.

Reasoning: Explain how your evidence supports your claim. Identify the force that is causing the pattern of motion within the pendulum.

Target Response

- Gravity is the force that causes the pattern and motion within pendulums. How fast or slow the pattern occurs is based on the length of the pendulum.

EVALUATE – SCIENCE

1. What kind of pattern /cycle does a swing make when you push it?

2. What is keeping the pendulum moving?

3. What is one cycle swing from left to right of a pendulum called?

4. TRUE or FALSE. An object has to touch another object to cause an effect.

5. How can forces cause patterns within systems and objects.

Answer key

1. Pendulum swing

2. Gravitational pull

3. Period

4. FALSE

5. The forces push and pull on the objects.

EVALUATE – MATH

1. What did we measure in this experiment?
    A. Distance
    B. Time
    C. Weight
    D. Volume
2. True or False: You can graph any data on a line graph
3. True or False: All fractions are less than 1.
4. What is a numerical quantity that is not a whole number:
    A. Whole
    B. Fraction
    C. Area
    D. Volume
5. What is the type of graph that we used in this experiment?

Answer Key

1. B

2. False

3. False

4. B

5. Line Plot