

Name: _____

Period: _____

Pendulums: a look at data and variables

Challenge Criteria

- build a pendulum that allows you collect data
- change variables and collect data on the tests
- represent data in tables and graphs

Constraints

- you must use washers as your bob
- you must use the LEGO kits to build the pendulum
- the string for the pendulum will be provided
- you **must** work in a group of 2-3. 1 is not enough and 4 is too many.
- you have **2 class periods** to build your device and collect data

Groups - *this project requires team members to play different parts. Some of you will need to play more than one part. You don't need a project manager or parts manager.*

- parts manager
- builder
- sketcher
- data collector
- timer
- project managers

A. Pendulum construction

The pendulum has these basic parts:

1. Base structure - the base structure must be stable and free-standing. You can hold the base of the structure when the pendulum is swinging. Also, you will be increasing the height of your base structure, so think about that while you are designing it. **Your shortest base structure should be about 20 cm tall.**
2. The pivot - the pivot is what the string is attached to. It must move freely on the rod at the top of your base structure.
3. The bob and carrier. Your bob is made of washers and the carrier made out of LEGO. The carrier is tied to the end of the string. Your carrier allows you to take away and add washers without changing the length of your pendulum. You will start with one washer.

4. The pendulum is really just the length from the pivot to the center of the bob.

Make sure your first pendulum is at least 15 cm long.

B. Testing your pendulum

We want to make sure our pendulums work well, so our data is accurate.

⦿ A pendulum that is too short will not create the correct momentum to keep it going.

⦿ Friction at the pivot will slow it down.

⦿ Stability is also important. We want to avoid pendulums that sway back and forth too much.

***To test, pull the bob back about 30 degrees. Make sure it will pass the equilibrium point at least 25 times**

C. Data collection

1. Assign these roles in your group. Each person should try them all.

⦿ Timer

⦿ Counter

⦿ Pendulum controller

2. Start collecting data for the period of your pendulum

1. MEASURE THE LENGTH OF YOUR PENDULUM FROM THE PIVOT TO THE CENTER OF THE BOB. *Measure length to the tenths (ex: 17.4 cm)*

2. Pull back the bob (with one washer) to about 30 degrees.

3. Time how long it takes for 10 periods (use a timer). A period is one complete cycle from where you let go. *Measure time to the hundredths (ex: 21.34 seconds)*

4. Record your data in the data table on the next page.

5. Test 3 times and take the average

3. Add one more washer to your pendulum

1. Collect data the same way as #2

4. Make your base structure taller and your pendulum longer

1. Collect data as you did with the first pendulum. Make sure to measure your pendulum from the pivot to the middle of the bob. Start again with one washer. Increase the length of your pendulum by **at least 7 cm**.

5. Structure redesign

1. Redesign your structure to hang off a table on it's own with a pendulum attached. Lengthen the pendulum (about 10 cm) and collect data. Lengthen your pendulum a second time (about 10cm) and collect data. Make sure you get data for 1 & 2 washers for each length.

Length in cm	Trial #1	Trial #2	Trial #3	Average
___ cm / 1 washer				
/ 2 washers				
/ 1 washer				
/ 2 washers				
/ 1 washer				
/ 2 washers				
/ 1 washer				
/ 2 washers				

Answer the questions on your own

1. What are the independent variables (what we changed)?
2. What is the dependent variable (the data we collected)?
3. What are the control variables (controls)? What did we need to keep the same throughout all of the tests?

4. Did both of the independent variables cause a significant change in the period of the pendulum? Explain.

5. What were the priorities of the engineering part of the project?

6. Sketch and explain one modification your group had to make during the project.
Use your group sketch as a model. Try to refer to specific pieces.