**Catapults: Launching into Physics**

**Lesson 3: Launching Our Ideas**

**Stem Grant Grade Band Team: 6-8A**

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**Key Terms:**

**Math**: Angles, area, radius, diameter, and circumference.

**Science**: Force, distance, mass, Newton, velocity, and kilogram.

**Learning Objectives:**

Students will be able to:

1. calculate the area of two dimensional figures.

2. explain the relationship between area, radius and circumference.

3. apply their understanding of factors affecting projectile motion and levers.

**WMAS Science**

**D.8.5** While conducting investigations, explain the motion of objects by describing the forces acting on them

**WMAS Math (Common Core)**

 **7.G.4.** Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.

**Information & Technology Standards:**

**B.8.5.** Record and organize information

**Career Cluster Pathways in Manufacturing:**

Manufacturing, Production, Process, Development

**Materials:** 1 per group

Tape measure, protractor, target template/paper, large compass or push pin with string and ruler, spring scale, balance scale, Catapult Journal, Data Collection Chart, pencil, calculator, group catapult, ping pong ball, golf ball, rubber ball

**Procedures:**

**Day 1**

1. Hand out target template to each group.

2. Create a target following the directions in the packet.

3. Calculate the area of the three different circles within the target and record information in

 the Catapult Journal.

4. Hand out Data Collection Chart (1 per child).

5. Go over, step-by-step, the procedures with students.

6. Answer any questions they may have.

7. Students should gather materials.

8. Have each group place their catapults 1-5 meters away from their target.

9. Students should use the rest of the hour practicing and making changes to their design if

 desired and choose a specific angle to launch for the following day. (Make sure they record

 changes in their Catapult Journal)

**Day 2**

10. Hand out Data Collection Chart 2 (1 per child).

11. Students should use the entire hour filling out the Data Collection Chart in their groups and

 answering the lab questions.

**Assessment:**

**Pre-assessment**

Pre-test administered before the project begins.

**Formative Assessment**

Students will be assessed based on their Data Collection Charts and Lab handout (Data Collection Chart and Lab handout attached). They also have to construct their target template.

 **Post-assessment**

Students will complete the Post Assessment following Lesson 4.

**Reflection on REACT:**

1. **Relating**:
Students will use problem solving skills to create combinations of force and mass that will increase efficiency of a catapult. This could be carried over to different types of machines that they will encounter in everyday life.
2. **Experiencing:**
Before the lesson students will learn the key concepts in the lesson, such as force, motion, velocity, surface area, circumference, and measuring angles to name some. They will also research and construct a catapult that will be used in this lesson. During the lesson students will use the before mentioned skills to collect data on their catapult. After the lesson they will analyze the data collected to make conclusions on the efficiency of their catapult and then compare to other groups in the class.
3. **Applying:**They will take their knowledge of mass, force, velocity, and the units Newton and kilograms and apply them to collecting of data to improve the accuracy and efficiency of their catapult. Students will take their knowledge of area, radius, diameter, and circumference to construct the target. After collecting the data, they will use formulas and deductive reasoning to find the efficiency of their catapult.
4. **Cooperating:**
Students will work in groups to collect data and test catapults.
5. **Transferring:**
Students will take the data collected and analyze it to describe the accuracy/efficiency of their catapult and then take that data and compare it to other groups in the class. The process of data collecting will also help them in future science labs and math skills.

Catapults: Launching into Physics

Launching Procedures

Group Name:

Group Members:

Date & Time:

**Directions:** Follow the steps below, in order, to fill in data collection chart accurately. If there are any questions, please ask the teacher!

**Materials Needed:**

Tape measure, protractor, target template/paper, large compass or push pin with string and ruler, spring scale, balance scale, Catapult Journal, Data Collection Chart, pencil, calculator, group catapult, ping pong ball, golf ball, bouncy ball (Super Ball)

**Procedures**

**Day 1**

1. Collect enough red and white paper to make 3 red circles and 2 white of the following diameters:
	1. Red: 50cm, 30cm, 10cm
	2. White: 40cm & 20cm
2. Use your compass or push-pin compass to trace circles.
3. Cut out the circles.
4. Stack the circles, using the center point to line them up, from largest to smallest diameter and glue them together.
5. Label the point values on each circle of the target starting with 50 at the center circle and ending with 10 in the outer most circle.



50 points

10 cm in diameter

1. Calculate the area for each point ring.
2. Gather materials for launch (catapult, meter sticks, protractor, balls, target, and balance scale)
3. Enter in data for Day 1 Data Collection Chart
	1. Choose a force for your launch arm and enter into the table
	2. Choose a ball and measure its mass. Enter into table.
	3. Launch the ball a total of 3-5 times and enter distances for each.
	4. Calculate the average distance.
	5. Do steps a-d with two new forces
4. Decide, as a group, which amount of force you will use for your final testing and record your explanation in your Catapult Journal.

**Day 2**

1. Enter your force of launch arm for all three trials.
2. Choose a ball type and measure the mass. Record it in the Day 2 Data Collection Table.
3. Record the angle of your launch arm. This will remain the same for all trials.
4. Using the spring scale, measure the force it takes to pull the launch arm to the force you chose. Enter it into your data table under trial 1.
5. Launch the ball and record the distance in trial 1 column.
6. Do steps 11 and 12 four more times.
7. Repeat steps 10-13 for a golf ball.
8. Repeat steps 10-13 for a rubber ball.
9. Clean up area and put all materials away.
10. Put finished data tables into your Catapult Journals (tape or glue into it).

**Data Collection Chart**

**Day 1**

Force of Launch Arm:

Mass of Ball:

Type of Ball:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | Trial 1 | Trial 2 | Trial 3 | Trial 4  | Trial 5 |
| Distance (cm) | -------------- |  |  |  |  |  |

Average Distance:

Force of Launch Arm:

Mass of Ball:

Type of Ball:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | Trial 1 | Trial 2 | Trial 3 | Trial 4  | Trial 5 |
| Distance (cm) | -------------- |  |  |  |  |  |

Average Distance:

Force of Launch Arm:

Mass of Ball:

Type of Ball:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | Trial 1 | Trial 2 | Trial 3 | Trial 4  | Trial 5 |
| Distance (cm) | -------------- |  |  |  |  |  |

Average Distance:

**Data Collection Chart**

**Day 2**

Force (determined on Day 1):

Mass (kg):

Type of Ball: Ping-Pong Ball

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Trial 1 | Trial 2 | Trial 3 | Trial 4 | Trial 5 | Average |
| Distance (cm) |  |  |  |  |  |  |
| Angle |  | ----------------- | ----------------- | ------------------ | ----------------- | ----------------- |
| Point Value |  |  |  |  |  | Total Points |

Force (determined on Day 1):

Mass (kg):

Type of Ball: Golf Ball

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Trial 1 | Trial 2 | Trial 3 | Trial 4 | Trial 5 | Average |
| Distance (cm) |  |  |  |  |  |  |
| Angle |  | ----------------- | ----------------- | ----------------- | ---------------- | ----------------- |
| Point Value |  |  |  |  |  | Total Points |

Force (determined on Day 1):

Mass (kg):

Type of Ball: Rubber Ball

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Trial 1 | Trial 2 | Trial 3 | Trial 4 | Trial 5 | Average |
| Distance (cm) |  |  |  |  |  |  |
| Angle |  | ----------------- | ----------------- | ----------------- | ----------------- | ----------------- |
| Point Value |  |  |  |  |  | Total Points |