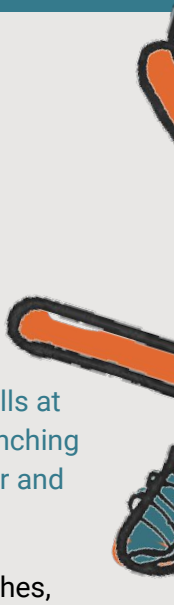
MAN THE CATAPULT!

ELEMENTARY SCHOOL LEVEL 1



The castle is under siege! Experimenting with upcycled materials, students will be launching cotton balls at their enemies in no time. Catapults use a lever with tension. A fulcrum is the leverage point for the launching beam of the catapult. By changing the position of the fulcrum, students can alter the length of the lever and distance/trajectory of the projectile.

EDUCATIONAL STANDARDS:

NGSS CONNECTION:
2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.*

2-PS1-3. Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.

COMMON CORE CONNECTION:
W.2.7 Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations).

W.2.8 Recall information from experiences or gather information from provided sources to answer a question.

MP.2 Reason abstractly and quantitatively.

MP.4 Model with mathematics.

MP.5 Use appropriate tools strategically.

2.MD.A.1 Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes.

2.MD.A.3 Estimate lengths using units of inches, feet, centimeters, and meters.

2.MD.A.4 Measure to determine how much longer one object is than another, expressing the length difference in terms of a standard length unit.

DOK:
Level 3 - Strategic Thinking
Level 4 - Extended Thinking

MATERIALS NEEDED:

- ❏ Craft sticks
- ❏ Rubber bands
- ❏ Construction paper
- ❏ Cotton balls

DIRECTIONS:

1. Build the Fulcrum by stacking 5 of the craft sticks on top of each other and fasten them using the rubber bands.
2. Attach two sticks tightly on one end with a rubber band.
3. Wedge the fulcrum between the two sticks.
4. Once students find the ideal fulcrum point, use a rubber band to fasten it in place to the other two sticks.

5. Use the construction paper to make a basket, use tape or glue to hold it in place.

6. Put a cotton ball in the basket and let it fly!

OBJECTIVE:

Students will be able to design a catapult through an iterative process to compete in a carnival challenge to defeat the Dragon.
*Teacher or students can create game setup (Think of a cornhole/bean bag toss game or duck shooter game)

ESSENTIAL QUESTION:

- How might we create a catapult to launch objects at the dragon to win?

TAKE IT TO THE NEXT LEVEL:

- How far can you get the cotton ball to soar? How high? What do we need to adjust?
- Can you measure and keep track of the distances?
- Can we scale this design up to make a large device?
- How about building targets? Can you hone in and hit your mark?

FUN FACTS

A. Catapult translates to “war machine for throwing” in Latin!

B. There are 3 types of Catapults; the *Mangonel* (the design you most likely are familiar with), the *Ballista* (looks like a giant crossbow!), and the *Trebuchet* (a giant sling-like catapult).

C. The world record for a modern catapult is currently held by the "Chucky III", which hurled a ~10 lb pumpkin 3,636 ft!

ENGAGE:

1. Read books on dragons, knights, catapults with students
    a. The Knight and the Dragon, Tomie DePaola
    b. Days of the Knights: A Tale of Castles and Battles, Christopher Maynard
    c. A Year in the Castle, Rachel Coombs
    d. Break the Siege: Make Your Own Catapults, Rob Ives
2. Introduce the project as a carnival game to students.

EXPLORE:

1. Task students with discovering ways to make a catapult (launcher)
    a. Students can explore the various Two Bit Circus Foundation materials
    b. Sketch, write out different designs to try. Use different materials.

    *Students should have a healthy level of independence during this portion. There a are a multitude of ways students can design a catapult. There is no "right answer"

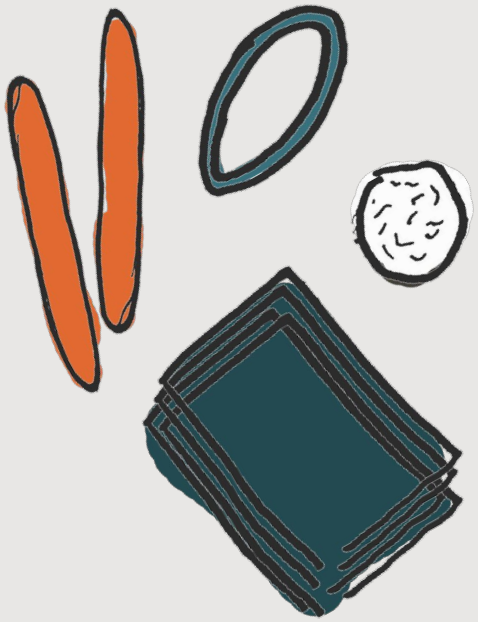
2. The teacher facilitates student progress through positively constructed guided questions.
    a.How does your design work?
    b.How might we allow the catapult to launch an object higher? Faster?

EXPLAIN:

1. Students build their initial catapults
    a. There will be significant design challenges and failures
    b. Support students without directing and encourage problem-solving.
2. Challenge students' thinking and encourage growth
3. Question (Informal evaluation)
    a. "What if you made this an inch longer?"
    b. "What happens if you use another material?"
4. Give mini-lessons when needed on lever and fulcrum. (Two Bit Circus Foundation has simple machine setups available)
    a. The project may be combined with other science principles (Newton's laws, energy, torque)
    b. Students could conduct an exploration activity—who made the first lever/fulcrum?
5. Have students test how various materials affect the catapult. (Informal evaluation)
    a. Rank materials
        i. Flexibility
        ii. Hardness
        iii. Heaviness
    b. Make different versions to test

ELABORATE:

1. Students revise their designs to improve them.
    a. Improvements should be seen in lever and fulcrum designs
    b. Improvement in accuracy.
2. Probe students for understanding (evaluation criteria)
    a. Challenge their science understanding
    b. Ask for precise measurements of lever arms and other components
    c. Question their Design Thinking Process
        i. Why did you pick these materials?
        ii. Why did this configuration work best?
        iii. Would you make any future changes if you had to do this again?
        iv. What have you learned as a team?
3. Students compete in the challenge
    a. Teams take turns launching objects at the Dragon board
        i. Record scores for each team
4. Reflection
    a. Have students reflect further on their designs and those of others
        i. Do a gallery walk to showcase student work
        ii. Encourage the diversity in designs
        iii. Encourage the mentality of “failing forward”
            1. Failures are great learning tools
            2. Positive reinforcement of success



CATAPULT DESIGNS: SKETCH YOUR IDEAS

STUDENT HANDOUT

NAME:_____

Material	Flexibility	Hardness	Heaviness

Sketch Your Ideas

Materials tried	Purpose