

Lesson Plans: Simple Machines, Odd Machine

The Lever as a Machine

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Grades 6-8

Time required: 60 minutes

Materials required:

Part A: various objects that could be used as a lever such as a ruler, plastic serving spoons, meter sticks, swimming noodles, CD case, paint sticks, plastic knives or forks, etc. Choose fun objects that are not too heavy and will not injure students if dropped. You will also need a small bucket or box to catch marshmallows.

Part B: low-temp mini-glue guns, mini-glue sticks, rubber bands of various sizes, popsicle or craft sticks, coffee stirrers, straws, large paper clips, plastic spoons, string, 3 x 5 index cards, scissors, rulers, Ziploc baggies-gallon size, small post-it notes (approximately 1 cm width), sharpie marker and jumbo marshmallows. Timer

Teacher Preparation: (Prep-time approximately 1 hour)

Part A: Pre-Machine Launch

Gather a variety of lever type objects such as paint sticks, plastic serving spoons, etc so that each student will have one to use. Purchase 1-2 bags of jumbo marshmallows for launching. Have sharpie pens available for students to mark their marshmallow before launch.

Part B: Catapult Construction

All materials can be purchased at a grocery store or discount store such as Wal-Mart or K-Mart, etc. When purchasing items, try to incorporate as much color as possible so students can create fun products (Fluorescent color index cards and color rubber bands and straws). Students will work in groups for the activity (preferably 3-4) and each group will need a bag of materials. Set-up each bag as follows:

- 2 3 x 5 index cards
- 3 large paper clips
- 2 mini glue sticks
- 10 craft or popsicle sticks
- 10 rubber bands of various size
- 5 coffee stirrers
- 2 straws
- 1 plastic spoon
- 1 12 inch piece of string
- 1 pair of scissors
- 1 metric ruler

- 1 gallon size zip-loc bag (all materials will go in here to give to student groups)

Have small post-it notes available for student use after catapults are built.

Learning Objectives and Educational Goals:

- Students will use an everyday object as a simple machine, the lever.
- Students will define first, second, and third class levers.
- Students will design a machine that uses a lever as a central component.
- Students will test various machine designs and evaluate their performance as it relates to the task.
- Students will identify the fulcrum, the resistance force, and the effort force on a student designed machine.
- Students will identify the class of lever used in a student designed machine.
- Students will evaluate the effectiveness of the different classes of levers in various machines.
- Students will discuss possible improvements to their designs and evaluate their machines effectiveness.
- Students will describe how forces act on their machines and determine its effectiveness.

Procedure:

Part A: Opener-

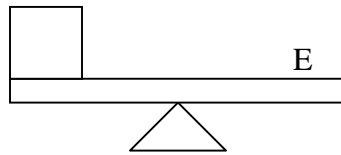
1. Students will be given a jumbo marshmallow at the beginning of class and instructed not to eat it! Under teacher supervision, students will need to use a sharpie marker to label their marshmallow with their name or some identifying mark.
2. Teacher will give each student an object such as a large plastic serving spoon, ruler or meter stick, swimming noodle, etc that could be used as a lever. Say to students: "Today is the day you get to have fun getting back at your teacher for all that homework I have given you in science this year! In a moment, when I say go, you will use the object I gave you as a tool to launch a marshmallow at me. There are two rules you have to follow though. Number 1: The marshmallow may only be touching the object before it goes into the air (in other words, you may not launch it with your hand). Number 2: The object must be touching the desk or chair as you launch the marshmallow (in other words, you may not use your object like a bat to hit the marshmallow at me!) Are there any questions?"
3. Instruct students to set up their tools to launch the marshmallow. Accept any way they choose as long as it follows the rules. Most students will choose to use their tool like a lever. Do not use the word lever when talking about it to the students until after launch discussion. Remind

students to use safety precautions when launching their marshmallows by being careful not to hit another student with their tool. Students will all launch at the same time at the count of three.

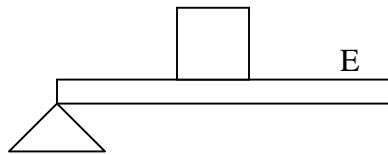
- Put on your goggles and move about 3 yards away from the students into "launch zone." Use a bucket or box to try to catch the marshmallows as they are launched. When you are ready, count to three and allow students to launch marshmallows. Here is where I really ham it up with students..."ahhhhhhhhhh, help me! and watch out!"
- After launch, have students help to gather all marshmallows and place in bucket for use later. Ask students to describe to you how they used their tool to launch the marshmallow. After several students answer, have students identify the simple machine they used to launch the marshmallow. Students should begin to see they are using tools as levers; you may introduce vocabulary at this time.
- Briefly review or describe the main parts of a lever to all students. The fulcrum, the resistance force, and the effort force. You may also include illustrations of the three classes of levers.

Three classes of levers:

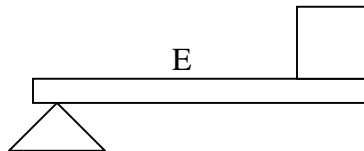
1st class lever



2nd Class Lever



3rd Class Lever



- Ask students to identify which lever most used to launch the marshmallow in the opening activity. Most will probably realize they used their object as a first class lever. (Ex.

Placing marshmallow on one end and applying force to the other end to get it in the air with the desk or table serving as a fulcrum.)

8. Prepare students to move to lab or activity tables for Part two.

Part Two: Catapult Design and Construction:

1. Divide students into groups of two or three students. Students should be instructed to prepare to design and build a catapult to launch their marshmallow at the teacher. Each group will be given a baggie of materials (see teacher preparation section) to use to construct their catapults. A brief description of catapults may be given as well. (I generally DO NOT show pictures, because I want them to free design and figure out what type of lever works the best without seeing successful designs first.)
2. Instruct students they may use the scissors, ruler, and glue gun to help build their catapults, but they may not be parts of the actual catapult. All other materials may be used as part of the catapult.
3. Students are first instructed they may take all the materials out of the bag and examine them. Give the students 3 minutes for brainstorming. Students may NOT start building yet, but instead they should talk with their partners about the possible designs and share ideas with each other as a team. Start timer set for three minutes. Remind students to think about the classes of levers, forces, and materials as they create their ideas for the catapult.
4. When time is up, reset timer for 25 minutes. Instruct students they now have 25 minutes to design and build their catapults. At the end of the 25 minute time period, construction will stop and students will test their designs. Begin timer and instruct students to begin working.
5. As students are building their catapult, move around the room to each students group and ask questions about design choices and how they think forces and levers play into their design. Also talk to students about good structures (shapes such as triangles, and using bracing) but don't just give these ideas out...try to encourage students to figure them out as they go and evaluate their choices.
6. After about 15 minutes, tell students they may have one and only one additional item by request, but they must talk about it with their group and be sure about what they want because they will only get one. This will allow students some flexibility beyond what the kit contains yet also help them assign a value to their choice.
7. When the timer reaches 25 minutes, instruct students to stop working. (If students appear to be struggling and need a few additional minutes, I will

- generally allow them some time. Most students come up with a working product in the 25 minute time period.
8. Assemble students together with their catapults. Hand out the marshmallows from Part A and allow students to shoot their catapults at the instructor as they did earlier. Students may not see marshmallow fly as far, but they should be more controlled and more likely to hit the bucket. Allow students two or three tries at shooting their catapults.
 9. After testing begins, hand out three small post-it notes to each group. Tell students to label the notes as follows: resistance, effort and fulcrum (each on a different note).
 10. After students label their machines, have students sit in a circle and check their answers with other students by leading a class discussion. Did they label the effort and resistance correctly? Did they identify the correct fulcrum? Ask other students to agree or disagree and make sure that all machines are labeled correctly.
 11. As the student discussion takes place, ask students to identify which class of lever they built based on the location of the fulcrum, resistance and effort forces applied. (Most students will build a second class lever and some will build 1st class levers.)
 12. As the discussion continues, bring in additional examples to compare to their machines and also examples of the types of levers found in the human body (Head/Skull- First class, Foot-Second class, and arm-third class).
 13. Set up a catapult hall of fame for all students to display their catapults at the end of the discussion. Small prizes may be awarded as well for longest shot, most sturdy construction, etc.

Every group that participated in this activity in my classes was able to build a successful catapult. Second class lever catapult generally do the best. I only had one catapult that did not work after its first test. Have fun and good luck! The kids love doing this and come up with some pretty creative designs!!!

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