MINI CATAPULTS (K-G2)

In this workshop, students will engineer a working catapult to take home. The Works Museum's educators will provide a prescribed set of materials to use during building, basic instructions, and a variety of examples for students to use as their construction guides. Educators will also instruct and monitor students for safe tool use. Students will have time to test their catapults' flinging ability, in order to refine the design and understand how projectiles fly. See p. 3 for standards this workshop supports.

SCIENCE CONCEPTS

Catapults are excellent examples of objects made of smaller components that each make a job easier.

- The catapult has many different parts that each perform an important job: the base, the launch arm, etc.
- The choices students make in designing and building each part affect the performance of the finished catapult.

Objects move because of **forces**.

- Students **pull** back on the catapult, powering it up.
- When released, the catapult's moving arm **pushes** a projectile, making it move in turn.
- **Gravity** and **air resistance** eventually stop the projectile.

Educators will also stress the [Engineering Design Process] to students.

- Students will have ample time to test their catapults with provided projectiles.
- They will investigate weak areas of their catapult's build, and strengthen and improve on their first attempts.
- Educators will stress that the cyclical process of design, create, test, and redesign is more important than attempting to achieve a working catapult on the first try.

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BEFORE YOU VISIT

What makes objects start moving or stop moving?	Some force acts on the object. Gravity might make an object fall, or the ground might stop it. People might push an object, or the air or ground might slow it until it stops.
What happens when one part of a machine breaks?	Sometimes the whole machine stops working, or sometimes it doesn't work as well as before. And sometimes a part is just for show, and the machine keeps working.
Is there one way to make any machine?	Not often. Cars must have wheels, an engine, and seats, but come in many shapes and sizes. Students' catapults will all have some parts in common, but will look—and sometimes behave—quite differently.

AFTER YOU VISIT

Questions

- Ask students to discuss the changes they made to their catapults during the workshop. What specific changes did they make? Why? Here is a good time to talk about vital changes (i.e., part of their catapult fell apart and required strengthening), versus improvements (i.e., the student wanted their projectile to go farther and made appropriate changes).

Activities

Students should have time during the workshop to refine their catapult design and compare with other students. But teachers can take this further.

- Teachers and students can compare and contrast the shape of the path projectiles take from different catapults.
    1. The length of the launch arm affects the projectile's path. What differences or similarities do students notice across designs?
    2. The amount of "kick" the catapult has depends on the student's choice of design. Which catapults seem to have the most power? Do they share any design details?
- With different or more materials, how can students design better projectiles? Students might cut shapes out of foam. Marshmallows and gummy candy might also be appropriate, but teachers should beware of hard objects that could be effective—but dangerous!—projectiles.

CAREERS THAT USE ENGINEERING

Carpenter: For people who like working with their hands, carpentry is a field with many different kinds of work. Carpenters might be responsible for creating and building furniture, like cabinets and tables. Or they might do the physical work of building a house.

Mechanical engineer: More highly technical than a carpenter, in many ways mechanical engineers use the same basic skills. Engineers spend their time figuring out how to design and build a machine or object to do a specific job. Mechanical engineers might design a new car motor, or build a skycrane to drop a robot on Mars.

Biomechanical engineer: If people seem more interesting than machines to some students, bioengineering might interest them. These engineers need to study biology and anatomy, but do not need to become doctors. They combine science of living things with physics and mechanical engineering concepts to design and build medical devices, including prosthetic arms, legs, and hands.

Learn about **more careers** that use engineering!

MINNESOTA ACADEMIC STANDARDS FOR SCIENCE K-12

0.1.1.21 Use observations to develop an accurate description of a natural phenomenon and compare one's observations and descriptions with those of others.

1.1.1.1.1 When asked "How do You Know?", students support their answer with observations.

1.1.3.1.1 Observe that many living and nonliving things are made of parts and that if a part is missing or broken, they may not function properly.

1.1.3.2.1 Recognize that tools are used by people, including scientists and engineers, to gather information and solve problems.

2.1.2.2.1 Identify a need or problem and construct an object that helps to meet the need or solve the problem.

2.1.2.2.2 Describe why some materials are better than others for making a particular object and how materials that are better in some ways may be worse in other ways.

2.2.1.1.1 Describe objects in terms of color, size, shape, weight, texture, flexibility, strength and the types of materials in the object.

2.2.2.1.2 Demonstrate that objects move in a variety of ways, including a straight line, a curve, a circle, back and forth, and at different speeds.

2.2.2.2.1 Describe how push and pull forces can make objects move