Digger

Category: Physics: Mechanics

Type: Make & Take

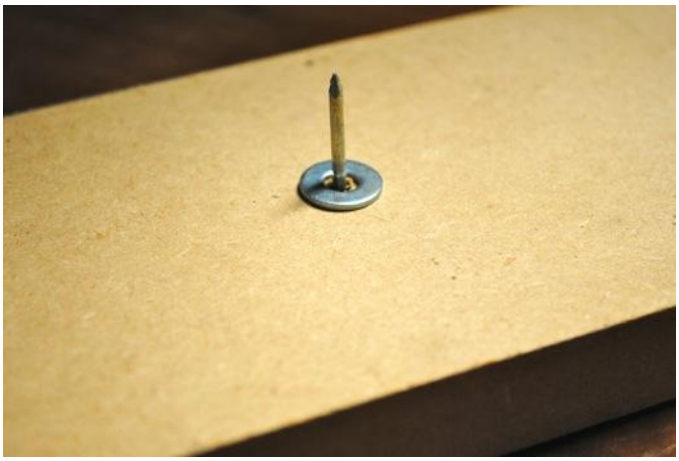
Rough Parts List:

5	Large craft sticks
3	Blocks of wood of different sizes
1	Cup
1	Nail
1	Washer
1	Binder clip
	Pushpins
	Hammer
	Hot glue gun

How To:

Drill 5 evenly spaced holes into the craft sticks.

Drill a hole in the center of the largest wood block.



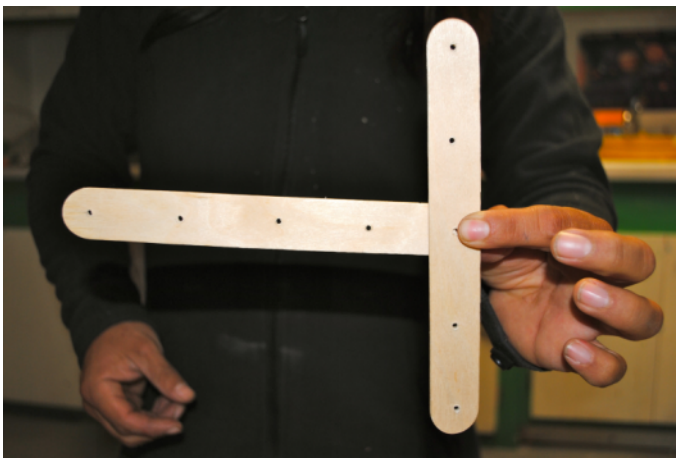
Hammer a nail through the wood block and place a washer over the nail.

Hammer a 2nd piece of wood onto the nail.

The two blocks of wood should be loose enough to spin around.

Glue a smaller block of wood onto the edge of the 2nd block.

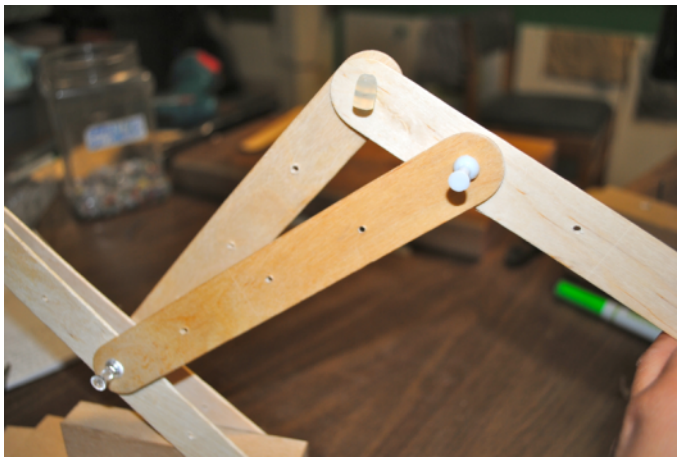
Pin a craft stick near the edge of the 3rd block.



Glue 2 sticks together in the shape of a T.

Tack the T to the other side of the block.

Tack a craft stick in the
center hole of the 1st craft stick.



Attach the 5th craft stick by
pinning the 1st hole to the stationary "T" stick
and the 2nd hole to the mobile pinned "T".

Attach a clip onto the end of the 5th stick.

Glue a cup onto the flat part of the clip.

Operate the crane to scoop
and drop different items.

Fine Points:

→ Pin position can be changed on the stick with the cup. Try putting them farther apart or more toward the cup-end of the stick.

Concepts Involved:

- Many machines use levers to help do work. If you look at bulldozers, backhoes, cranes, and other construction equipment, there are levers everywhere.
- Levers can increase or decrease a force, and increase or decrease the distance it moves. However, when one of these quantities increases, the other always decreases.
- Multiple levers working together can multiply the effect of any single one of them.

Elaboration:

Simple machines help us do work. There are three basic simple machines: the pulley, the inclined plane, and the lever. Each one takes an input force and multiplies it, or decreases it while increasing its distance. The equation is W = f x d, that is work equals force times distance. Work in equals work out – that's the Law of the Conservation of Energy – and so you don't get something for nothing.

Usually we think of levers increasing force, such as the examples of a long pole lifting a heavy object, a jack handle, scissors or a long-handled wrench. They can just as well increase distance though, as in the example of the zigzag arm and most levers on machines and in our body. Think of your forearm. The elbow is the pivot point, called the fulcrum. The muscle to pull up the forearm pulls very near the elbow so it moves a small distance. But your hand, holding something such as a ball, moves a much longer distance. Again, you don't get something for nothing, so your arm muscle is providing a much larger force than the one that is given to the ball.

Increasing the size of the sticks or arms in this project would increase their reach, but the ratio of movement would stay the same. So, for the lever arm, if your fingers move two inches pulling the two end levers together but the pompom goes forward 20 inches, that is a one to ten ratio. With bigger sticks, the ratio would stay the same, but the distances would increase.

Focus Questions:

1. What would happen if you doubled the size of the sticks on this project?
2. What do you think would break first on the Digger if you tried to move too heavy of an object?
3. Brooms and seesaws are examples of levers. Can you think of a few more levers that you use every day?

Links to k-12 California Content Standards:

Grades k-8 Standard Set Investigation and Experimentation

Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other strands, students should develop their own questions and perform investigations.

Grades k-12 Mathematical Reasoning:

1.0 Students make decisions about how to approach problems:
1.1 Analyze problems by identifying relationships, distinguishing relevant from irrelevant information, sequencing and prioritizing information, and observing patterns.
1.2 Determine when and how to break a problem into simpler parts.

2.0 Students use strategies, skills, and concepts in finding solutions:
2.1 Use estimation to verify the reasonableness of calculated results.
2.2 Apply strategies and results from simpler problems to more complex problems.
2.3 Use a variety of methods, such as words, numbers, symbols, charts, graphs, tables, diagrams, and models, to explain mathematical reasoning.
2.5 Indicate the relative advantages of exact and approximate solutions to problems and give answers to a specified degree of accuracy.

3.0 Students move beyond a particular problem by generalizing to other situations:
3.1 Evaluate the reasonableness of the solution in the context of the original situation.
3.2 Note the method of deriving the solution and demonstrate a conceptual understanding of the derivation by solving similar problems.
3.3 Develop generalizations of the results obtained and apply them in other circumstances.

Grade 2 Standard Set 1. Physical Sciences:

The motion of objects can be observed and measured.
1.c Students know the way to change how something is moving is by giving it a push or a pull. The size of the change is related to the strength, or the amount of force, of the push or pull.
1.d Students know tools and machines are used to apply pushes and pulls (forces) to make things move.

Grade 3 Standard Set 1. Physical Sciences (Energy & Matter)

1.d Students know energy can be carried from one place to another by waves, such as water waves and sound waves, by electric current, and by moving objects.

Grade 8 Standard Set 2. Forces:

Unbalanced forces cause changes in velocity.

2.a Students know a force has both direction and magnitude.