

Western Engineering Outreach

Construct a Crane

Grade 3-5

Meet Today's ENG HERO!



S.F. Asokanathan - Professor with Western Engineering

S.F. Asokanathan is a Professor in the Department of Mechanical and Materials Engineering at Western University. Dr. Asokanathan completed his B.Tech (Mechanical Engineering) in India and his PhD (Solid Mechanics Division) in the University of Waterloo, Canada. Professor Asokanathan's research interests are in the areas of Dynamic Systems and Control as applied, in particular, to Flexible Structures and Rotating and Axially Moving Flexible Multi-body Systems. Specific applications cover a range of Mechanical, Aerospace and Biological Systems.

To learn more about Dr. Asokanathan visit:

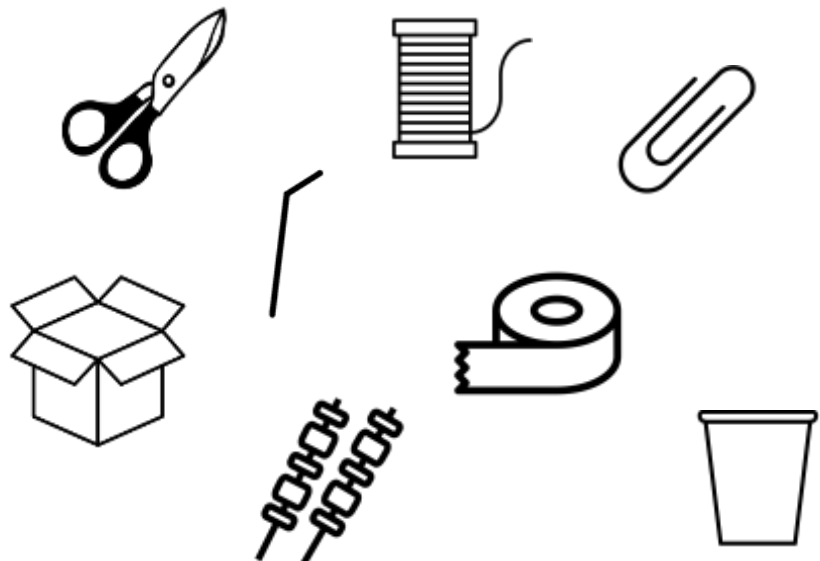
https://www.eng.uwo.ca/mechanical/faculty/asokanathan_s/index.html

Learning Goal:

- Pulleys change the speed, direction, motion of, and the force exerted on moving object
- Pulleys make it possible for a small input force to generate a large output force
- Curriculum Connections: Grade 3- Forces Causing Movement: Grade 4- Pulleys and Gears: Grade 5- Forces Acting on Structures and Mechanisms.

Materials Needed:

- 2 Skewers
- 2 Straws
- Tape
- Scissors
- Cardboard
- String
- 1 Paperclip
- 1 Cup



Engineering and Science Connections:

Today, we will be exploring Pulleys!

What is a Pulley?

Pulley systems are basic but extremely useful in many aspects of our lives. They can be used to lift objects, or more generally, to move an object in a continuous line. Fixed pulley systems are attached to a fixed point, and the rope is attached to the object. It is one of the original simple machines; their initial use was to lift buckets of water from wells. Some other modern examples are:

- elevators
- cranes
- exercise equipment
- flag poles
- curtains at a theatre

Note how most of these examples deal with lifting heavy objects.



What type of engineering do pulleys relate to?

A Mechanical Engineer! Mechanical engineers work with anything that moves: such as cars, trains, busses, planes, and anything that has moving parts such as clocks. Mechanical Engineers are responsible for a lot of things in our daily life like:

- Designing a safety harness for rides in amusement parks
- Functionality of solar panels on a space telescope
- Designing and development of surgical robots to improve the process

Fun Fact: The cruise control was invented by a blind mechanical engineer, Ralph Teetor.

What is Mechanical advantage?

Advantage gained by using simple machines to accomplish work with less effort. This is a major goal for engineers, though it comes at the cost of more needed materials, or more distance needed for the machine to work.



Video Recommendation:

What is a Pulley? How do they work?

<https://www.youtube.com/watch?v=LiBcur1aqcg>

Activity:

Before beginning, think about the following questions:

- Where have you seen a pulley before?
- What could you use a pulley for?
- What does a pulley system consist of

Building Your Crane

Today we are all Mechanical Engineers. We are challenged to build a crane that can carry a cup of water without spilling it.

Part 1: Hand Crank

1. First, grab a cardboard box making sure it is standing up and strong (tape the sides). Put something heavy in it to keep in its place.
2. Using scissors or a safety knife, cut through the box making a small door as shown on the right.
3. Using a screwdriver poke a hole big enough for your straw (put 2 straws inside each other for a better result)



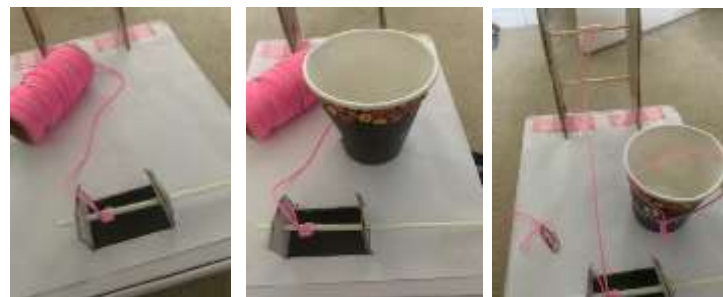
Part 2: Arms

4. To make the arms, cut 2 rectangular pieces of Cardboard (make them equal in size). Cut the sides to be on angle, and tape them to the box from the angled side. (you can use hot glue if you want)
5. Cut the skewer into 3-4 pieces, tape them together to make it thicker.
6. Insert your straws in the holes you made in step 3.
7. Using hot glue, stick them between the 2 arms as shown



Part 3: Final Touches

8. take one end of your string and tie it tightly around the straw from the first few steps, and hot glue it to the straw to prevent rotation.
9. Poke 2 holes to the top of the plastic cup to insert the string.
10. take the string and place it behind the first skewer, up to the front of the second one then tie it to a paperclip.
11. Cut a short piece of string, tie one end to the cup using the hole, and the other side of the string to the second hole, then hang it on the paperclip.
12. Fill the cup with water (or anything else) and use the straw as a hand crank to pull up the cup.



What Did You Learn?



- What is a Pulley?
- Why do we need pulleys?
- What would happen if pulleys didn't exist?
- Name 3 different examples of pulleys?
- What do we do to make our pulley stronger?

Future Learning



- Now that you have built a crane, try building a different type of pulley, using different materials from around your house. Did it work? What are the key parts to a good pulley?

Share your creations!

We would love to see what you made. Email us at discover@uwo.ca or tag us on social media.

Instagram: @westemueng

Twitter: @westemueng

Facebook: @westemueng

Thanks for discovering with us!