Western Engineering Outreach

DIY Lock Box

Grade 3-5

Meet Today's ENG HERO!

Louis Ferreira - Professor with Western Engineering

Louis Ferreira has a joint appointment in the departments of Surgery, and Mechanical & Materials Engineering at Western University. His research is primarily in the field of Medical Mechatronics, with special interest in orthopaedic surgery and the biomechanics of major joints. The focus of his work is to improve outcomes and eliminate unnecessary surgical revisions. *To learn more about Dr. Ferreira visit:* https://www.eng.uwo.ca/mechanical/faculty/ferreira_l/index.html

Learning Goal:

- Students will explore mechanical engineering as they design and build their own functioning lock box. They will see how the pieces of the box must work together to function properly.
- Curriculum Connections: Grade 3 - Forces causing movement, Grade 4- Pulleys and Gears, Grade 5: Forces acting on Structures ad Mechanisms.

Materials Needed:

- Cardboard
- 1 Skewer
- Scissors or safety knife
- 1 small Paper
- 1 Marker
- Hot Glue or any strong Glue

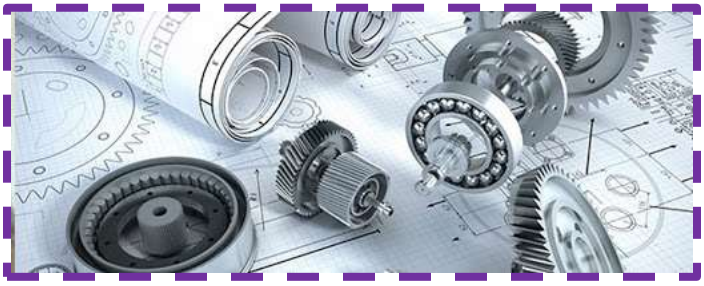
DIY LOCK BOX

Engineering and Science Connections:

Today, we will explore mechanical engineering as we design and build our own functioning lock box.

What is Mechanical Engineering?

- Mechanical engineering is one of the broadest engineering disciplines. Mechanical engineers design, develop, build, and test. They deal with anything that moves, from components to machines to the human body.



What is a Lock Box?

- Basically, it is a device that selectively allows entry, depending on whether the person trying to enter has the correct key or code

Why is it helpful to have a Lock Box?

- Keep things safe, keep important things secure, prevent theft, etc.
- Locks have internal mechanisms that need to be designed precisely in order for the lock to function. More frequently now, locks use more than mechanical pieces. Think of a door lock that requires a combination typed into a keypad. This type of lock requires the use of electronic circuitry to function.

What is a combination lock?

- A type of locking device in which a sequence of symbols, usually numbers, is used to open a lock.
- Combination locks have existed from as early as 1206. An engineer named Al-Jazari documented a combination lock in his book called *The Book of Knowledge of Ingenious Mechanical Devices*. Two such locks are kept in museums in Boston and Copenhagen.
- Some common uses for combination locks are seen in bicycle locks, briefcases, and locker locks.

Video Recommendation: *How does a Combination Lock work?*

https://www.youtube.com/watch?v=sftkP4CjjZs

DIY LOCK BOX

Approximate Measurements:

Outside box:

- Wide rectangle = 30 cm x 12 cm
- Thin Rectangle = 30 cm x 6 cm
- Back of base = 12 cm x 6 cm

Drawer:

- Base = 25 cm x 10 cm
- Long Sides = 25 cm x 4.5 cm
- Back and front of drawer = 10 cm x 4.5 cm
- Extra front rectangle = 12 cm x 7 cm →

Lock:

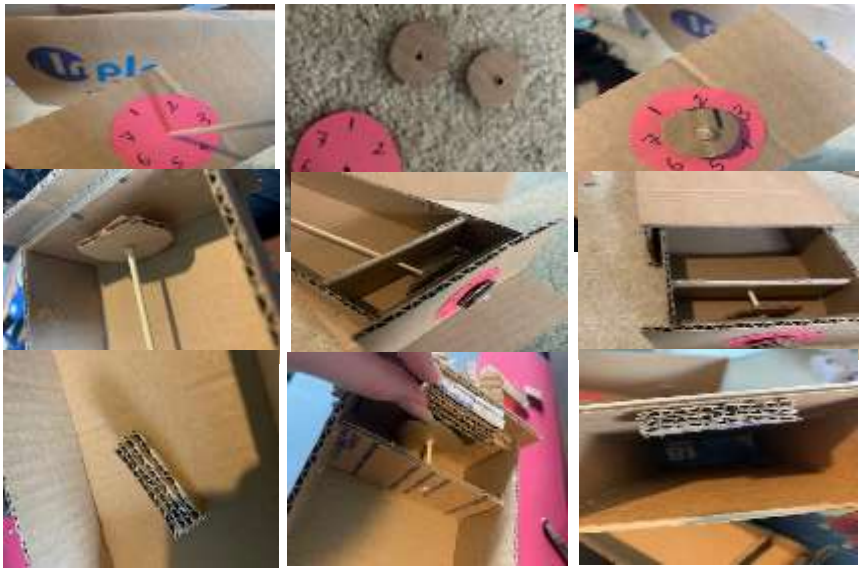
- Inside lock = 2 cm Diameter.
- Top block = 1.2 cm →

Activity:

Rather than making a combination lock, we will make a secure box with only one cam (the disk that locks and unlocks the box). To unlock it, it must simply be in the correct position, which students will note before they finish the box.

1. Cut out your cardboard, and make a box with one opening (front)
2. Now to make the drawer, cut the base and make sure it is slightly smaller than the box so that it slides in the box we have made.
3. Cut out the rest of the rectangles to make a box with an open top.
4. Glue another layer to the front of the drawer.
5. Cut another rectangle that is bigger than the front of the drawer as shown in picture 7. And insert a skewer through all layers.

6. On a piece of paper, draw a circle small enough to fit on the front of he drawer, and write however many numbers you would like. (one of those numbers will be the passcode)
7. Cut out 2 smaller circles of cardboard, glue them on top of each other.
8. Insert the 2 small circles in the skewer on top of your code paper, glue the end of the skewer to the 2 circles.
9. From the inside of the drawer, insert a circle with a straight edge and glue it to the skewer.
10. Cut out another rectangle, insert it in the drawer. Glue the skewer to it, then cut out the rest of the skewer.



11. Glue few rectangles on top of each other, make it as thick as the distance between the edge of the circle and the top of the drawer. (Do not glue it yet)
12. Now take that piece and glue it to the top of the box that was done in the first few steps of this activity.
13. Slide the box inside the drawer with the edge of the circle facing upwards, mark your code.
14. Put your stuff in the drawer, close it, and turn the cam to lock it.

What Did You Learn?

- What is a lock box?
- Why is it important?
- What type of engineering is involved?

Future Learning

- Turn this activity into an experiment! Unlocking a box with one cam could be easy, now try to create a lock box that has 3 cams, to make it hard for others to open it.

Share your creations!

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

Instagram: @westernueng
Twitter: @westernueng
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Thanks for discovering with us!