Hydraulic Scissor Lift

Objective

To build a demo hydraulic scissor lift
and to study the underlying principles

Background

Pascal's principle
A pressure applied at any point in an enclosed
fluid is transmitted equally in all directions.

Mechanical advantage of lever
Lever amplifies the input distance at the output

Materials

Popsicles
Syringes (10 ml and 20 ml)
Tube
Cotton swabs
Copper wire

Procedure

Make 3 holes in the popsicles - right, center, left
Connect the popsicles together to form an X
Connect the Xs together
Connect the top platform
Connect the two syringes together using the tube
Connect the output piston to the bottom X

Observations

Pascal's principle

1. When the input syringe piston is pushed in,
   the output syringe piston moves out

2. Since the input syringe is wide and the output syringe is narrow,
   for a short in-movement for the input syringe,
   the output syringe has a relatively long out-movement

Mechanical advantage of lever

1. When the ends of the X are brought together,
   the X becomes tall

2. For a short horizontal movement,
   the vertical movement is relatively large

Experiments

When the input syringe piston is pushed all the way in,
the output syringe piston moves out,
which brings the ends of the X together,
that extends the lift (tall and skinny)
Maximum height = cm

When the input syringe piston is pulled all the way out,
the output syringe piston moves in,
which pushes the ends of the X apart,
that contracts the lift (short and squished)
Minimum height = cm

Limitations

Compressible Fluid

Since air is compressible, when the input piston is pushed in,
the output piston does not push out as much as it would have
if the fluid were to be incompressible

Friction

Some input effort is lost due to friction

- Friction between syringe piston and syringe cylinder
- Friction between popsicles and cotton swabs
- Friction between popsicles and base

Strength

Since popsicles are not very strong,
the lift is not very strong and hence can not bear heavy loads.

To try next

Replace air with water

water is less compressible than air

Replace popsicles with wood or metal

stronger material can build a sturdier lift which can lift heavier loads

References

https://www.wikiwand.com/en/Pascal's_law
https://www.wikiwand.com/en/Lever