Safety Contract (5-10 minutes)

Hand out the Science Safety contracts. Go over each expectation--one by one. Talk about why that expectation is important and what could happen if we didn't follow them. When done, ask children to sign them and to glue them in notebooks!

Simple Engagement (30 minutes)

Guide children to the scientific concept they will be learning through an activity.

The experiment will be simple.
The experiment will use the contents of the box.

In this case, pull out 2 syringes from the box.
Fill 1 syringe with water. Connect a tube to the empty syringe.
Push and Pull the plunger of a syringe. What happens?

Explain Pascal's Law.
Explain about compressible and incompressible media.

Video: https://www.youtube.com/watch?v=YlmRa-9zDF8

Show the class some pictures and videos of hydraulic systems.

Experiment by removing the water and operating syringes on air.

Ask children to record this data.

Today's lesson is about Hydraulic Systems

The basic idea behind any hydraulic system is very simple; force that is applied at one point is transmitted to another point using a liquid (that can not be **compressed**). Pull out a syringe from your box and attach it to another syringe. Make sure that plunger of one syringe is completely inside and that of other syringe is completely outside. Now push the plunger of the syringe inside. What happens? The plunger of other syringe moves outside. Now apply force on the plunger that is moving outside so as to stop it from moving further. You will notice that you are still able to push the plunger of syringe inside. This is because air is compressible. Meaning air can be compressed. But liquids or solids cannot be compressed easily. Fill one syringe with water and now repeat the process. What happens? You are not

able to push the plunger of the syringe inside and if you force it too much the water comes out of the connecting pipe. This happens because water is less compressible than air.

What you have built right now is a hydraulic system. Pushed water forces water in the connecting tube to move into the connected syringe. To make space for this water, the plunger of the connected syringe moves outwards. This moving plunger then can be connected to a mechanism. Hence, pushing/pulling of plunger moves the mechanism forward/backward, up/down.

Project Engagement

1. Reading Instruction Manual and identifying parts (10 minutes)

a. Guide the children through the basics of Instruction Manual.

2. Construction (150 minutes)

a. Build and Explore.

b. When Rack and Pinion mechanism is being built, introduce children to gears. Gears are toothed wheels that are used to transfer power from one part of a machine to another. For gears to work perfectly, their teeth must match with one another; too loose or too tight, and the teeth get stuck. In your crane, one of the gears is circular whereas the other one is straight. This straight gear is called RACK and the circular gear is called PINION. When the straight gear pushes forward, the circular gear rotates.
    i. Plan a simple activity around Rack and Pinion Mechanism.
    ii. In this case, ask the children to count the teeth on the Straight Gear and the Round Gear.
    iii. Help the children to calculate by how much (half a circle, complete circle, etc.) would the Straight Gear be able to turn the Round Gear.
    iv. Ask the children to note down their results. These will be verified, once the Mast is ready.

3. Challenges (30 minutes)

a. Explain about Crane - **https://www.youtube.com/watch?v=bLfov3RhNhw**
   A crane is a machine that is used to lift/lower/shift objects from one place to another. A crane has 4 main sections. First section, Base, has wheels or tracks attached to it.
   Second section, Mast, is supporting tower of the crane. Mast gives the crane its height.
   Third section, Boom, is arm of the crane.
   Last section, Hook, is used to pick up materials. In your crane Grabber holds the objects, lifts up using Boom Lines, and moves it to some other place using Mast's Rotation.

b. What happens if Grippers were not fixed to the Rectangle Plate?
   i. Extension: Use different materials as Grippers and note your results.

c. What happens if Hydraulic Crane was operated on air?

d. What would happen if Support on 4 legs was removed?
   i. Extension: A simple activity asking children to suggest and create better support for legs.

e. Add weight to the Box (that is lifted). Ask children to note down the result.
   i. Extension: A simple activity asking children to suggest ways of stabilizing the crane with increased load.

f. Ask the children to observe that the Mast of the crane is tilted.
   i. Ask the children what would happen if the tilt was configured in the other direction. Ask them to note down the hypothesis with reason.
   ii. Ask the children to change the configuration of the Mast, and verify the result.