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## Engino STL24

# Engino STEAM Labs How Hydraulics Work Kit - Instruction Manual

Brand: Engino | Model: STL24

## INTRODUCTION

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The Engino STEAM Labs How Hydraulics Work kit is an educational construction set designed to introduce users aged 8 and up to the principles of hydraulics and fluid mechanics. This kit allows for the construction of four different models, providing a hands-on learning experience through building, drawing, experimenting, and theoretical study.

The kit emphasizes a multi-level learning system, integrating art with science, technology, engineering, and mathematics (STEAM) concepts. It features a patented connecting system for easy assembly and disassembly, along with both printed and interactive 3D instructions available via a dedicated app.



Figure 1: Overview of the four hydraulic models that can be constructed with this kit.

## SAFETY INFORMATION

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- **Age Recommendation:** This kit is suitable for users aged 8 years and older. Adult supervision is recommended for younger users.
- **Small Parts:** The kit contains small parts which may pose a choking hazard for children under 3 years. Keep all components out of reach of infants and toddlers.
- **Proper Use:** Use the components only as instructed in the manual. Do not attempt to modify or force parts together, as this may cause damage or injury.
- **Disassembly Tool:** Use the provided extraction tool carefully for disassembly to avoid pinching fingers.
- **Material Safety:** All materials are child-safe and non-toxic. However, do not ingest any parts.

## WHAT'S IN THE BOX

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Upon opening the Engino STEAM Labs How Hydraulics Work kit, you should find the following components:

- Approximately 80 construction parts
- Instruction booklet (printed)

- Extraction tool for disassembly
- Sheets of paper with pre-defined sketches for model customization
- Theory & Activity book

Please check all contents against the packing list provided in the box to ensure all pieces are present before beginning assembly.

## SETUP AND ASSEMBLY

The Engino kit utilizes a patented snap-fit connecting system for straightforward assembly. Follow the instructions carefully for each model.

### 1. Building the Models (Level 1)

The kit includes instructions for building four distinct models. Two models have printed instructions, while the other two can be built using the interactive 3D instructions available through the Engino kidCAD app.



Figure 2: Example of printed building instructions for a model.

- **Printed Instructions:** Refer to the included booklet for step-by-step visual guides for the designated models.
- **3D Interactive Instructions:** Download the Engino kidCAD 3D viewer app (available on Google Play and

the App Store) for interactive 3D assembly guides. This app allows you to rotate, zoom, explode, and implode models to understand each step clearly.

**Engino kidCAD**  
(3D Viewer)

GET IT ON  
Google Play

Available on the  
App Store

- ROTATE IN 3D!
- ZOOM IN AND OUT!
- EXPLODE AND IMplode!
- FIND AND EXPLORE MORE MODELS!

**3D interactive instructions**  
to download on your smart device

**FREE APP TO VIEW 3D MODELS**

Figure 3: The Engino kidCAD app provides interactive 3D building instructions.

## 2. Adding Surfaces (Level 2: Drawing)

Once the structural build is complete, you can customize your models using the provided paper sheets. These sheets have pre-defined sketches that can be painted, cut, and attached to your models to enhance their appearance.

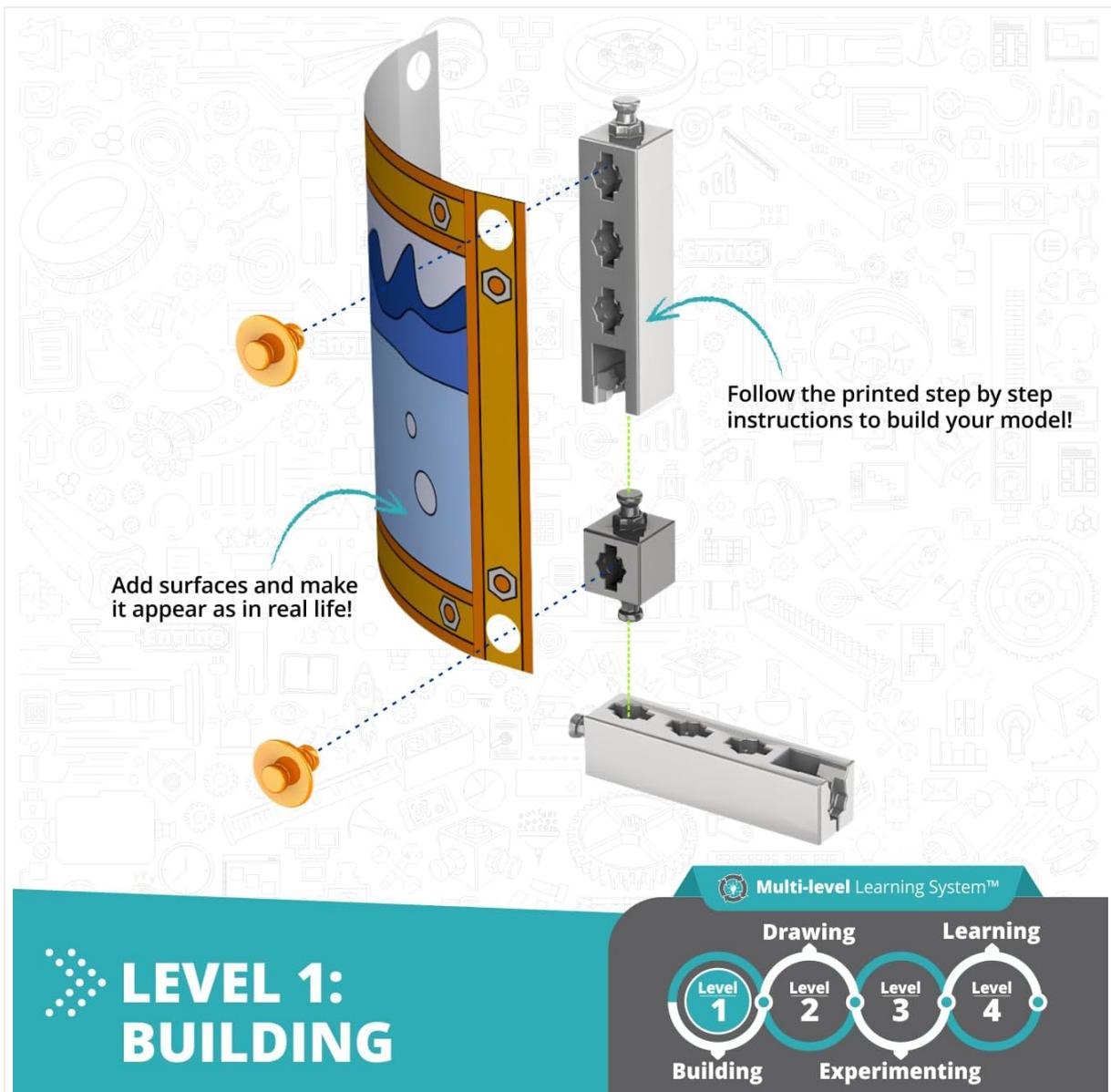


Figure 4: Attaching decorative surfaces to your model.

You can also use the blank side of these sheets or your own paper to create unique designs, fostering creativity and personal expression.

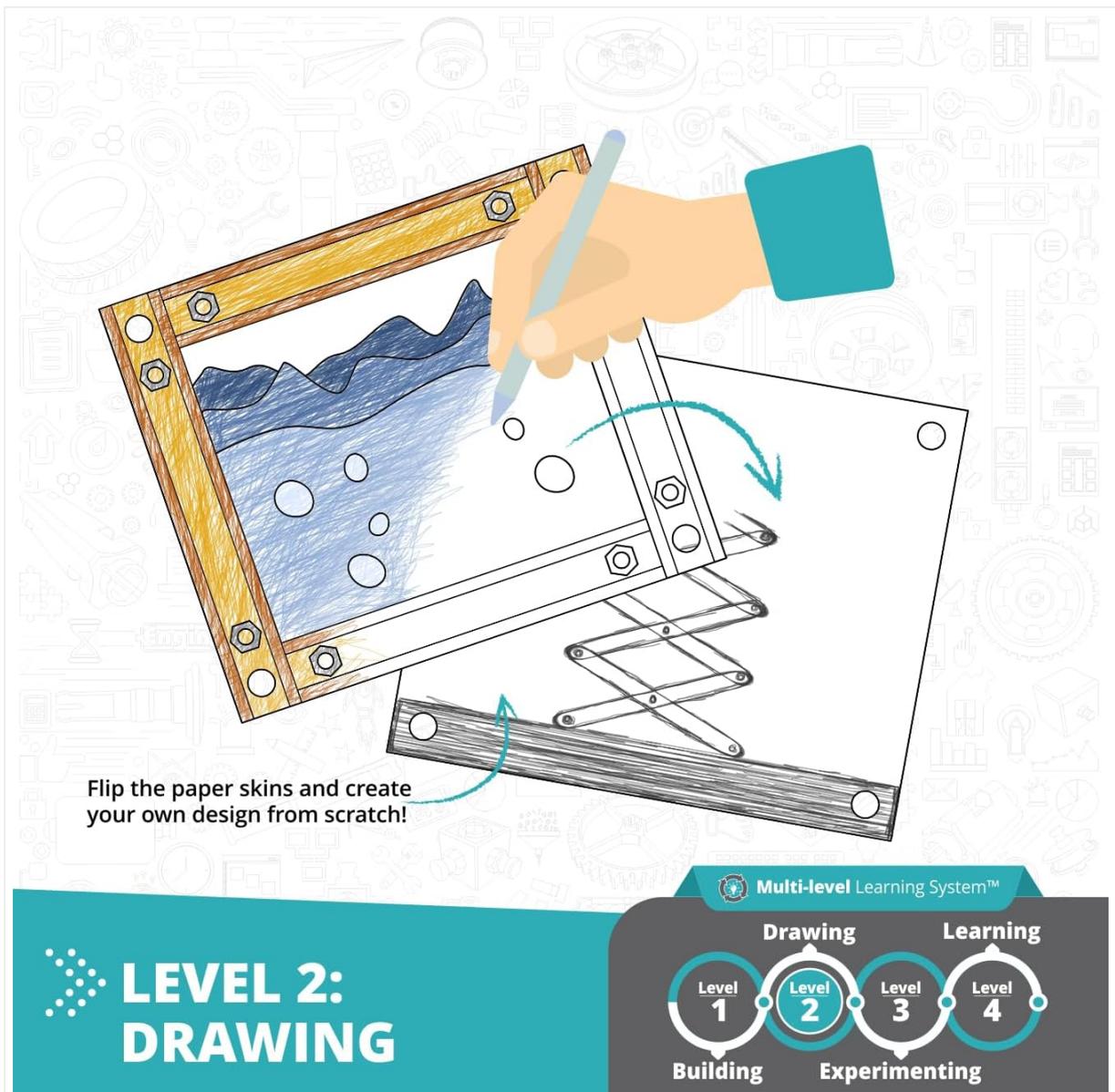


Figure 5: Customizing model appearance through drawing.

## OPERATING INSTRUCTIONS (EXPERIMENTATION AND LEARNING)

This kit is designed for hands-on experimentation to understand hydraulic principles. The "Theory & Activity" book guides you through various experiments and provides background information.

### 1. Experimenting (Level 3)

Each model allows for specific experiments related to hydraulics. For example, with the Hydraulic Platform model, you can investigate how force applied to a small piston can lift heavier objects via a larger piston, demonstrating Pascal's principle.

Carry out the experiment and write down your observations!

### Experiment

#### Hydraulic Platform

Mr John, a forklift driver, presses a button and easily lifts heavy pallets up to the factory shelves. "How does this machine work?" he asked Mr Jack, the engineer. Carry out the experiment below and help Mr John find out!

**Materials Needed:**  
 - Engino® Hydraulics (5TL24).  
 - A plastic cup (see page 10).  
 - Pebbles.

**Build:**  
 Find the instructions in pages 11-16 and build the Hydraulic Platform model.

**Step 01:**  
 Push the pistons of both syringes all the way in. Set the piston of the large syringe to 5ml. Join one nozzle of the rubber tubing to this syringe. Then join the small syringe with the other nozzle of the rubber tubing. Push the piston of the large syringe inwards and do exercise 1.

**Exercise: 01**  
**What happens to the platform when you push the piston of the large syringe?**

.....

**Step 02:**  
 Remove the platform, the large syringe and the tubing from the model. Detach the small syringe and remove the black part (see on the right) from your model. Then, join one nozzle of the tubing to the large syringe and place it on the top of the model. Put the platform back to the model. Set the piston of the small syringe so that it reads 5ml. Then join the other nozzle of the rubber tubing with the small syringe. Now, press the piston and do exercise 2.

**Exercise: 02**  
**Did you notice any difference? Was it easier or more difficult to lift the platform?**

.....

**Step 03:**  
 Fill the cup with small pebbles and place it onto the platform. Then repeat the comparison by pushing the large or small piston by switching the two syringes as explained above. Answer the questions of exercises 3 and 4.

**Exercise: 03**  
**Is it easier to lift the weight by pushing the large or the small piston? Place a tick (✓) in the correct answer box.**

Small  
 Large

**Exercise: 04**  
**Fill the gaps of the following paragraph by using the words from the box.**

easier, amplified, smaller, size

A hydraulic machine is construction of a rubber tubing fully filled with air, and the two syringes with different ..... When the acting force is applied to the piston with the ..... surface area, then the force is ..... Hence, it is ..... to lift up heavy objects when using such machines.

Excellent, you have just discovered how a hydraulic machine works! The following pages teach you a bit more about hydraulics.

**03**

**04**

# LEVEL 3: EXPERIMENTING

Multi-level Learning System™

**Building**

Level 1

Level 2

**Level 3**

**Experimenting**

Level 4

**Learning**

Figure 6: Example of an experiment from the activity book, focusing on a hydraulic platform.

- Follow the step-by-step instructions for each experiment in the "Theory & Activity" book.
- Observe the results carefully and record your findings.
- Answer the questions provided to deepen your understanding of the concepts.

## 2. Learning (Level 4)

The "Theory & Activity" book also contains an introduction to the scientific principles behind hydraulics, including concepts like fluid mechanics, pressure, and historical context such as Archimedes' Principle.

Read the background theory and learn about some amazing facts relating to fluids!

## Introduction

### What we will learn

Fluids (and the study of fluid principles) is one of the most important areas of physics. Water and air, the most important elements of life, are both fluids. The motion of air determines how warm or cold a room is. Pipes provide water to our houses. Have you ever wondered why divers think about water depth and limits? How can you lift a heavy car to change a tyre without much effort?



This booklet of STEAM: Hydraulics Science starts with an introduction to what you will learn. In the next few pages you will build a hydraulic platform model to learn the scientific principles through experiment. Note that the printed building instructions of the model are found at the end of this booklet. Continue to the theoretical section to learn about their applications in daily life. Please consult the building tips and follow the online building instructions as explained in page 10. You will also learn to build more exciting models like a hydrostatic tower, communicating vessels, and a siphon device. Finally, there is a quick quiz to test your new knowledge.



### History of Fluids principles

Ancient civilizations settled where there was a lot of water supply, such as rivers and seas. Over time, people learned to build structures to protect themselves against floods. They also developed simple rafts so they could cross the sea to explore or to trade with other people.

Ocean water covers nearly 70% of the Earth. The Earth's atmosphere is made up of different gases. Predictions of ocean circulation patterns and weather forecasts are possible when we know how fluids move. From biology, we know our bodies are made of fluids and all cellular activities involve fluids.



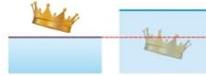
01

### Archimedes' Principle

One of the most famous scientists and inventors in history was Archimedes who died in 212 BC. Due to his cleverness, he was regularly given puzzles to solve. One famous story is when a king asked him to solve a puzzle to find out if his crown was made of pure gold, or whether it was impure and made of other metals. Archimedes ended up solving the puzzle while having a bath.



As Archimedes got into his bathtub, he noticed that the water level was rising. As more of his body became covered with water, the water level in the bathtub would continue to rise. This crucial observation made him think of ways to correlate the volume of his submerged body to the level of raised water. He concluded that the volume of the displaced water is equal to the volume of an object immersed in the water.



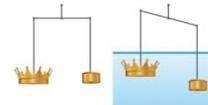
### Did you know?

Archimedes invented a machine which is still used today called the "Archimedes screw". It consists of a large circular pipe enclosing a spiral helix, with its lower end submerged in the water. As the device is turned the water rises up the pipe and collects at the top, much like a primitive well.



Archimedes screw used for raising water

To complete the King's puzzle, Archimedes borrowed some pure gold. Outside of water, the King's crown and the pure gold weighed the same. Archimedes knew that if they were made of metals of different densities they would displace different volumes of water, and so would no longer weigh the same when submerged underwater! This is how Archimedes proved that the crown was impure.



Follow the next few pages to see an experiment and discover how you can easily lift heavy objects!

02

# LEVEL 4: LEARNING

## Multi-level Learning System™

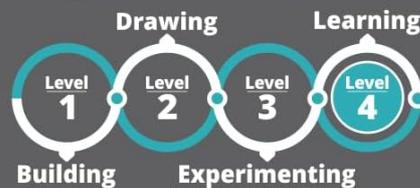


Figure 7: Excerpt from the theory book explaining fluid mechanics and historical principles.

- Read the theoretical explanations to understand the science behind your experiments.
- Engage with the "Did you know?" sections and other informational tidbits to broaden your knowledge.
- The free Augmented Reality (AR) app can make the content more engaging and entertaining.

## MAINTENANCE

- **Cleaning:** Wipe parts with a dry or slightly damp cloth. Do not use harsh chemicals or abrasive cleaners.
- **Storage:** Store all components in their original packaging or a suitable container to prevent loss and damage. Keep the kit in a cool, dry place away from direct sunlight.
- **Part Integrity:** Regularly inspect parts for any signs of wear or damage. Replace any broken or severely worn parts to ensure proper function and safety.

## TROUBLESHOOTING

- **Parts not fitting:** Ensure you are using the correct parts as indicated in the instructions. Engino's patented connecting system requires a firm but gentle snap. Avoid excessive force.
- **Difficulty disassembling:** Use the provided extraction tool. Squeeze the tool to disassemble small parts or push it into the hole to pop out locked parts. Refer to the instruction booklet for visual guidance on using the

tool.

- **Model instability:** Double-check all connections to ensure they are securely snapped into place. Refer to the 3D app or printed instructions to verify the correct assembly sequence.
- **Hydraulic system not working:** Ensure all tubing connections are tight and free of leaks. Verify that syringes are properly filled and connected according to the experiment instructions. Air bubbles in the system can affect performance.
- **Missing parts:** If you find any parts missing, please contact Engino customer support with your product model number (STL24) and a description of the missing components.

## SPECIFICATIONS

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<b>Model Number</b>	STL24
<b>Product Dimensions</b>	8.07 x 11.42 x 2.28 inches
<b>Item Weight</b>	1.01 pounds
<b>Recommended Age</b>	8 years and up
<b>Number of Parts</b>	80
<b>Number of Models</b>	4
<b>Manufacturer</b>	ENGINO-NET LIMITED
<b>Language</b>	English

## WARRANTY AND SUPPORT

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For any questions, concerns, or support regarding your Engino STEAM Labs How Hydraulics Work kit (Model STL24), please contact ENGINO-NET LIMITED directly. Refer to the packaging or the official Engino website for the most current contact information.

Engino is committed to providing quality educational toys. If you encounter any manufacturing defects or require assistance with parts, please reach out to their customer service team.