



## Tower Crane

### Science

- Experiment and measure the effect of force on an object
- Forces and structures
- Scientific investigation
- Simple machines – Pulleys

### Technology

- Assembling components
- Construct simple machines
- Controlling mechanisms – motors
- Evaluating
- Mechanical advantage

### Engineering

- Describe and explain parts of a structure and the effects of loads
- Engineering design
- Test and evaluate before making improvements

### Mathematics

- Determine percent of error
- Select and apply techniques and tools to accurately measure length with appropriate levels of precision
- Understand the metric system of measurement

### Vocabulary

- Fixed pulley
- Friction
- Load
- Mechanical advantage
- Movable pulley
- Pulley block and tackle
- Pulley system
- Slip

### Other materials required

- Measuring tape
- Stop-watch
- Weighing scales

## Connect



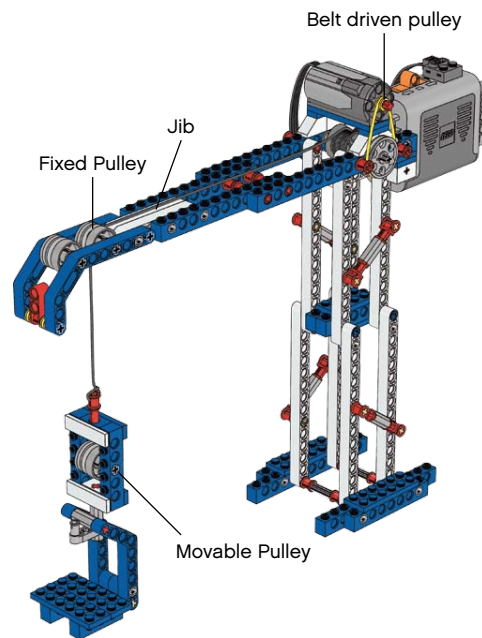
Cranes are widely used to lift heavy objects and move them to different positions and heights. They are used on docks for loading and unloading ships. They are used in the construction industry for moving building materials. They are used in factories for moving goods and machinery. There are several different types of crane. Some are fixed to the ground, others can move around.

**You will build a model Tower Crane and investigate how its function is influenced by changes to the pulley system.**

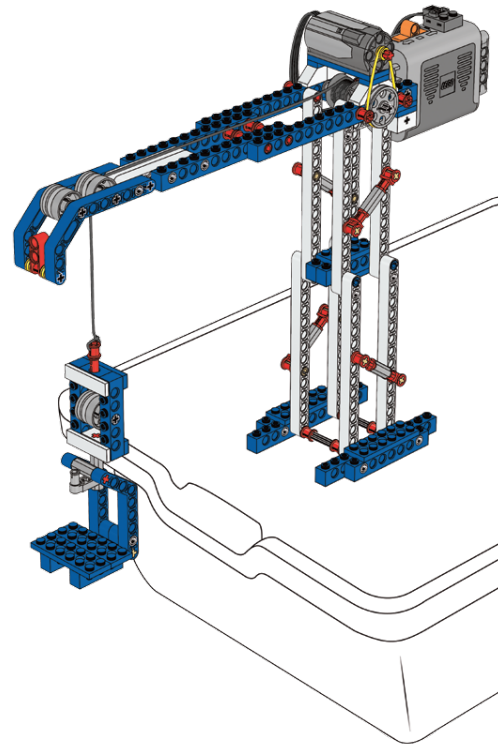
## Construct

### Build the Tower Crane and Load

(Building Instruction 16A and 16B to page 28, step 38)



- Place the Tower Crane on the lid on top of the blue LEGO® storage box



- Turn on the motor by pushing the battery box switch forward and let the string unwind and then let the motor wind it back up again
- Make sure all pulley wheels turn freely

## Contemplate

### Why do cranes use pulleys?

Cranes use pulley systems because they can pull with less effort than is needed in a direct lift.

First, observe the mechanical advantage and predict with which speed pulley setup A will lift the load.

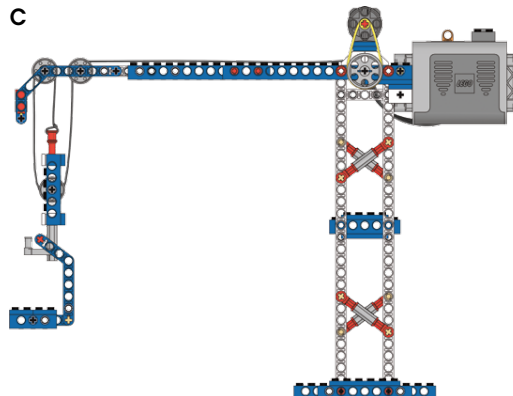
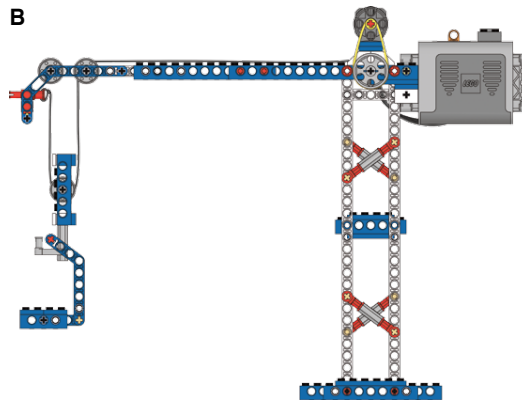
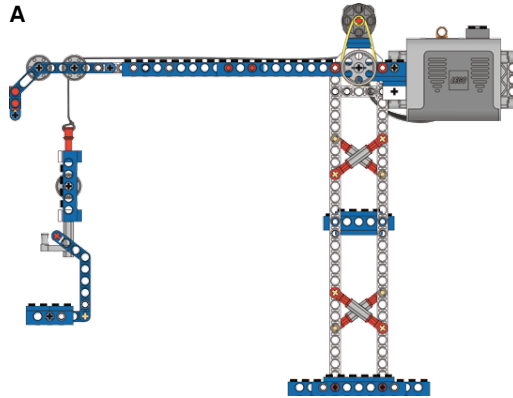
*Record the mechanical advantage and your predictions on the worksheet.*

Then test your prediction.

*Record your findings on the worksheet.*

Next, follow the same procedure for pulley setups B and C.

### Explaining the test results.



**Hint:**  
To accurately measure force, use a force meter.

**Hint:**  
The LEGO® string is 2 meters (≈ 2 yd) long.

**Hint:**  
You can find all of the formulas you need to perform this investigation in the Principle Models section for Pulleys.

## Continue

### Redesign needed?

Tower Cranes are often built to match specific needs.

Now redesign the Tower Crane to make it the best in its class. We have highlighted some questions you could explore. Choose one area that you would like to investigate.

Then design a test that will help you explore how it functions and possible additional improvements you could make to your new Tower Crane. Remember to record all your test results.

