

Boat Pulley

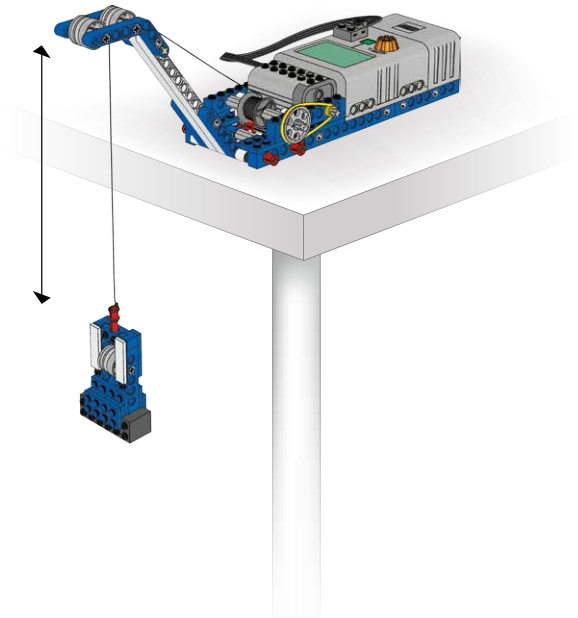
Name(s): _____

Date and subject: _____

Build the Boat Pulley

(building instructions booklets 6A and 6B, to page 63, step 26)

- Test the model's functionality. Loosening bushings can reduce friction
- Connect the plugs properly by pressing them firmly together
- Let the load hang with as much string as possible pulled down
- Charge the boat pulley with a minimum of 50 joules (J)



Lifting the Load

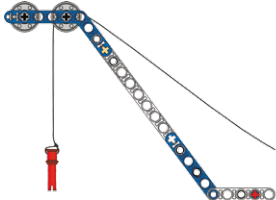
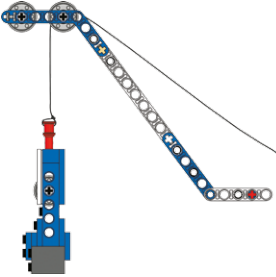
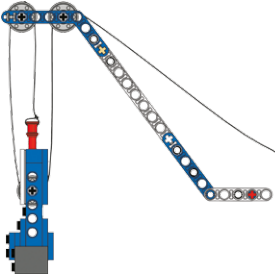
(building instructions booklets 6A and 6B, to page 64, step 1)

First, predict and investigate how much power the boat pulley needs to lift with the load removed. Read and record your findings.

Then, predict and investigate how much average power the boat pulley needs to lift the load with one fixed pulley. Read and record your findings.

Next, rebuild the boat pulley, and predict and investigate the influence on the power needed to lift the load with a new pulley system, now with two fixed and one movable pulley.

The power the boat pulley uses to lift with the load removed, must be subtracted from the two other findings, in order to compare the pulley systems.

			
My Prediction	(W)	(W)	(W)
My Findings	(W)	(W)	(W)

Investigating Efficiency

Investigate the percentage of efficiency of the boat pulley both by calculating the ideal and measuring the actual amount of work that needs to be applied to be able to lift a load over a vertical distance of 60 cm (= 24 in.).

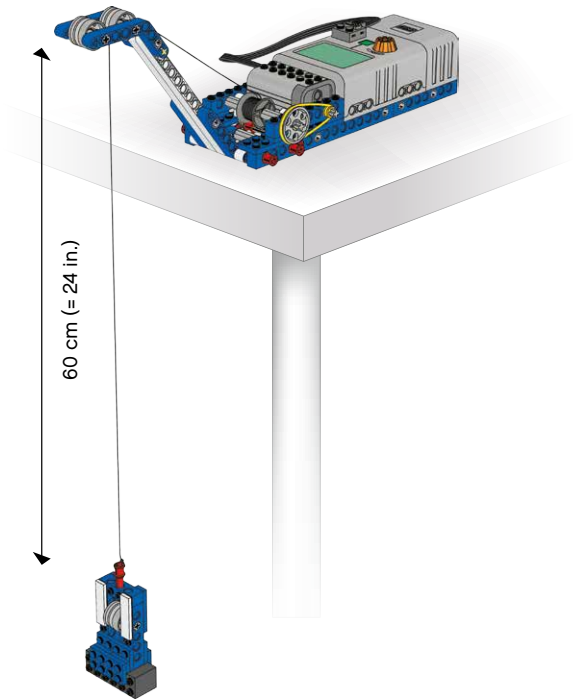
First, calculate the ideal amount of work needed by using this formula:

$$\text{Work (J)} = \text{Force (N)} \times \text{Distance (m)}$$

Then, investigate the actual amount of work needed, by reading the consumption of joules (J) on the Energy Meter display. Record your findings.

Next, calculate the percentage of efficiency of the boat pulley by using this formula:

$$\text{Efficiency} = \frac{\text{Work Done}}{\text{Energy Used}} \times 100$$



Ideal amount of work needed (J)	(J)
Actual amount of work needed (J)	(J)
Percentage of efficiency for boat pulley (%)	(%)





Identifying Variables

Identify and write down at least three variables, explaining clearly how these affect the efficiency of the boat pulley.

Boat Pulley

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NGSS GOALS	 BRONZE	 SILVER	 GOLD	 PLATINUM
1. Student work related to this Crosscutting Concept: In this project, we identified those variables that affected our boat pulley's efficiency.				
Cause and effect: Mechanism and explanation. Use cause and effect relationships to explain observations in designed systems.	<ul style="list-style-type: none"> We identified at least one variable that affect the efficiency of our boat pulley. <input type="checkbox"/>	<ul style="list-style-type: none"> We met Bronze. We identified two more variables that affect the efficiency of our boat pulley. <input type="checkbox"/>	<ul style="list-style-type: none"> We met Silver. For all three variables, we explained what effect they would have on the boat pulley's efficiency. <input type="checkbox"/>	<ul style="list-style-type: none"> We met Gold. We identified and explained the effect of at least one more variable on the boat pulley's efficiency. <input type="checkbox"/>
2. Student work related to this Practice: In this project, we built a boat pulley and investigated how much power was required to lift a load using two different pulley systems.				
Planning and carrying out investigations: Collect data to test design solutions under a range of conditions.	<ul style="list-style-type: none"> We completed predictions and measurements for the average power our boat pulley needed to move the string with no load. <input type="checkbox"/>	<ul style="list-style-type: none"> We met Bronze. We completed predictions and measurements for our boat pulley while lifting a load. <input type="checkbox"/>	<ul style="list-style-type: none"> We met Silver. We rebuilt our boat pulley to include a moveable pulley. We completed predictions and measurements for the new pulley system. <input type="checkbox"/>	<ul style="list-style-type: none"> We met Gold. We proposed a design for a new pulley system that contained two moving pulleys. We predicted the average power our boat pulley would need with the new pulley system. <input type="checkbox"/>
3. Student work related to this Practice: In this project, we completed several mathematical calculations including Work and Efficiency.				
Using mathematics and computational thinking: Apply mathematical concepts such as ratio, percent, and basic operations to scientific and engineering questions.	<ul style="list-style-type: none"> We obtained measurements for the force and distance required to lift the boat pulley's load. <input type="checkbox"/>	<ul style="list-style-type: none"> We met Bronze. We correctly calculated the Ideal Work needed to lift the load. We used the Energy Meter to measure the Actual Work needed to lift the load. <input type="checkbox"/>	<ul style="list-style-type: none"> We met Silver. We calculated the boat pulley's efficiency. <input type="checkbox"/>	<ul style="list-style-type: none"> We met Gold. We completed the necessary measurements and calculations to determine the efficiency of the boat pulley with a moveable pulley in the system. <input type="checkbox"/>
Notes:				