



Machines

STEM Sims

Lesson 2: Pulley and Trials

Pulleys are a type of simple machine often found in our daily lives. Pulley systems come in many different types, such as single, multiple, fixed, and moveable pulleys. Are you ready to do some heavy lifting to investigate pulleys?

Here are some definitions to help you in your investigation.

- Machine - a device that can change the force on, the distance moved, and/or the speed moved of an object
- Pulley - a simple machine made up of a wheel and a flexible rope or other material
- Variable - something that can change
- Fair Test - an experiment in which one variable changes and all other variables remain the same
- Trials - how many times an experiment is repeated
- Force - any push or pull on something
- Newtons (N) - a unit of measure of force
- Effort Force - a force that is applied by a person on an object. This is also called the applied or lifting force.
- Load - something that is being lifted or moved. Also called the force on mass due to gravity.
- Mass - the amount of matter in an object
- Kilograms (kg) - a unit of measure of mass

Doing the Science

Part I. 1.0 Kilogram Mass

1. Start the *Machines Simulation* by clicking on the "Simulation" tab.
2. Select the "Pulleys" button at the bottom of the screen.
3. Make sure the top-left pulley (Single, Fixed) is selected from the four pulley buttons at the bottom of the screen.
4. Use the Newton Converter button at the bottom right-hand corner of the screen if you need help converting the hanging mass from kilograms to newtons for the Force on Mass Due to Gravity column.
5. Select the green "Pull" button on the Force Device in the middle of the screen.
6. Note and record in Table 1 the height the 1.0-kg mass lifts off the ground, the applied force, and the distance the Force Device pulled the string that is displayed on the Force Device.
7. Select the "Reset" button.
8. Repeat steps 5 and 7 for a total of five trials. Make sure to enter your data in Table 1 for each trial.

Table 1. Force and Distance Moved

Trial #	Mass (kg)	Force on Mass Due to Gravity (N)	Height Mass Lifted (m)	Applied Force (N)	Distance Force Device Moved String (m)

Part II. 2.0 Kilogram Mass

9. Select the "Reset" button.
10. Select the 2.0-kg mass to replace the 1.0-kg mass on the pulley. Repeat the Part I experiment with the 2.0-kg mass. Make sure to note and record your data in Table 2.

Table 2. Force and Distance Moved

Trial #	Mass (kg)	Force on Mass Due to Gravity (N)	Height Mass Lifted (m)	Applied Force (N)	Distance Force Device Moved String (m)

Part III. Moveable Pulleys

11. Select the "Reset" button.
12. Select the top-right pulley (Single, Moveable) is selected from the four pulley buttons at the bottom of the screen.
13. Use the Newton Converter button at the bottom right-hand corner of the screen if you need help converting the hanging mass from kilograms to newtons for the Force on Mass Due to Gravity column.
14. Select the green "Pull" button on the Force Device in the middle of the screen.
15. Note and record in Table 3 the height the 1.0-kg mass lifts off the ground, the applied force, and the distance the Force Device pulled the string that is displayed on the Force Device.

16. Select the "Reset" button.
17. Repeat steps 14 and 16 for a total of five trials. Make sure to enter your data in Table 3 for each trial.

Table 3. Force and Distance Moved

Trial #	Mass (kg)	Force on Mass Due to Gravity (N)	Height Mass Lifted (m)	Applied Force (N)	Distance Force Device Moved String (m)

Do You Understand?

1. Name the variable(s) you investigated in Part III of this experiment.

2. How many trials did you complete in the Part III experiment?

3. Were the values of each trial in Part III *exactly* the same? Explain why the values were or were not identical.

4. Imagine that you completed 100 trials in the Part III experiment. What should happen to the quality of the results from your experiment?

5. Which would be the better fair test experiment, one in which you completed 10 trials or one that you did 100 trials? Please explain your answer.

6. For Part II of the study, what was the direction of the effort force?

7. For Part II of the study, what was the direction of the load force?

8. For Part II of the study, describe how the effort force exerted by the Force Device compared to the force on the hanging mass due to gravity.

9. For Part II of the study, describe how the distance the Force Device moved the string (input distance) compared to the distance the hanging mass moved (output distance).

10. Can a single, fixed pulley that you used in Parts I and II be used by you to lift something that has a much greater mass than you could lift on your own without using the pulley system?

11. Describe and discuss how a single, fixed pulley used in Parts I and II can be useful in accomplishing a task involving lifting a load.

12. How did the pulley system in Part III of this investigation differ from the pulley used in Parts I and II?

13. For Part III, how did the amount of effort force compare to the amount of load force that was lifted?

14. For Part III, how did the distance the effort force moved compare to the distance the load force moved?