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Pulleys and Mechanical Advantage

Lesson Logistics

Learning Outcomes

Grades 4-6
Materials and structures
Forces and simple machines
Initiating and planning

Class Organization

Ask the students to sit in a manner that facilitates class discussion and offers a clear view of the pulley system.

Ensure that each student has a *Student Handout* and a pencil.

Notes

A major step in the prep of this activity is choosing a good location. A key feature is an easily accessible top anchor. Some examples of good anchors are a solid tree branch (at least 20-30 cm in diameter) or an exposed structural beam in a laboratory, classroom or gymnasium. The anchor should be at least three metres above the ground and the surrounding area should be relatively flat and free of obstructions. Students will be able to lift themselves or their teacher a distance that is proportional to the height of the top anchor, meaning that a higher anchor will lead to a more impressive demonstration. However, setting up the pulley will be easier if the anchor is easy to reach with a ladder. Keeping these considerations in mind, a good height for the anchor would be between 3-5 m.

Before putting together the demonstration, all of the knots listed in *Additional Information* should be practiced so that they can be tied with ease. Test the strength of each knot and make sure they all match the pictures. Do not try to build the pulley system before being comfortable tying each knot.

It is recommended that an adult volunteer be present for this activity.

The pulleys themselves can pinch fingers if students are not careful and the rope can cause rope burns if it suddenly slips, so some students may wish to wear gloves.

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Further Exploration

Different Types of Pulleys

Provide teams of four students with various sorts of pulleys, string and a weight. Give the class some time to explore how they could use the objects to move or lift the weight. Ask a reporter from each team to share their group's construction with the class. The students can examine their design in comparison to the other teams. In addition, the students can suggest how their design might be useful in settings outside of the classroom.

An alternative approach would be to arrange stations with various types of pulleys. Ask the students to walk from station to station and experiment with the pulleys. Ask them to reflect on and discuss the differences between the various pulleys.

Applications of Pulleys

Ask the students to find examples of how pulleys are used outside the classroom and bring in pictures to share with the class.

Simple Machines

Students can look for examples of other simple objects that make some forms of work easier. They can bring in a picture, a model or the object itself and be prepared to present the object to their group members. They can describe how the object does work and in turn makes a job easier. Once each team has presented to each other then the class can work together to classify these objects into similar groups. This will be a great introduction to other simple machines.

Mechanical Advantage

Students can be challenged to design and construct an original product such as a tool or toy that uses simple machines to demonstrate mechanical advantage. You can host an inventor forum for the students to showcase their work. Judges could be invited to decide on the most marketable design based on criteria such as functionality.