

## Activity Instructions

The following item will be needed for this activity:

- pulley system (see *Prep Instructions*)

### Part I - Lifting the Teacher

#### Step 1

Select two students who think they are capable of lifting the teacher using the pulley construction. The activity will be more effective if the students are different sizes since this may challenge some of the students' initial conceptions.

#### Step 2

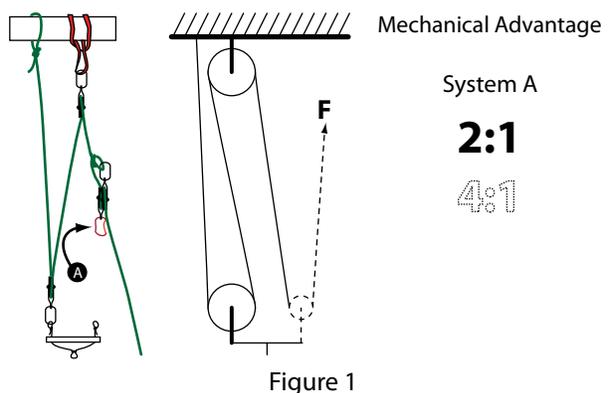
Ask the students in the class to make hypotheses about whether each student will be able to successfully lift the teacher.

#### Step 3

After the students have recorded their hypotheses on the *Student Handout*, allow a few students or groups to share their hypotheses with the whole class, providing an explanation for their assumption.

#### Step 4

Give the students a few minutes to draw a labelled sketch of the simple pulley system (System A in **figure 1**). **Figure 1** illustrates the simplest mechanical advantage that can be achieved with the pulley. The bold 2:1 is shown by the solid lines, while the white 4:1 can be achieved if the dotted pulley is added.



#### Step 5

Using the simple pulley system, ask each selected student to attempt to lift the teacher.

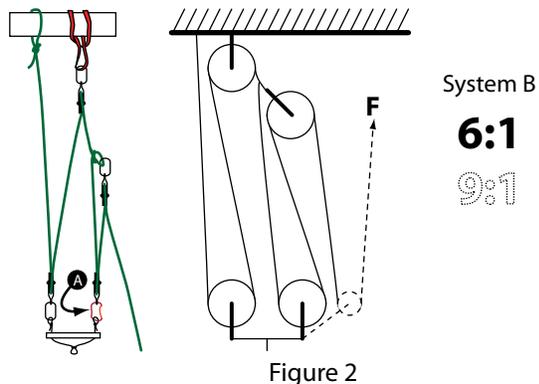
## Pulleys and Mechanical Advantage - Activity Instructions

### Step 6

Ask the students to record their results and observations after each trial.

### Step 7

Explain to the class that the students will have a second chance to lift the teacher, this time using a different set-up. Encourage the students to pay close attention as the set-up is changed from a simple pulley system to a compound pulley system (System B in **Figure 2**). Similar to **figure 1**, **figure 2** shows a 6:1 advantage with the solid lines, and a 9:1 advantage with the dotted lines.



### Step 8

Give the students a few minutes to draw a labelled sketch of the compound pulley system.

### Step 9

Allow the selected students to attempt to lift the teacher using the compound pulley system.

### Step 10

Again, ask the students to record their results and observations after each trial.

## Part II - Students Lifting Themselves

The pulley apparatus that was constructed can demonstrate the effects of changing mechanical advantage. First, students can try to lift their own weight with no mechanical advantage by using a pull-up bar or an equivalent structure. Next, students can lift themselves with a mechanical advantage of 2:1 using a simple pulley system. By combining two simple systems into a compound system, the students can lift themselves with a 6:1 mechanical advantage.

### Step 1

Find a suitable pull-up bar near the pulley apparatus, such as a bar in the school gym, a tree branch, monkey bars or anything else that is available. By trying to do a pull-up on this bar, the student is approximating the feeling of lifting him or herself with no mechanical advantage.

## Pulleys and Mechanical Advantage - Activity Instructions

### Step 2

In order to achieve a 2:1 mechanical advantage using the pulley system, first unclip the carabiner labelled **A** in **figure 1**. When a student sits on the seat and lifts him or herself, he or she is now experiencing a simple pulley system.

### Step 3

Reconnecting carabiner **A** results in an increase to a 6:1 mechanical advantage, while only adding two pulleys to the system. As a result, friction should not play a large role and students will be able to feel a significant change between the different mechanical advantages.

## Part III - Extension or Alternative Activity: The Pulley Tug-of-War

This alternative demonstration shows students how mechanical advantage can be used as an aid in a tug-of-war. The demonstration uses almost the same pulley system as before, but this time it will be set up parallel to the ground and anchored on a tree, telephone pole or another solid, vertical post (**Figure 3**). One student should be able to compete in a tug of war against two or more other students. This demonstration is simply qualitative and would be best for younger children. For older students, it may be interesting to let them design their own pulley systems and then compare the results.

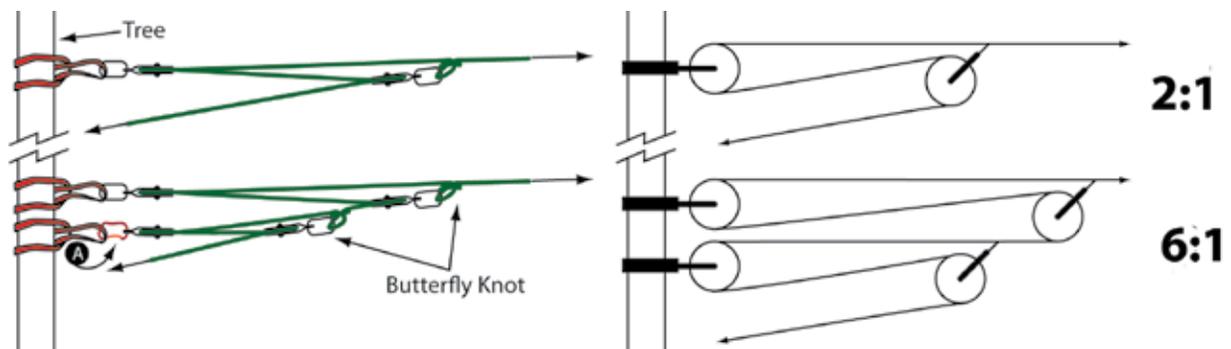


Figure 3