

Simple Machines/Pulleys

PRESENTATION FOR GRADES K-2

Name simple machines

Materials

none

Procedure

1. Name simple machines (inclined plane, pulley, etc.).
2. Discuss machines like toothbrushes, brooms, as well as more complicated machines like vacuum cleaners and the like.
3. Discuss places where students may have seen pulleys in use in industrial settings (crane, etc.).
4. Pass out pulley for students to examine.
5. Discuss what a crane helps us do.

Single line experiment

Materials

- One line over pulley with cup on each end
- group of 30 washers tied together
- **Prepare chart on board as follows:**

Number of Strings | Washers

1 |
2 |
3 |
6 |
8 |

Procedure

1. Point out single lifting line (note that the line on the other side of the pulley doesn't count.) NOTE: Be sure to keep tension on the "lifting" when you dump out the washers. Otherwise the string will jump pulley wheels and you'll have a mess getting it back. After student puts a few washers in the cup, there will be adequate tension that the cup can be let go.
2. Ask students what appears different among the 5 setups. (more wheels on pulleys, more lifting strings)
3. Ask students to guess how many washers will be required to lift the cup containing 30 washers.
4. Select student and all count together as washers are added by student. If some students picked numbers less than 30, stop at these numbers and test. In any case, stop at 30 and note balance. (There is a possibility that balance may not occur due to variance in weight of washers.)
5. Demonstrate that the 31st washer pulls down the 2nd cup.
6. Note that distance "pulling" cup goes down is the same as that which the "lifted" cup goes up. If you wish, you can go to the 8-string setup now and demonstrate that the "pulling cup" moves a long way compared to the "lifted" cup.
7. Select a "scribe" and have this person write the number of washers required across from the 1 on the table.

Multiple line experiments

Materials

Same as above

Procedure

1. Move to the 2-lifting line setup. Have students guess the number of washer required to lift this cup.
2. Select student and all count together as washers are added by student. Note the number of washers required and have the scribe write this across from the “2” on the table. Be sure that students understand that the pulley and lifting lines are making the lifting job easier. (Fewer washers were required.) Students will begin to see what is happening and will tend to guess numbers in decreasing numbers as you progress through the experiment.
3. Repeat the above experiment with a different student each time for the 3, 6, and 8 lifting line setups, having the scribe write down the number of washer each time.
4. Make sure that students understand the concepts behind what is happening. You may wish to reinforce the idea that you’re having to “pull further, but less hard” to get the job done.

Lifting the teacher or presenter

Materials

- Block and tackle with attached swing seat securely attached to monkey bars, doorframe or other sturdy location
- Secure the lifting line if something is handy to prevent anyone from being dropped.
- Always have a hand close to the lifting rope to assist.

Procedure

1. Ask students if they think they can use pulleys to help lift each other or a teacher (or presenter). Go to location where block and tackle is set up. (Be

sure to take down setup if you are using playground areas between experiments, especially if the equipment will be unattended. Otherwise children may be injured playing with the in an unsupervised way.)

2. Divide into two equal groups. The first group is the “lifters” and the second is the “sitters”. One at a time a “sitter” sits on
3. the swing while the “lifter” lifts him/her. See if the lifter can hold the sitter up with one hand. Note how the pulley is helping. After each experiment the lifter and sitter go to the back of the opposite lines so that everyone has a turn lifting and sitting.
4. See if the class can lift a teacher or presenter (tug-of-war fashion). With 4 lifting lines this is no problem if the block tackle is large enough.
5. Close by noting how pulley helps us to do work more easily.

PRESENTATION FOR GRADES 3-5

Name simple machines

Materials

None

Procedure

1. Name simple machines (inclined plane, pulley, etc.) Discuss machines like toothbrushes, brooms, as well as more complicated machines like vacuum cleaners and the like.
2. Discuss places where students may have seen pulleys in use in industrial settings (crane, etc.) Pass out pulley for students to examine.
3. What does a crane help us do?

Single line experiment

Materials

- One line over pulley with cup on each end
- group of 30 washers tied together
- yardstick
- **Prepare two charts on board as follows:**

<u>Number of Strings</u>	<u> Washers</u>
1	
3	
5	
7	

<u>Number of Strings</u>	<u> Washers</u>
2	
4	
6	
8	

Procedure

1. Point out single lifting line (note that the line on the other side of the pulley doesn't count.) NOTE: Be sure to keep tension on the "lifting" when you dump out the washers. Otherwise the string will jump the pulley wheels and you'll have a mess getting it back. After student puts a few washers in the cup, there will be adequate tension that the cup can be let go.
2. Ask students to guess how many washers will be required to lift the cup containing 30 washers.
3. Select student and all count together as washers are added by student. If some students picked numbers less than 30, stop at these numbers and test. In any case, stop at 30 and note balance. (There is a possibility that balance may not occur due to variance in weight of washers.)
4. Demonstrate that the 31st washer pulls down the 2nd cup.

5. Note that distance “pulling” cup goes down is the same as that which the “lifted” cup goes up. If you wish, you can go to the 8-string setup now and demonstrate that the “pulling cup” moves a long way compared to the “lifted” cup.

Multiple line experiments

Materials

Same as above.

Procedure

1. Divide the group into two sections with one presenter for each. If only one presenter is available, this may NOT be viable. Group 1 will work on the 1,3,5,7 chart while the other will work on the 2,4,6,8 chart.
2. Repeat the above experiment with each group determining the number of washers required to lift the cup and record the results on each chart.
3. Discuss the two charts and note the pattern. Make sure that students understand the concepts behind what is happening. You may wish to reinforce the idea that you’re having to “pull further, but less hard” to get the job done.

Lifting the teacher or presenter & graphing earlier results

Materials

- Block and tackle with attached swing seat securely attached to monkey bars, doorframe, or other sturdy location
- Secure the lifting line if something is handy to prevent anyone from being dropped
- In any case, a presenter will always have a hand close to the lifting rope to assist.

- Graph sheets will be required.

Procedure

1. Ask students if they think they can use pulleys to help lift each other or a teacher (or presenter). Go to location where block and tackle is set up. (Be sure to take down setup if you are using playground areas between experiments, especially if the equipment will be unattended. Otherwise children may be injured playing with the in an unsupervised way.)
2. Divide into two equal groups. The first group is the “lifters” and the second is the “sitters”. One at a time a “sitter” sits on
3. the swing while the “lifter” lifts him/her. See if the lifter can hold the sitter up with one hand. Note how the pulley is helping.
4. After each experiment the lifter and sitter go to the back of the opposite lines so that everyone has a turn lifting and sitting.
5. See if the class can lift a teacher or presenter (tug-of-war fashion). With 4 lifting lines this is no problem if the block tackle is large enough.
6. Return to the classroom and have students help graph “number of lifting lines” vs. “washers”. Interpolate a curve through these points and note the relationship. Close by noting how pulleys help us to do work more easily.