

Magic Tricks

Materials:

- Pencil
- Eraser
- 20 pennies
- 30 cm ruler

Safety:

- None applicable

Curriculum Connection:

Grade 5, Cluster 3: Forces and Simple Machines

- 5-3-01 Use appropriate vocabulary related to their investigations of forces and simple machines.
- 5-3-02 Describe, using diagrams, the forces acting on an object and the effects of increasing or decreasing them.
- 5-3-03 Investigate a variety of levers used to accomplish particular tasks in order to compare them qualitatively with respect to fulcrum position, applied force, and load.

Rationale:

Building on the discrepant event that I prepared last year helped me frame the narrative. Relatively speaking, this is a fairly straight forward model of a first class lever, using materials readily available in every classroom. Student can work their way through the follow up questions either by themselves or in small groups. The parts of the lever are easily manipulated. This aspect of the experiment will help to further the students' understanding of the relationship between the position of the fulcrum in relation to how much force is then needed to move the load.

Magic Tricks

When Timmy heard that Marvin the Amazing Magician would be performing at this month's assembly, he hurried home to crack open his magic kit. He vowed that Marvin the Amazing Magician would not trick him this year, and planned on studying every trick in the book.

As he studied each trick he began to feel very confident that he knew how Marvin the Amazing Magician was going to pull each one off. Card tricks, disappearing and reappearing rabbits, ribbon pulling and coin tricks. None of them were going to get by Timmy.

When the school assembled the next day, Timmy settled in quite comfortably. The first trick was the disappearing rabbit. No problem, he thought. There is some sort of trap door in the table. The coin tricks were up next. All slight of hand. Timmy even caught a glimpse of where Marvin the Amazing Magician hid the quarter. Then, Marvin the Amazing Magician laid the ground work for a levitating trick. A nervous Timmy stiffened up.

Marvin the Amazing Magician said he could make the principal, a much larger man than he, levitate. Timmy thought that there is no way that this could be possible. Then the unthinkable happened. To Timmy's amazement, the principal shot up like a rocket! Marvin the Amazing Magician asked two other teachers to stand next to the principal. All three people were now levitating!

Timmy turned to his friend Steve and said, "I don't understand! I studied every trick in the book! How is that possible?!?!"

Steve replied calmly, "Don't sweat it Timmy. Come with me and I will show you how he did it."

At this point, conduct a brainstorm with the class to see what kinds of ideas they may have for how the magician made the three people levitate.

When they got back to the science class, Steve took a 30 centimeter ruler, a regular pencil, a standard pink eraser and a hand full of pennies out of his desk and placed them on top of the table. First, he put the pencil down. Then he laid the ruler over the pencil so the two were perpendicular to each other.

Steve handed Timmy the eraser and asked, “Timmy, how heavy do you think this eraser is?”

“I’m not sure,” Timmy replied.

“Guess the weight using these pennies as your unit of measurement,” Steve instructed. “Simply put, about how many pennies do you need to achieve the same weight as the eraser?”

Have students perform their estimations here. The students should record their estimations on the worksheet provided.

Timmy held the eraser in one hand and a few pennies in the other hand. After a few attempts of picking up and putting down pennies, Timmy stated that about eight pennies were needed to achieve the same weight as the eraser.

“Okay. About eight pennies you say. Let’s find out if you are right.”

Steve repositioned the ruler so that an equal amount of the ruler was on either side of the pencil. Then he asked Timmy to describe where on the ruler a perfect balance would occur. Timmy replied that a balance would exist when neither end of the ruler is touching the desk, at the same time. He then instructed Timmy to place the eraser on one end and the eight pennies on the other end. The eraser raised up and the pennies sank down. Timmy adjusted the amount pennies until he found the balance.

Have students perform the experiment here. They will need to ensure that the ruler is straddling the pencil properly, so that the ruler is balanced. Have them place the eraser, place the pennies and determine if there are too many or not enough pennies to balance the eraser. The students should record their observations on the worksheet provided until a balance has been reached.

After determining that the eraser weighed the same as ten pennies, Steve instructed Timmy to move the pencil closer to the eraser side of the ruler and reapply the eraser and the pennies. This time the pennies weighed down the side of the ruler while the eraser was raised up. Timmy looked confused.

Steve explained that the experiment being performed showed the properties of the simple machine called a first class lever. The characteristics include a fulcrum (the pencil), a balance bar (the ruler), the load (the eraser), and the force (the pennies).

A first class lever will position the fulcrum in between the load and the force. For balance to be achieved, the load and the force need to be equal weights, with the fulcrum in the middle of the bar. If the fulcrum is positioned closer to the load, the amount of force needed to balance the lever will be less.

Have the students represent this understanding by drawing a picture of the first class lever.

“So, Marvin the Amazing Magician had everyone on a first class lever, which was disguised on the stage. In order to lift the teachers, he positioned the fulcrum closer to the load. Acting as the force, Marvin the Amazing Magician did not need to exert as much force in order to move the load,” Timmy realized.

“Perfect explanation, Timmy,” Steve replied. “But, what would happen if the fulcrum were closer to the force?”

At this point the students should leave the narrative and begin to conduct their own investigations into first class levers, starting with moving the fulcrum closer to the force. The students, working in groups of two or three, will need to alter one of the other variables as well. They will need to determine which variable they want to change, which variables will remain the same and how to measure the change.

Example: Students may position the fulcrum at any spot on the ruler and measure how many pennies will be needed to create a balance with the eraser.

To conclude, have each student summarize their findings.

Summary Questions:

Each of the following objects are found in the story. Identify which part of the lever each object represents.

The pencil

The eraser

The pennies

The ruler

Explain in your own words how a first class lever works. Draw a diagram and clearly label each part.

Can you think of any other objects that are first class levers? Give examples and represent with a labelled diagram.

***Are all levers designed like first class levers? In other words, can you think of any other objects where the fulcrum is not in between the load and the force?
HINT: THINK SECOND AND THIRD CLASS***

From your perspective, did Timmy ruin his enjoyment of the magic show by trying to figure out how all the tricks were performed before the show? Would you want to know?