

STEM Sims™

# Energy Downer



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## Do you need an idea for a scientific study?

Try out one of our ideas or make one of your own.

Start learning right now about mechanical and electrical energy conversions. Take the following brief quiz to see how much you already know about elevators. See the bottom of page 4 to check your answers.

- Elevators are how many times safer than escalators?
  - none, escalators are safer
  - two
  - twelve
  - twenty
- What is the maximum altitude that a single cable elevator can reach?
  - 700 feet
  - 1400 feet
  - 1700 feet
  - 3400 feet
- Every day, how many people are lifted by elevators?
  - 1/3 of the world's population
  - 1/2 of the world's population
  - 2/3 of the world's population
  - the world's population
- How many people were required to operate the elevators at the ancient Roman Coliseum?
  - 20
  - 75
  - 200
  - 475
- Where was the first manual button elevator installed?
  - Empire State Building
  - New York Marriot
  - Chrysler Building
  - The New York Times Building

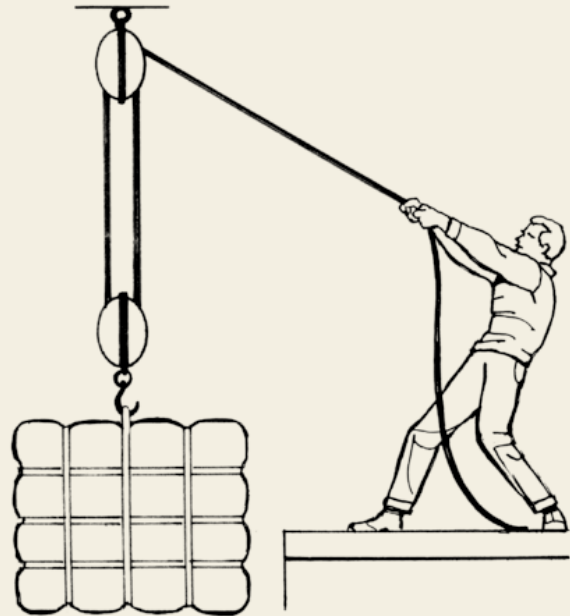


## Pulley Play

Elevators are actually just slightly more complex versions of pulleys, one of the six simple machines. The load, or elevator box, is attached by a cable and strung around a wheel pulley to a counterweight used for balance. As the elevator goes up, the counterweight goes down, and vice versa. It requires a lot of energy, but it's much easier than trying to push the elevator straight up from the bottom. Do you have the brawn and the brains to move heavy objects?

### Supplies Needed

two rolling pins  
long rope or twine  
three participants  
adult supervision



### Procedure

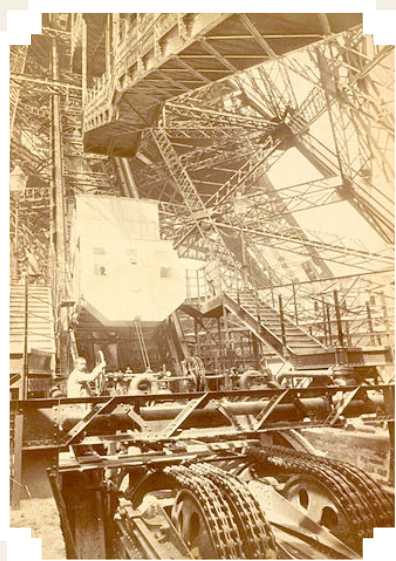
1. First, tie a knot around rolling pin 1.
2. Now, have one person hold rolling pin 1 and have a second person stand six feet away holding rolling pin 2.
3. Then have the third person wrap the rope from rolling pin 1 to rolling pin 2 and back three or four times forming loops, leaving the loose end by rolling pin 1.
4. Next, the first person and the second person should hold tight and take a solid stance.
5. Finally, the third person should take the end of the rope and exert force by pulling behind person one in order to try to tighten the loops.

### Questions

1. How many pulleys are in this system?
2. Was it hard for person one and person two to hold their ground?
3. What role does the rolling pin play in this setup? What else could you use instead?

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## Elevator Music to My Ears



You may think all elevators are the same but, in fact, there are quite a few variations. The earliest elevators were created around 300 B.C. and were powered by animals, people, or by hydropower. Elevators in the 19th century were used primarily to transport building supplies, usually driven by steam. Sir William Armstrong innovated the elevator scene by suggesting a hydraulic elevator that raised and lowered the load by using pressure from water to move the piston. The braking mechanism still used in elevators today, however, was invented in 1853 by American inventor Elisha Otis. The very first public steam-powered passenger elevator was installed in 1857 in a department store with five floors. The addition of Otis's brakes made the elevators safer in the event that a cable broke, making taller skyscrapers possible. The first electrically powered elevator was not invented until 23 years later by German inventor Werner von Siemens.

Today most passenger elevators are traction elevators powered by either alternating current (AC) or direct current (DC) motors. Cables support the load on one side, and run through a pulley to connect to a counterweight on the other side. The counterweight not only helps to speed up the load when the elevator car is going up, but it also helps to slow down the car when going down. The largest amounts of energy are expended by the system when full elevator loads are raised and empty loads are lowered. Electrical energy is converted into mechanical energy in traction elevators. Regenerative drive elevators, however, in addition to converting electrical to mechanical energy, use converters to turn gravitational potential energy (GPE) into usable electrical energy. Any time the load or counterweight that is moving downward has a greater weight than the load or counterweight moving upward, a portion of the GPE of the larger falling weight is converted to electricity using the system's generator. And in case you were wondering, the reason we have elevator music today is that people in the 1920s were scared to use these new machines, so the sounds were meant to alleviate their fears and relax them. Ba-da-da-da-da-dum...da-da-da-da-da-da-da-da-dum...

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**Answers:** Page 2 Answers: 1) d. 2) c. 3) a. 4) c. 5) b. Page 3 Answers: 1) Two pulleys. 2) Yes, it should be difficult as the third person should be pulling the two people together 3) The rolling pins act as the fulcrum pulleys and you could use anything that rolls along one axis.

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