STEM Sims™

Space Elevator

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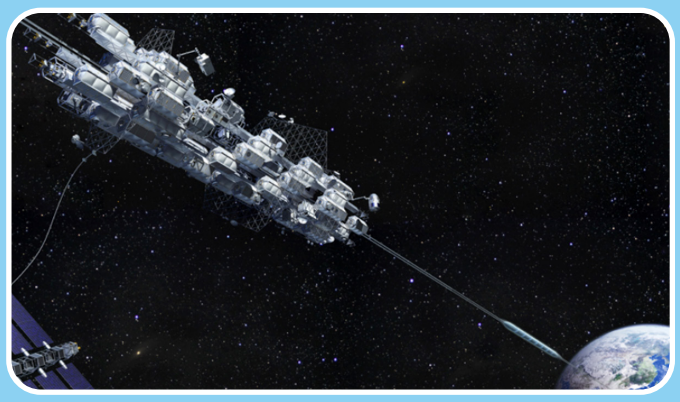
Do you need an idea for a scientific study?
Try out one of our ideas or make one of your own.

Ready for a low-cost way to travel to Earth's upper atmosphere and beyond? How about taking an elevator? Take the following brief quiz to see how much you already know about Earth's atmosphere and space elevators. See the bottom of page 4 to check your answers.

1. If the space elevator had an average speed of 300 km/hour, about how long is the expected travel time to outer space?
   a. 5 minutes
   b. 5 hours
   c. 5 days
   d. 5 weeks



2. In what year do experts expect the first space elevators to become operational?
   a. 2025
   b. 2050
   c. 2100
   d. 2250

3. In what year was the concept for the first space elevator presented?
   a. 1895
   b. 1925
   c. 1945
   d. 1965

4. What is the temperature in the outermost layer of Earth's atmosphere?
   a. -200 °C
   b. -2 °C
   c. +2 °C
   d. +2000 °C

5. About how far can an air particle in the outermost layer of Earth's atmosphere travel before colliding with another air particle?
   a. a few nanometers
   b. a few millimeters
   c. a few meters
   d. a few kilometers

Getting Heavy

While your mass cannot be easily changed, you can do a simple experiment to change how much you weigh. Weight is a measure of how hard the force of gravity pulls you down towards Earth. With a tall building, high-speed elevator, and a standard bathroom scale you're ready to either gain or lose some weight. Get started now with your investigation.

Materials Required
1- high-speed elevator in a tall building
1– standard bathroom scale

Procedure

1. Do *not* conduct this investigation *without* first receiving permission.
2. Locate a high-speed building elevator and after receiving permission, place the scale on the floor near the elevator's wall.
3. Stand on the bathroom scale and observe your weight. Record this value in Table 1.
4. Continue standing on the scale and make sure you can reach the wall if needed.
5. Select the highest floor of the building and observe your weight as you and the elevator move upward.
6. Record in Table 1 the *greatest* weight value during your upward movement.
7. Continue standing on the scale and select the ground floor.
8. Record in Table 1 the *smallest* weight value during your downward movement.

Table 1. Your Weight Data

Elevator Motion	Weight (pounds)
Stationary	
Upward	
Downward	

Questions

1. Propose a reason why your weight changed as you and the elevator moved upward.

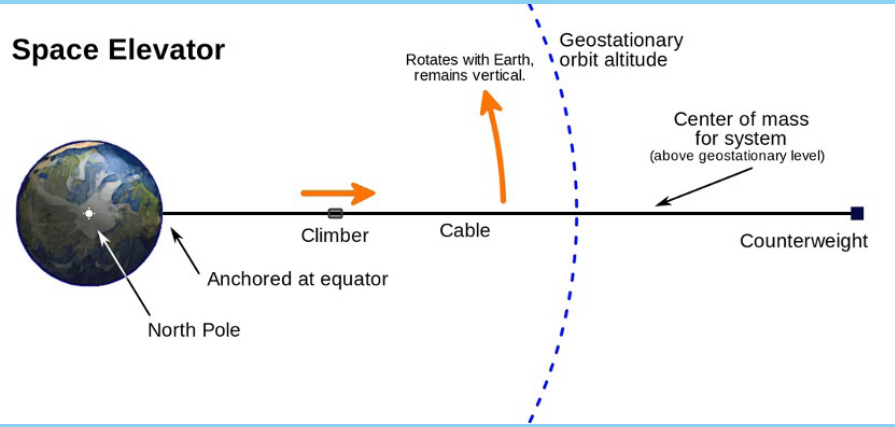
2. Propose a reason why your weight changed as you and the elevator moved downward.

3. Construct an explanation as to which of these weight changes might cause a problem to someone experiencing a space elevator.

Space Elevator

Take a Ride into Space

Scientists have continuously searched for ways to travel to outer space more easily and at lower costs. Currently, the cost to move materials to space via a rocket is about $25,000 per kilogram of material. The use of a space elevator is expected to drop this cost to between $5 to $300 per kilogram. This could mean that people could visit outer space not for tens of millions of dollars, but potentially for thousands of dollars. The line of people wanting to take this trip is expected to be long once the space elevator becomes practical.



One of the most critical elements of a space elevator in the cable that connects the ground with the counterweight positioned in space. Steel, aluminum, and titanium do not support the necessary forces to keep the cable intact. Kevlar, carbon-graphite fibers, and carbon nanotubes have been proposed to meet the demands of the high strength and low weight required for the cable. While some proposed these materials as possible solutions, the long length required for the cable has not yet been realized at a cost favorable to their development.

Several safety issues arise that technologists must overcome before anyone can make this trip. First, traditional aircraft, spacecraft, and satellites might collide with the cable attaching the elevator to the ground. Air-space traffic controllers would be needed to ensure the safety of all. Next, meteoroids and space junk could also strike the elevator. This would require additional mass be added to the elevator to protect the passengers from these possible collisions. Lastly, the elevator would pass through the Van Allen radiation belt on its journey to space. The elevator would need shielding to protect passengers from harmful radiation exposure during their journey.

Please visit our site for more helpful information:
STEMsims.com

Answers: Page 2 Answers: 1) c, 2) b, 3) a, 4) d, 5) d. **Page 3 Answers:** Getting Heavy 1) The acceleration of the elevator created a force pressing down on the floor of the elevator as the elevator lifted you upward. 2) The acceleration of the elevator downward reduced the force on the floor exerted by you. 3) Answers will vary.