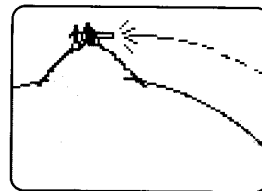


# 30 Newton's Mountain

The concept investigated in this simulation is satellite motion.



---

## Situation A

Irene and Matt are on a mountain whose top is above Earth's atmosphere. On the mountain is a super-cannon capable of firing a cannonball at up to 10.00 km/s. Since the cannon is above Earth's atmosphere, there is no air resistance to slow the cannonball after it is fired. Irene is worried that a cannonball fired at too high a speed will circle around the earth and hit them in the back. Matt does not believe this can happen. Who is correct?

### Make a Prediction

1. Is it possible for the cannonball to circle Earth and hit them in the back as Irene says? Predict who you think will be correct and explain your answer. Write your prediction below.

---

---

---

---

---

---

---



**Run Simulation** Set *Cannonball's speed* to 6.00 km/s. Click the *Tracking On* button. Set the *Vector Display* to *Off*. Click the *Run* button and observe the simulation. Click the *Reset* button. Set *Cannonball's speed* to 8.00 km/s. Click the *Run* button and observe the simulation.

2. Was Irene correct? Describe the result of the simulation with a cannonball speed of 6.00 km/s. Describe the result of the simulation with a cannonball speed of 8.00 km/s.

---

---

---

---

---

---

---

Now investigate what will happen when the cannonball has a speed greater than 8.00 km/s by running the simulation as directed below.



**Run Simulation** Click the *Reset* button. Set *Cannonball's speed* to 10.00 km/s. Click the *Tracking On* button. Set the *Vector Display* to *Off*. Click the *Run* button and observe the simulation.

3. What happened when the cannonball was fired at a speed of 10.00 km/s? Explain the results.

---

---

---

---

---

Now investigate in more detail the simulation for a cannonball speed of 8.00 km/s by running the simulation as directed below.



**Run Simulation** Click the *Reset* button. Set *Cannonball's speed* to 8.00 km/s. Click the *Tracking On* button. Set the *Vector Display* to *On*. Click the *Run* button and observe the simulation. Note: Two vectors labeled **FG** and **V** will appear on the computer screen. The vector labeled **FG** represents the force of gravity acting on the cannonball. The vector labeled **V** represents the cannonball's velocity.

4. Does the velocity vector **V** change length as the cannonball orbits Earth? Explain why or why not.

---

---

---

---

---

---

5. Does the force of gravity vector **FG** change length as the cannonball orbits Earth? Explain why or why not.

---

---

---

---

---

---

6. How are the directions of the  $\mathbf{V}$  and  $\mathbf{FG}$  vectors related to each other? Is there any component of the  $\mathbf{FG}$  vector acting along the  $\mathbf{V}$  vector?

---

---

---

---

---

7. How does the force of gravity vector  $\mathbf{FG}$  affect the speed of the cannonball as it orbits Earth?

---

---

---

---

---

8. Does the cannonball's height above Earth change as it orbits? Does the cannonball's potential energy change as it orbits Earth? Explain why or why not.

---

---

---

---

---

9. Does the cannonball's kinetic energy change as it orbits Earth? Explain why or why not.

---

---

---

---

---