Force And Motion

Physical Science | Lesson Guide

4th Grade

Photo Description

A student in a red shirt is jumping over an orange cone on a grassy field, demonstrating how forces act on their body to make it move. The athlete's legs are bent and lifted high, showing the upward push needed to leave the ground. Other students and spectators watch in the background, indicating this is a school athletic activity or field day event.

Scientific Phenomena

Anchoring Phenomenon: Why can a person jump into the air and then come back down?

This image captures the fundamental interaction between forces and motion. When the student pushes their legs down against the ground with force, the ground pushes back with an equal and opposite force (Newton's Third Law). This upward force is greater than the student's weight, causing them to accelerate upward into the air. Once airborne, gravity pulls the student downward, bringing them back to the ground. The student's muscles generated the initial force, demonstrating how living things use energy to create motion.

Core Science Concepts

* Force: A push or pull that can change how something moves. In jumping, the student's leg muscles push down on the ground.

* Motion: A change in position or place. The student moves upward through the air and then downward back to the ground.

* Gravity: An invisible force that pulls objects toward Earth. Gravity is what brings the student back down after jumping.

* Newton's Third Law of Motion: For every action, there is an equal and opposite reaction. The student pushes down on the ground; the ground pushes up on the student with equal force.

Pedagogical Tip:

When teaching force and motion with this image, have students first feel forces on their own bodies before explaining them abstractly. Ask students to push against a wall and feel the wall push back, or jump and feel gravity pull them down. Concrete, kinesthetic experiences help Fourth Graders internalize these invisible concepts.

UDL Suggestions:

Representation: Use slow-motion video of jumping to help students see the stages of motion more clearly. Provide labeled diagrams showing forces as arrows (push down, push up, gravity pulling down) so visual learners can see force directions.

Action & Expression: Allow students to demonstrate their understanding by creating their own jumping sequences, drawing force diagrams, or building simple lever systems rather than relying only on written responses.

Engagement: Connect jumping to real-world contexts students care about—sports, dance, playground games—to make the concept personally relevant.

Zoom In / Zoom Out

Zoom In: Muscle Cells at Work
When the student's leg muscles contract to jump, millions of tiny muscle cells are shortening all at once. Inside each muscle cell, even tinier structures called mitochondria are burning chemical energy from food (glucose) to power the muscle fibers. The muscle cells pull on bones like tiny ropes, creating the force needed to push off the ground. This is why eating healthy food gives us energy to jump higher and run faster—our cells need that fuel!

Zoom Out: Athletic Systems and School Communities
This jumping activity is part of a larger school field day event or athletic program. When you zoom out, you see how individual students' jumps connect to team competitions, school fitness goals, and community wellness. The presence of spectators and other students shows how physical activity brings people together. These school events also connect to larger systems: local parks and recreation departments that maintain athletic fields, coaches and physical education teachers who train students, and even city planning that decides where athletic facilities are built. One student's jump is part of a much bigger system of health, community, and human movement!

Discussion Questions

1. What forces are acting on the student while they are in the air? (Bloom's: Understand | DOK: 1)
2. Why does the student come back down to the ground instead of staying in the air? (Bloom's: Explain | DOK: 2)
3. If the student jumped on the Moon instead of Earth, how would the jump be different, and why? (Bloom's: Analyze | DOK: 3)
4. How could the student jump even higher, and what force would need to change? (Bloom's: Apply | DOK: 2)

Potential Student Misconceptions

Misconception 1: "Gravity only pulls things down after they jump."
Clarification: Gravity is always pulling on the student, even before they jump and while they're in the air. When jumping, the student's leg muscles push harder than gravity pulls, so the student moves up. Once in the air, gravity keeps pulling, which is why the student comes back down. Gravity never stops working—it's constant!

Misconception 2: "The student needs to push on something in the air to stay up longer."
Clarification: Once the student leaves the ground, there's nothing to push on, so the student cannot push themselves higher. The only force acting on the student in the air is gravity pulling downward. The student's time in the air is determined by how hard they pushed off the ground at the start—a bigger push = more time in the air. But nothing can make them stay up once they jump; gravity always brings them back down.

Misconception 3: "Heavier students can't jump as high as lighter students."
Clarification: A heavier student can jump just as high as a lighter student if their muscles are strong enough to push with the right amount of force. Gravity does pull harder on heavier objects, but stronger muscles can overcome that. It's about the force the muscles create, not just body weight. This is why athletes of all sizes can be excellent jumpers!

Extension Activities

1. Jump Height Challenge: Have students jump while you measure how high they jump using a meter stick or tape on a wall. Then ask them to predict how their jump height would change if they bent their knees more before jumping, jumped with one leg, or swung their arms. Test predictions and measure again. This connects to force (more bend = more push force) and motion (different forces = different heights).

2. Force Detective Walk: Take the class on a "force walk" around the school playground. Students identify and sketch examples of forces in action—pushing on swings, friction on the slide, gravity pulling the ball down. Have them label each force as a push, pull, or gravity, and explain how it changes motion.

3. Design a Better Jump: Provide students with simple materials (foam blocks, boxes, ramps) and ask them to design a landing zone that would help them jump safely over obstacles. Challenge them to explain how their design works using force and motion vocabulary. This connects physics to engineering and safety.

Cross-Curricular Ideas

Math Connection: Measuring and Graphing Jump Heights
Have students measure their own jump heights using a meter stick or tape on a wall. Record the data and create a bar graph showing the class results. Students can calculate the average jump height, find the highest and lowest jumps, and discuss why some students jump higher than others using force and motion concepts. This connects measurement, data organization, and real-world application of math.

ELA Connection: "How-To" Writing and Scientific Explanation
Ask students to write a detailed "How to Jump Higher" guide that explains the steps using force and motion vocabulary. Students must use complete sentences, proper sequence words (first, next, then, finally), and scientific terms like "force," "gravity," and "push." This builds writing skills while reinforcing science vocabulary and conceptual understanding.

Social Studies Connection: Olympic Athletes and Global Sports
Connect the jumping activity to Olympic long jump and high jump competitions. Research famous Olympic jumpers from different countries and cultures. Discuss how athletic competitions bring people from around the world together. Students can learn about the history of jumping events in sports and how different cultures value physical achievement.

Art Connection: Motion Drawing and Force Diagrams
Have students create drawings or paintings that show a person jumping in different stages—crouching, pushing off, in the air, landing. They can use arrows and colors to represent the forces acting on the jumper (red arrows for pushes, blue for gravity, etc.). This combines artistic expression with scientific communication and helps students visualize invisible forces in creative ways.

STEM Career Connection

Sports Physical Therapist
Sports physical therapists help athletes recover from injuries and prevent future injuries. They study how bodies move during activities like jumping and understand forces and motion to design exercises that keep athletes healthy and strong. A physical therapist might watch a student jump, notice if their form is incorrect, and teach them safer ways to jump that won't hurt their knees or ankles. They combine knowledge of bones, muscles, and physics to help people move better.
Average Annual Salary: $91,000 USD

Biomechanical Engineer

Biomechanical engineers study how human bodies move and design equipment to help people jump, run, and play better. They might design special shoes with springs that help athletes jump higher, or create protective gear that keeps jumpers safe. These engineers use computers, physics, and knowledge of the human body to invent new sports technology.
Average Annual Salary: $75,000 USD

Physical Education Teacher or Coach
Physical education teachers and coaches help students stay healthy and active by planning activities like field day events, teaching proper jumping technique, and explaining why movement and exercise matter for our bodies. They use their understanding of forces, motion, and human health to inspire students to be active and physically fit. Many coaches also help athletes improve their performance in sports like track and field, where jumping is essential.
Average Annual Salary: $62,000 USD

NGSS Connections

Performance Expectation:
4-PS3-3: Ask questions and predict outcomes about the changes in energy when objects collide, objects are pushed or pulled over a distance, and/or objects are dropped to make work easier. (Forces and Motion)

Disciplinary Core Ideas:
 4-PS2.A Forces and Motion* – Objects are pushed or pulled by forces, and forces can change the direction or speed of an object's motion.
 4-PS2.B Types of Interactions* – Electric and magnetic forces between a two objects act even when the objects are not in contact; contact forces, such as frictional force, act only when objects are touching.

Crosscutting Concepts:
* Cause and Effect – The student's leg muscles (cause) produce a push force that creates upward motion (effect).
* Energy and Matter – The student's chemical energy from food is converted into mechanical energy (motion) during the jump.

Science Vocabulary

* Force: A push or pull that can make something start moving, stop moving, or change direction.

* Gravity: An invisible force that pulls things toward Earth and keeps us from floating away.

* Motion: The act of moving from one place to another.

* Push: A force that moves something away from you.

* Newton's Third Law: The rule that says when one thing pushes on another, the other thing pushes back just as hard.

External Resources

Children's Books:
 Push and Pull* by Lola M. Schaefer (Pebble Books) – Simple, illustrated exploration of pushes and pulls in everyday life.
 Forces Make Things Move* by Kimberly Brubaker Bradley (HarperCollins) – Engaging narrative that explains forces through relatable examples.
 What Makes Things Move?* by Jennifer Boothroyd (Lerner Publishing) – Accessible text with photos of real-world force and motion examples.

Coaching Note: This jumping activity is an excellent, safe starting point for Fourth Grade force and motion study. It uses students' own bodies and experiences, making abstract concepts concrete. Consider filming student jumps and analyzing the motion frame-by-frame during future lessons to deepen conceptual understanding of speed, distance, and force.