



Gravity Games

DESCRIPTION

This lesson guide integrates a series of activities designed to demonstrate gravity's role in recreation.

OBJECTIVES

Students will

- Demonstrate the use of gravity as an energy source for motion
- Identify aspects of gravity involved in various common games
- Develop modifications to overcome the effect of microgravity on toys

NASA SUMMER OF INNOVATION UNIT

Physical Science—Gravity

GRADE LEVELS

4 – 6

CONNECTION TO CURRICULUM

Science and Mathematics

TEACHER PREPARATION TIME

1.5 hours

LESSON TIME NEEDED

9 hours *Complexity: Moderate*

NATIONAL STANDARDS

National Science Education Standards (NSTA)

Science as Inquiry

- Skills necessary to become independent inquirers about the natural world

Physical Science

- Motions and Forces
- Transfer of Energy

Science in Personal and Social Perspectives

- Science and technology in society

Common Core State Standards for Mathematics (NCTM)

Number and Operations

- Perform operations with multi-digit whole numbers and with decimals to hundredths

Measurement and Data

- Represent and interpret data

Expressions and Equations

- Reason about and solve one-variable equations and inequalities

MANAGEMENT

The marble run activity and spaced out sports require a fair amount of room and may be noisy. Groups of four to five students are recommended for both activities. If performing the entire toys in space activity, you will need videoconferencing capability.

CONTENT RESEARCH

The force of gravity permeates all aspects of life as we know it including social and recreational interactions. Gravity's downward pull provides a ready source of energy for both starting and stopping motion.

Key Terms:

- **Gravity:** the attractive force between any two massive objects
- **Friction:** the retarding force generated when two objects are in contact and move with respect to each other.
- **Inertia:** the tendency of an object to maintain its state of motion
- **Energy:** the ability to do work
- **Microgravity:** the minimized effect of gravity experienced by objects in freefall
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Misconceptions:

Students often forget the importance of gravity in everyday tasks and neglect the amount of modification necessary to perform those tasks in microgravity. They may also believe that, because objects in orbit appear to float, there is no gravity in orbit. The actual pull of gravity on objects in low Earth orbit is only 10 percent less than at the surface of the Earth.

LESSON ACTIVITIES

The suggested sequence starts by introducing the need for gravity in recreation and progresses to studying different aspects of gravity's effects and modifying tasks to account for microgravity.

Marble Run

Students use marbles and flexible pipe insulation to create roller-coaster style tracks.

http://er.jsc.nasa.gov/seh/amuse_park_physics.pdf

Spaced Out Sports

Students perform a series of activities to explore aspects of gravity's effect on games. The first four activities are relevant to this lesson.

<http://education.ssc.nasa.gov/spacedoutsports.asp>

Toys In Space

Students explore the effects of microgravity on toys and create modifications to them during a videoconference event.

<http://aesp.nasa.okstate.edu/ftp/anderson/toysweb/index.htm>

RELATED RESOURCES

Short video clip introducing the importance and limitations of gravity

http://www.nasa.gov/mov/162014main_013_PullofGravity.mov

Short video explaining microgravity

http://www.nasa.gov/mov/196818main_053_Impact_Microgravity.mov

DISCUSSION QUESTIONS

Each activity includes questions for discussion.

Additional questions:

- Why would NASA scientists study toys? *Toys often employ principles necessary for complex equipment but in a simpler form*
- What part of a rollercoaster ride is like spaceflight? *The downhill portions are similar to orbit in terms of the feel of gravity*

MATERIALS

- Marbles
- Stopwatches
- Multiple half pieces of copper pipe insulation (gray, spongy) each 6 ft long
- Masking tape
- Meterstick
- CDs
- ½-in.-diameter PVC segments ¾ in. long
- Round balloons
- One-hole #2 rubber stoppers
- Hot glue guns and glue
- Cardboard
- String
- Metal washers
- Paper punch
- Short dowels
- Swivel chair
- Two hand weights (2 to 3 lb)
- Cellophane tape
- Cardstock boomerangs
- Assorted toys, matching toys in space video clips

ASSESSMENT ACTIVITIES

Each activity has a series of questions in the student pages.

Pretest/Posttest questions:

- What is gravity? *The attractive force between any two massive objects*
- List two toys that depend on gravity. *Answers will vary but should indicate the need for downward pull*
- How does gravity help a rollercoaster? *After the first hill, it provides the energy for the ride*

ENRICHMENT

- Students may want to explore other amusement park rides that require gravity.
- Have students combine all segments of track to create a giant rollercoaster.
- Have students perform other challenges from Spaced Out Sports.