



Physics Explorations and Projects

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PEP



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Gravitation on Earth

You have lived your entire life within a gravitational force field on Earth. Can you feel it, right now? Do you know how the gravitational field of the Earth is measured or defined? In this activity you will investigate Earth's gravity two different ways.

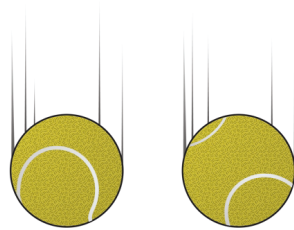


Figure 1

PRELIMINARY OBSERVATIONS

1. Observe two objects of the same size but different mass as they are dropped at the same time from the same height.
2. Discuss your observations with your group or class. Questions to consider include:
 - What do you notice?
 - Can we identify the forces acting on each object?
 - Is there a way to eliminate all the forces on the object except gravity?
3. Draw a qualitative graph that represents the motion. Label the axes and add a few words of explanation.
4. Observe two objects with different masses as you hold or lift them.
5. Discuss your observations with your group or class. Questions to consider include:
 - What do you notice?
 - What makes these objects feel different from each other?
 - Does gravity affect what we feel when we hold or lift an object?

PROCEDURE

Part I

1. Discuss and decide what variables you will use to describe the motion of an object moving only under the influence of the force of gravity on Earth.
 - Consider any previous models of motion you have developed.
 - Plan to have a quantitative result (a number and units).

Experiment 3

2. Develop a purpose and a procedure for your investigation.
 - Your purpose should ask a question or propose a model for describing the motion of an object moving only under the influence of the force of gravity on Earth.
 - Include the measurement equipment you will use.
 - Decide how much data or observation to take in order to have enough information to satisfy your purpose and stand up to questioning by your peers.
3. Carry out the investigation and record your data and observations. Make sure all group members have access to the data.

Part II

1. Discuss and decide what variables you will use to describe the quantity of the force of gravity acting on an object.
 - Consider what factors may affect the force of gravity on an object and how you could vary them.
 - Remember that only one independent variable may be changed at a time.
2. Develop a purpose and a procedure for your investigation.
 - Your purpose should ask a question or propose a model for determining the force of gravity on an object on Earth.
 - Include the measurement equipment you will use.
 - Decide how much data or observation to take in order to have enough information to satisfy your purpose and stand up to questioning by your peers.
3. Carry out the investigation and record your data and observations. Make sure all group members have access to the data.

ANALYSIS

For the two parts, ask yourself: Is the graph linear? If not, you may need to perform one or more mathematical operations on your data. Develop a mathematical model for your data and discuss with your group how your variables fit into the model. When you discuss the results with your class, be sure to share your model and ideas.

Examine your graphs and those of your peers. Look for patterns and consistencies. In class discussion, come to a consensus model for motion of a falling object on Earth and a consensus model for the force of gravity on any object on Earth. How confident are you that these models will work elsewhere on Earth? You may need to do some reading or some research.

EXTENSION

Find a video of the *Feather & Hammer Drop on Moon* on the Internet and download a copy of the video that can be analyzed using video analysis. Perform video analysis of the falling feather and hammer to determine if gravity models are dependent on the planetary body.

Solar Cells

Imagine a solar farm, a huge array of solar panels pointed toward the sun, collecting light and converting it into electricity. Solar energy is appealing for many reasons—it's plentiful, clean, and has a smaller impact on the environment than many other forms of energy production. Scientists have been extolling the virtues of renewable energy for decades and policy-makers are coming to realize their importance. Solar farms are multiplying as renewable energy becomes more and more important to our planet's health.

PRELIMINARY OBSERVATIONS

On a much smaller scale, a single solar cell can drive enough electricity to sound a buzzer or light an LED. What is the chain of energy transformations that take place in such a circuit? If the solar panel were to produce more or less electrical power, how would you know? What variables influence how much electrical power the solar cell produces?

PROCEDURE

1. Discuss and decide what variable(s) you will control. Consider the tools you have available and determine how you will measure or calculate the electrical power.
2. Develop a purpose and a procedure for your investigation.
 - Your purpose should ask a question or propose a model for how your chosen variable affects the power produced by a solar cell.
 - Identify the measurement equipment you will use.
 - Decide how much data to collect in order to have enough information to satisfy your purpose and stand up to questioning by your peers.
 - Make sure that you can keep other variables constant during your investigation.
3. Carry out the investigation and record your data and observations. Make sure all group members have access to the data.

ANALYSIS

Examine your graphs. What kind of relationship appears to fit your data? Look for patterns and consistencies, and consider the range of values that you tested. Over what range of values does your relationship hold? Share your results with other lab groups and attempt to synthesize your all the results into a model in order to optimize the power output of a solar cell.

EXTENSIONS

1. Investigate the feasibility of putting solar panels on the roof of your school in order to provide supplementary power to the building. If solar panels prove to be cost-effective, write up a proposal to submit to the school board.
2. Research average sunny days in different cities. Are there certain geographic locations where solar power makes the most sense. Are high-latitude cities better candidates for the use of solar power than low-latitude cities?
3. Build a solar charging station for rechargeable batteries.