Gravity Lesson Plans

Jana Barrow
West Point Jr. High
2775 W 550 N
West Point, UT 84015
801-402-8100
jbarrow@dsdmail.net

Eighth Grade Integrated Science
Standard IV: Students will understand the relationships among energy, force, and motion.

Objective 2: Examine the force exerted on objects by gravity.

Intended Learning Outcomes (ILOs)
1. Use Science Process and Thinking Skills
   a. Observe objects and events for patterns and record both qualitative and quantitative information.
   e. When given a problem, plan and conduct experiments in which they:
      - Select appropriate format (e.g., graph, chart, diagram) to summarize data obtained.
4. Communicate Effectively Using Science Language and Reasoning
   a. Provide relevant data to support their inferences and conclusions.
   b. Use precise scientific language in oral and written communication.

Time Needed to Complete Inquiry:

Day 1 – What affects gravity?
Day 1 – Mass has no effect on how an object falls
Day 2 – Gravity is an accelerating force
Day 3 – Other factors associated with gravity (air resistance and terminal velocity)
Day 4 - Demonstrations of gravity (small groups or teacher) - optional

Inquiry: See Below

Prior Knowledge Needed: general lab safety procedures.

Safety Precautions: General safety precautions

Materials / Resources Needed for the Investigation:

Day 1 – What affects gravity? (Introduction)

- Chalkboard/whiteboard

Day 1 – Mass has no effect on how fast an object falls (guided inquiry)

- Objects of different masses with similar shapes
- Clay
- Meter sticks
- Scales should be available at student request

Day 2 – Gravity is an accelerating force (structured inquiry)

- Meter sticks
- Stopwatches
- Ball or similar object for each group

Day 3 – Other factors associated with gravity (air resistance and terminal velocity) (guided inquiry)

- Newspaper
- String
- Washers (small ones about ¼ inch)
- Scissors
- Rulers
- Stopwatches

Day 4 – Demonstrations of gravity (small groups or teacher) **optional. For use with discussion**

- spring scales
- weight (or bags of pennies)
- padding – piles of cloth or pillows
- Plastic/Styrofoam cup with hole in the bottom
- Water
- Book
- Flat sheet of paper cut to size of book
- Crumpled sheet of paper cut to same size as flat
- Similarly sized objects of different masses (balls, quarters, washers, etc.)

Procedures of the Investigation:

Day 1 – What affects gravity?

- Write "What affects gravity?" on the board. As a class generate a list of things that could affect gravity. You may also want to get the students to describe what they think gravity is.
- After this has activity has been completed, divide the class into groups of four. They will be working in these groups for the next couple of days (you may want to keep them in the same groups for the entire unit.)

Day 1 – Mass has no effect on how fast an object falls

- Mass and weight were probably included in the list. In groups give the students the objects you have available, (modeling clay, balls, books, metal washers, etc.) These objects should have different masses and negligible air resistance.
- Have the students experiment with the materials and collect data to answer the question, "Does an object's mass affect how fast it falls."
- After the students have finalized their investigations, bring the class back together as a whole and have them discuss what they learned about mass and gravity.
- The key thought that should arise is: "Mass has no effect on how fast gravity pulls something down."

Day 2 – Gravity is an accelerating force

- Have the students determine how long it takes an object to fall 1 meter. Due to variance in reaction times, the same person should always be the timer.
- Once they have determined how long it takes an object to fall 1 meter, have them use this information to predict how long it will take an object to fall 2 meters.
- Have the students test their prediction. They will probably be off by quite a bit.
- Ask students to make an inference about the discrepancy between their prediction and their actual results. Working in their groups, they should be able to infer that the object must be "speeding up" or accelerating as it falls.
- In 1.0 seconds, an object should fall 4.9 meters. You may want to then prove how far an object will fall in one second if you have access to a balcony within the building.

Day 3 – Other factors associated with gravity (air resistance and terminal velocity)

❖ Parachutes

- Cut a 22 in. (56 cm) by 22 in. (56 cm) square from a newspaper.
- Cut 4 separate strings about 20 in (50 cm) long.
- Tie a string to each corner of the newspaper square.
- Tie the 4 ends of the strings together in a knot. Be sure the strings are all the same length.
- Use a string about 4 in. (10 cm) long to attach 3 washers to the knot in the parachute strings.

1. Create a parachute within each group.
2. Assign each group to a specific location.
3. Drop parachutes from an agreed height, use stop watches to determine the length of time to land and record time of landing in seconds on a piece of paper.
4. Repeat Step 3 with 3 washers, 5 washers, 7 washers and 9 washers. For improved data analysis, repeat each drop at least three times, or compile class data.

Data Collection: Have students create a data table to show the time it took to drop, such as the following:

	3 washers	6 washers	9 washers	12 washers
Trial 1 or Group 1				
Trial 2 or Group 2				
Etc.				

Depending on the amount of practice students have had with data tables, assistance may be needed to construct the table.

Data Analysis:

- Ask students to make a concluding statement that interprets their data.
- Do a classroom "round robin" to see what their conclusions were. An appropriate conclusion would be that the more mass a parachute has, the faster it falls. Not much else can really be interpreted from the data.
- With this activity many students may say that mass has an effect on how fast an object falls. Remind them that on the first day they decided the **mass had no effect on how an object falls.**
- In their groups, have students develop a hypothesis that could account for this discrepancy. Ask them to think of ways in which they could test their hypothesis, and then test their hypothesis in their groups.
- TEACHER NOTES: This activity revolves around air resistance (friction of a falling object). The students need to be sure to understand that if all things fell in a vacuum, they would all fall at the same rate. Video examples of this are available from a variety of sources: clips of Neil Armstrong dropping a hammer and feather on the moon, the "Vomit Comet" – used by NASA to train astronauts about free fall, etc.

Extra Projects for Gravity Concepts:

- Some of these will be repeats of the previous days, but this information will help to reinforce concepts.
- Assign each group a demonstration to complete. Have them perform the activity, analyze what happens in their groups, propose explanations for what is happening, and then share that information as a class.
- As the information is shared with the class, correct any misconceptions/errors, and ensure that gravity information is accurate.

Project 1 – Weight vs. Mass – have each group perform all three situations.

- Students need to know that spring scales are used to measure weight and a balance is used to measure mass. Students also need to know the definitions of weight and mass.

Situation #1

- Have students attach a weight or bag of pennies to the spring scale.
- Record the weight from a standing/hanging position.
- Each member of the lab group needs to do the following:
    - Lay the scale flat on the table with the weight attached to the scale.

    - Lift the scale so the weight is resting on the table top. (The scale should read “0”.)
    - Rapidly lift the scale in an upward direction.
    - Record the highest reading obtained in the group.
- Repeat the above step until everyone in the group has had a chance to lift the scale (3 to 4 times).

Situation #2

- Each member of the group needs to then go through this sequence:
    - Hold the scale with the weight hanging free.
    - Quickly lower their hand in a downward motion
    - Watch the scale and record the lowest reading within the group.
- Repeat the above steps until everyone has had a chance to perform the experiment (3 to 4 times)

Situation #3

- Each member of the group needs to perform this sequence:
    - Hold the scale in midair with the weight hanging free.
    - Let go of the scale and drop it onto a well padded surface
    - Observe the scale as it is being dropped
    - Record the approximate weight observed.
- Repeat the above steps until everyone has had a chance to perform the experiment (3 to 4 times)

❖ In their groups, have students answer these questions:

1. Did the **weight** of your object change? If so, precisely describe how the weight was changed. Use the data you collected to support your conclusions.
2. Did the **mass** of your object change? If so, precisely describe how the mass was changed. Use the data you collected to support your conclusions.

❖ Have the groups give their answers and supporting evidence as a classroom “round robin.”

❖ Encourage classroom discussion about their answers. Always ask the students for supporting evidence.

❖ Make sure to clear up any misconceptions. You may want to consider some type of formative assessment.

Project 2 - Cup Drop

- Put a hole in the bottom of a Styrofoam or plastic cup.
- Fill with water and cover the hole
- Uncover the hole. **Discuss:** What happens? Why?
- Fill cup again and cover the hole
- Drop the full cup from a height. **Discuss:** What happened? Why did the water not come out of the hole?

Project 3 - Air Resistance

- Have a book and a flat sheet of paper cut to the same size.
- Drop both at the same time **Discuss**
- Crumple the piece of paper up into a ball. Drop the book and balled up paper from the same height. **Discuss what is happening. Have students explain what is happening**

Project 4 - Distance impacts on Gravity

- Take two similarly shaped objects with different masses (washers, balls, pennies, etc)
- Drop them from a standing position from the same height at the same time. Have an observer watch to see which lands first.
- Stand on a chair and drop from the same height at the same time. Have an observer watch to see which lands first.
- Stand at an even higher elevation (table, etc.) and do the same thing.