**Topic:** Gravity

**Grade Level:** 8-12

**Objectives:**

At the end of the class students will have an understanding of the following:

1. All objects would fall down with the same acceleration regardless of their mass when air resistance ignored.
2. Gravity causes unsupported objects to fall.
3. Air resistance affects acceleration of falling objects.
4. How human body is attracted to the Earth.
5. Gravitational force between two objects depends on the amount of mass of each of the objects and the distance between their center of mass.

**Materials:**

1. Balls in different sizes and weights
2. A book and a sheet of cardboard the same length and with as the book
3. A feather, a piece of paper and a penny.
4. A vacuum tube
5. Computer with internet connection

**Procedure:**

1. Start the lesson with a discussion of the velocity of the falling objects with different weights. Ask students to predict if heavier or larger object would fall faster than light or smaller object when they drop from the same height.
2. Divide the students into group of three of four. Give each group balls in different size and weights, a book and a sheet of cardboard, and a feather and a piece of paper to experiment.
3. Ask student design their own experiment to find out what is the relationship between objects mass and shape and their velocity when they fall. Students should record their findings and compare the results.
4. If needed teacher should guide students to make arrangement for the experiment. One of the students could stand on a desk or a chair to drop the objects while others observe and record the falling time for each object.
5. When students drop the feather and the sheet of paper from the same height, they will find out these objects fall than more slowly. Ask them what they think the reason for that. Explain the air resistance and how it reduces the velocity of falling objects. A falling object must push air molecules out of its way as it falls. The object reaches a constant velocity when the force of the friction of air molecules pushing up equals the force of gravity pulling down. The greater the surface area of the falling object, the greater the upward force of air resistance.
6. Suggest the students make a ball with a sheet of a paper and drop it. Compare the falling time the paper ball with the regular sheet of paper. Have the students discuss the difference.

7. Ask the students to predict what would happen if they try the same experiments in a vacuum tube. Demonstrate falling of a feather and a penny in a vacuum tube.

8. Connect to the website below to show students some short movies from Apollo Moon Landing. Discuss the reasons for why astronauts walk differently on moon. Web site: http://btc.montana.edu/keres/html/weight1.htm

9. Each student will write a report explaining the experiments and the results. The report will consist of the effects of gravity on falling objects and the relationship between mass and shape of the objects and acceleration of the falling objects.

Rationale:

National Science Education Standards (NAS, 1995) states “from the earliest grades, students should experience science in a form that engages them in the active construction of ideas and explanations that enhance their opportunities to develop the abilities of doing science”. According to Bruner (1973) learning is an active process in which learners construct new ideas or concepts based upon their current/past knowledge. Cognitive structure provides meaning and organization to experiences and allows the individual to "go beyond the information given". Understanding science concepts is a creative act. Students construct their own knowledge of science concepts and therefore they should be actively involved in the science lesson. One of the constructivist ways to actively engage students in learning science is hands-on science teaching. By collecting views of teachers, curriculum developers and writers Haury and Rillero (1994) concluded “hands-on learning in science to be any educational experience that actively involves people in manipulating objects to gain knowledge or understanding

Evaluation:

Students’ activity reports can be used to evaluate their performance.

- **Three points**: results accurately reported; illustrations or diagrams clearly labeled; conclusions explained logically in well-written, well-organized paragraphs

- **Two points**: results adequately reported; illustrations or diagrams included; paragraphs lacking in organization

- **One point**: reporting of results sketchy or inaccurate; no illustrations or diagrams; conclusions lacking in logic; paragraphs poorly organized
Resource:

This lesson plan is adapted from the following web site:
http://school.discovery.com/lessonplans/programs/invisibleforce/mat

References:

