week 7

Parachute Express

Build a parachute that takes the longest time to descend.

Subjects and Skills

- Gravity, air resistance
- Surface area, weight, ratios
- The history of parachutes

Materials

- String or yarn
- Plastic garbage bags
- Adhesive dots or tape
- Paper clips
- A site from which to drop the parachutes (e.g., tall bookshelf, stairwell, window)

Vocabulary

- Gravity
- Air resistance
- Canopy
- Renaissance
- Parachute

Purpose

An understanding of how the principles of gravity and air resistance can be utilized is fundamental for gaining comprehension of physics topics.

Objectives

Students will gain a better understanding of:

- the history of the design of the parachute;
- the functions and uses of parachutes;
- how forces of gravity and air resistance can be used for productivity;
- how the design, surface area, shape, and weight of a parachute can impact its performance; and
- how Leonardo da Vinci's artistic abilities related to innovation and design.

Activity Preparation

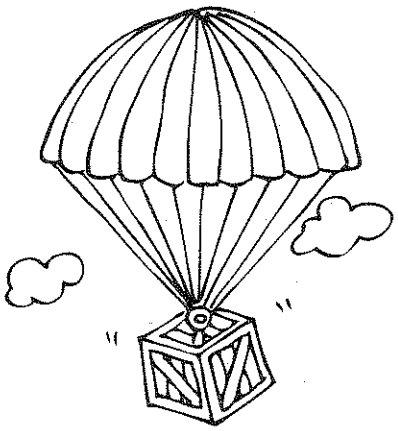
1. Run off activity sheets.
2. Gather materials and place them in two different areas of the room.
3. Bookmark websites to be used in class.
   a. http://inventors.about.com/od/italianinventors/a/LeonardoDaVinci.htm
   b. http://www.bbc.co.uk/schools/scienceclips/ages/10_11/forces_action_fs.shtml
   c. http://vimeo.com/38288667

Activity Procedure

1. Distribute the activity sheets and allow students to read and respond to Questions 1–3.
2. Ask students to share their responses.
3. Discuss Leonardo da Vinci's contributions by visiting Link a.
4. Have students continue to Question 4.
5. Brainstorm various ways in which parachutes have been used to help humankind. If there is time, continue the discussion to include possible uses for the future.
6. Discuss the terms *gravity*, *resistance*, *stability*, and *shape*. Ask how each of these can impact the performance of a parachute. To show how the weight of a parachute can change the speed of an object, go to Link b.
7. Introduce the term *canopy* (the part of the parachute that causes the air resistance). Ask students to discuss how the canopy's surface area impacts the parachute. (Canopies with a larger surface area produce more drag and therefore descend more slowly).
8. Before beginning the team challenge, review how to find the averages of data, as well as how to calculate surface area. If finding surface area is too advanced for your students, simply ask them to cross off Question 1 on the team challenge portion of their activity sheets.
9. Review the team challenge, and answer any questions that students may have. Ensure that all teams' parachutes are dropped from the same height.
10. Once the team challenge is completed, have students finish answering their questions.
11. Following the challenge, you may want to show the Extreme Parachuting (01:54) at Link c.
12. If you wish, assign one of the activities suggested in Extend the Learning With Parachutes: Activities.

Name: _____ Date: _____

Parachute Express



GOAL

- Build a parachute that takes the longest time to descend.

MATERIALS

- String or yarn
- Plastic garbage bags
- Paper clips
- Adhesive dots or tape

TIME TO CREATE

- 20 minutes

INDIVIDUAL ACTIVITY

Read the following, and then answer Questions 1–3. (Wait to continue until the teacher has instructed you to do so.)

Leonardo da Vinci was a remarkable Renaissance man who was very accomplished in many different disciplines—in fact, *Renaissance man* or *woman* has come to mean that somebody is known for significant accomplishments in multiple skill areas. Da Vinci was born in 1452 and is best known for his artwork, such as the Mona Lisa; however, in addition to showing artistic talent, da Vinci was a gifted scientist, with a strong curiosity and a creative vision of what was possible. Da Vinci conducted many experiments and created inventions well before modern science and invention as we know it had really begun. Many of his ideas for inventions and observations were meticulously sketched, with great attention to detail, in his journals. Highly curious, da Vinci created sketches that displayed a wide range of interests that often integrated art with math and science.

1. Think about air resistance. Which do you think would drop faster, a crumpled piece of paper, or one that was flat? Explain. _____

2. In your own words, define *parachute* and explain its purpose. _____

3. The first known written account of a parachute was found in da Vinci's notebooks from 1495; the first reported successful parachute jump wasn't made until 1783. How many years passed

before the concept of a parachute became a reality? _____. Why do you think it took so long? _____

4. Explain one way that parachutes are used today. _____

5. Some key concepts to understand when designing a parachute are gravity, air resistance, stability, and shape. How do gravity and air resistance impact a parachute?

How is shape related to stability of the parachute? _____

6. Leonardo's parachute sketches included proportional dimensions to allow a person to fall safely from a great height. Draw a sketch of a parachute. Include the measurements that would be appropriate to carry an adult.

7. Understanding basic physics concepts helps with the design of parachutes. Think about these concepts, and write down any ideas you may have about how modifying the parachute's design might impact its performance.
   a. changing the payload weight (the weight attached to the strings' base);
   b. lengthening, shortening, or changing the number of the suspension lines (strings attaching payload to parachute);
   c. increasing or decreasing the radius of the parachute, thus altering its size; and
   d. cutting holes and/or slits in the parachute fabric.

_____

_____

TEAM CHALLENGE

Participants will work together in teams of two or three for a total of 20 minutes to build a parachute with the most air resistance. The goal is to create a parachute that has the slowest descent (travel time from the release to the landing). Using the materials provided, build a parachute that, when weight is attached, will have the slowest descent. (All teams' parachutes will be dropped from the same height.)

The teacher will select groups and assign group numbers. Once the teacher starts the time, your group will have 20 minutes to gather supplies and design your parachute. Once the teacher signals that time is up, stop working immediately and bring your parachute to the test site. Any team that continues to work after time has been called may be disqualified.

Start Time _____ : _____ + 20 Minutes = _____ : _____ End Time

1. What is the surface area of your parachute's canopy? _____
2. Record the time of each team's parachute:

Parachute Times

Team 1 _____ : _____	Team 5 _____ : _____	Team 9 _____ : _____
Team 2 _____ : _____	Team 6 _____ : _____	Team 10 _____ : _____
Team 3 _____ : _____	Team 7 _____ : _____	Team 11 _____ : _____
Team 4 _____ : _____	Team 8 _____ : _____	Team 12 _____ : _____

3. What was the average time that it took for a team's parachute to descend?

   Average time for descent: _____ : _____

4. How did your parachute's time compare with the class average? _____

_____

_____

5. What is a contributing factor for a parachute to stay in the air longer, and why?

6. How would you modify your parachute to improve your design?

7. Parachutes have many uses. One way meteorologists use parachutes is for measuring the atmosphere over the oceans. Dropwindsondes, instruments used to measure pressure, temperature, humidity, and wind, are attached to parachutes and then dropped from an airplane. As they float down toward the ocean, they radio atmospheric information back to the airplane. Think about some of the concerns we have on Earth. How might we use parachutes to address those concerns?

EXTEND THE LEARNING WITH PARACHUTES: ACTIVITIES

1. **Design a parachute.** Visit NOVA's Mars exploration rover mission site and complete the interactive lesson at http://www.pbs.org/wgbh/nova/space/design-mars-parachute.html. You will design a parachute to help the Mars exploration rovers *Spirit* and *Opportunity* touch down safely on the red planet.
2. **Surface area.** At what point does increasing the size of a parachute no longer increase its effectiveness? Make several different parachutes with various canopy sizes. Test them, and record your results in a chart. Write a brief report about your findings.
3. **Literature connection:** Read Michael O. Tunnell's *Candy Bomber: The Story of the Berlin Airlift's "Chocolate Pilot."* Draw a picture depicting a scene from the book that features parachutes.
4. **Everyday materials.** Build a better parachute with materials you find around your house. Bring the parachute to school.