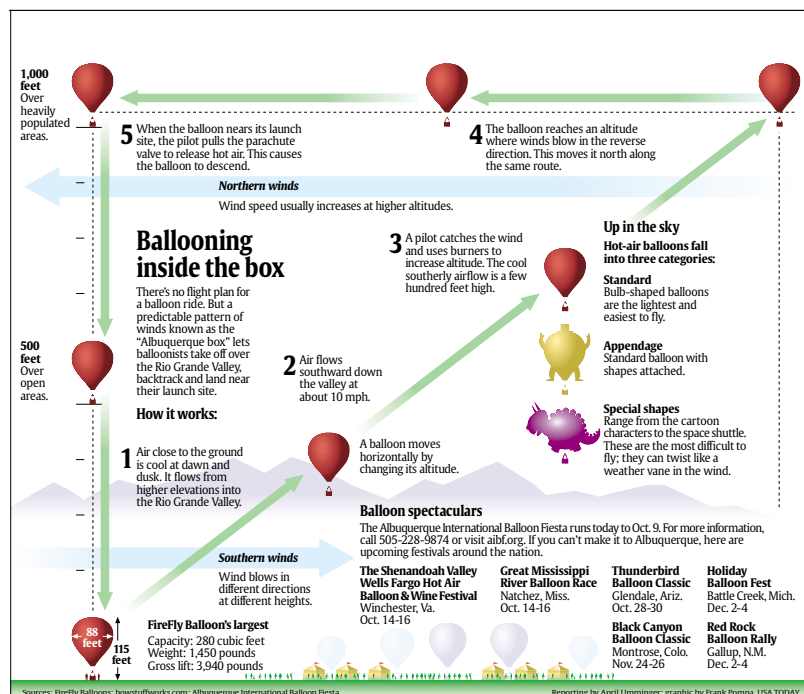


Ballooning inside the box

by: Bob Tower



Activity Overview:

In this activity using the USA TODAY Infograph, "Ballooning inside the box," students will explore geometric relationships using similar triangles. Identifying triangles with two pairs of congruent angles to explore similarity properties of the triangles is an essential part of this activity. Students will learn what happens to the ratios of corresponding sides of a variety of similar triangles. Applying the relationships to a real-world problem will help students understand how geometry is used to solve, in this case indirectly, problems.

Activity at a Glance:

- Grade level: 8-10
- Subject: Geometry
- Estimated time required: 30 minutes

Materials:

- TI-83 Plus family or TI-84 Plus family
- TI-ViewScreen™ calculator for instruction/demonstration
- Cabri™ Jr. Application
- Student handout
- Transparency
- USA TODAY newspapers (recommended)

Prerequisites:

Students should:

- know how to use Cabri Jr.
- have prior knowledge about similar polygons.
- have prior knowledge about solving proportions.
- have prior knowledge about angle of incidence and angle of reflection.



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Concepts:

- Similar triangles
- Corresponding sides of similar triangles are proportional

Objectives:

Students will:

- explore properties of ratios and proportions in the study of similar triangles.
- solve proportions to determine the indirect height of an object.

Background:

The purpose of this lesson is to help students develop a better understanding of similarity. In this activity students will use the USA TODAY Infograph, “Ballooning inside the box,” to understand concepts from their study of the similar polygons and proportions to determine the height of a hot-air balloon indirectly. Applying this to a real-world problem will help students understand when and where these types of formulas can be used. This activity is a critical link between proportional reasoning from algebra and similarity of triangles from geometry.

Preparation:

- Provide one graphing calculator for each student.
- Each student should have a copy of the corresponding student activity sheet.
- Provide each student with the following calculator file (*AppVar*) *SIMILAR*.

Classroom Management Tips:

- Have the students link their calculators and share the *AppVar* as part of the class period on the previous day or during the beginning of the class period when you are going to use this activity. Insure that graphing calculators have been updated with latest versions of operating system and Cabri Jr.
- Go over the relationship between the angle of incidence and the angle of reflection so that the students will understand why the triangles formed are similar.
- Review opening an *AppVars* using Cabri Jr. with your class before starting the activity.
- Students can work individually or in groups to assist each other during the activity.
- Have students discuss their discoveries while they work to better understand the relationships.
- Before starting the *AppVars*, remind students to carefully read the opening screen and the activity pages. It will help students to draw a diagram of the problem before starting Activity 2.

Data Source:

FireFly Balloons; howstuffworks.com; Albuquerque International Balloon Fiesta

National Council of Teachers of Mathematics (NCTM) Standards:

Geometry Standard

- Use visualization, spatial reasoning, and geometric modeling to solve problems.
- Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships.

Problem Solving Standard

- Solve problems that arise in mathematics and in other contexts.

Connections Standard

- Recognize and apply mathematics in contexts outside of mathematics.

Document Links:

TI Technology Guide, for information on the following:

- TI-83 Plus family or TI-84 Plus family
- Cabri Jr.

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Activity Extension:

- Challenge the students to find and bring in other examples of this type of graph from USA TODAY. Use these as additional problems for students to continue working on this topic or use as a review for an exam.

Curriculum Connection:

- Algebra
- Physics
- Physical Science

Assessment and Evaluation:

Activity 1: You will explore geometric relationships with similar triangles. Complete Activity 1 before answering the questions.

Step 1. Press \perp (Y = button), *Open...*, and press \sphericalangle . Highlight **SIMILAR** and press \sphericalangle . Look at the two triangles ABC and DEF, what conclusion can you make about them? **They are similar.**

Step 2. Press β , choose *Calculate*, and press \sphericalangle . Determine the three ratios in the lower right corner of the screen. Move the pointer to the measure of AC and press \sphericalangle . Move the pointer to the measure of DF, press ∞ and \sphericalangle to calculate the ratio for AC:DF. Move this value to AC:DF on the screen and press \sphericalangle . Repeat this procedure for the other ratios and press \square when finished. What can you conclude about these ratios? **They are equal in value.**

Step 3. After you have made a number of these changes, what can you conclude about the ratios? **The ratios are always equal as long as the corresponding angles are equal.**

Step 4. Complete the following:

- If two angles of one triangle are congruent to two angles of another triangle, then the triangles are **similar**.
- In similar figures, ratios of corresponding sides are **equal**.

Activity 2: Use the information from Activity 1 and the USA TODAY Infograph "Ballooning inside the box" to answer the Focus Questions.

Step 1. Maggie places a mirror on the ground 40.5 feet from the base of the basket. She walks backwards until she can see the top of the balloon in the middle of the mirror. At that point, Maggie's eyes are 5 feet off the ground and she is 2 feet from the mirror. What is the height of the balloon that Maggie is watching?

A. The balloon is approximately 101 feet (to the nearest foot).

Teacher Notes:

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Assessment and Evaluation:

Step 2. A balloon is anchored to the ground at the beginning of a race with a cable. The cable forms a perpendicular line from the basket to the ground. Maggie places a mirror on the ground 150 feet from the perpendicular line and walks backward until she can see the bottom of the basket in the mirror. Her eyes are 5 feet off the ground and she is 8 feet from the mirror. What is the altitude of the bottom of the basket?

A. The altitude is approximately 94 feet (to the nearest foot).

Step 3. Maggie is watching a balloon coming down. The balloon drops a 50 foot rope that forms a perpendicular with the ground. She is 6 feet from her mirror and looking at the bottom of the balloon in the mirror. She is kneeling and her eye level is 3 feet from the ground. How far is the mirror from the perpendicular line formed between the rope and ground?

A. The mirror is approximately 100 feet from the perpendicular line.

Teacher Notes:



If you are using the TI-Navigator Classroom Learning System, send the provided LearningCheck assessment to your class to gauge student understanding of the concepts presented in the activity. See the TI-Navigator Basic Skills Guide for additional information on how this classroom learning system may be integrated into the activity.