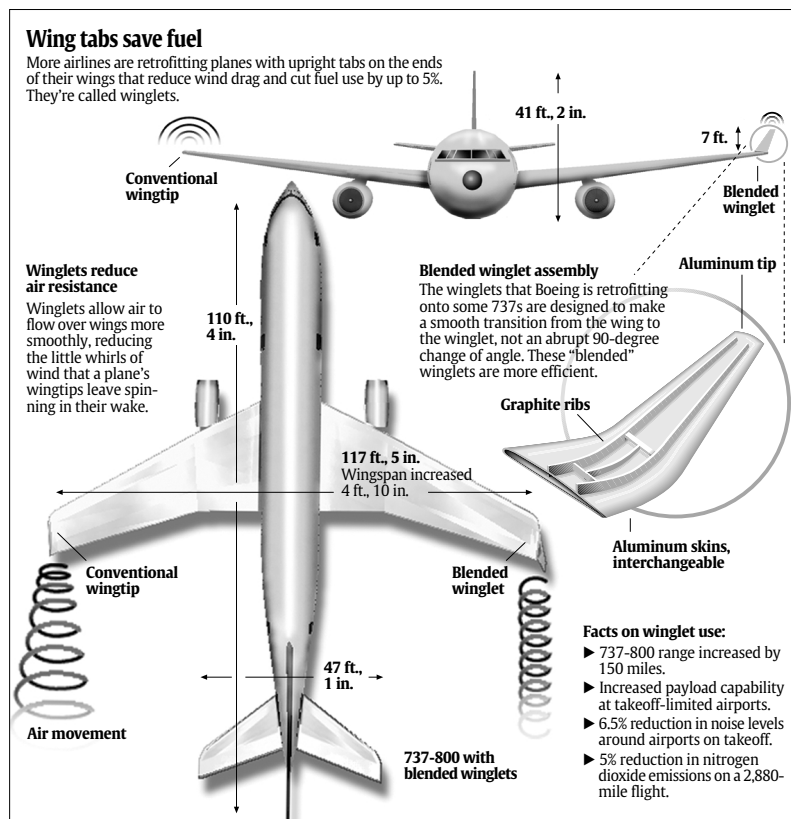




Wing tabs save fuel

by: Bob Tower



Activity Overview:

Using the USA TODAY Infograph, "Wing tabs save fuel," ratios and proportions will be used to explore the concept of similarity between a drawing/model and the actual dimensions. The effects of dilation (size change) on an image and pre-image will also be explored. In addition, students will look at what happens to the corresponding sides and areas of a quadrilateral as the dilation factor increases and decreases.

Activity at a Glance:

- Grade level: 9-12
- Subject: Geometry
- Estimated time required: 40-50 minutes

Materials:

- TI-83 Plus family or TI-84 Plus family
- Overhead view screen calculator for instruction/demonstration
- Student handout
- Transparency
- USA TODAY newspapers (recommended)
- Cabri[®] Jr. Application

Prerequisites:

Students should know:

- how to use Cabri Jr.
- how to solve a proportion
- how to work with percentages



© Copyright 2006 USA TODAY, a division of Gannett Co., Inc.

This activity was created for use with Texas Instruments handheld technology.

Copyright © 2000 by the National Council of Teachers of Mathematics, Inc. www.nctm.org. All rights reserved.

Wing tabs save fuel

Concepts:

- Solving proportions
- Percent change
- Ratios
- Properties of dilations and the effects of dilations on side measurement and area

Objectives:

Students will:

- explore the properties of a dilation on the measurement of corresponding sides and areas of a quadrilateral.
- use proportions to determine the dimensions of a scale model/drawing.
- use percentages to solve real-life problems.

Background:

The idea of changing size (dilation factor) is an effective way to study similarity. Changing the size of an object is useful in many areas, including architects, toy manufacturers, making maps (cartographer), and artists to name a few.

Ratios and proportions will be used to solve geometric and real-life problems, such as scale drawing and model building.

The winglets are decreasing noise, producing savings in fuel, and increasing the range (in miles) that the airplane can travel. Percentages will be used to determine the expected savings of gallons of fuel.

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 AppVars *Dilation*.
- Have students bring small metric rulers or provide rulers for the class.

Classroom Management Tips:

- The class will need Cabri Jr. 2.0 installed on their calculators.
- Discuss how to access Cabri Jr. and how to find and open the AppVars *Dilation* before starting the activity.
- Remind students about how to grab and move objects when using Cabri Jr.
- Have students work in pairs to discuss their observations about the effects of dilation.
- Activity 1 can be completed working in small groups so that students can check their measurements from the infograph with group members.
- Students can explore www.boeing.com/commercial/737family/technical.html before the activity is started to gain a better understanding of the design of the airplane with and without winglets.

Data Source:

Aviation Partners Boeing

National Council of Teachers of Mathematics (NCTM) Standards:

Geometry Standard

- Apply transformations and use symmetry to analyze mathematical situations.
- Use visualization, spatial reasoning, and geometric modeling to solve problems.

Problem Solving Standard

- Build new mathematical knowledge through problem solving.

Connections Standard

- Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.

Document Links:

TI Technology Guide, for information on the following:

- TI-83 Plus/TI-84 Plus
- Cabri Jr.
- TI-Navigator™ Classroom Learning System

Wing tabs save fuel

Activity Extension:

- Suggest that students explore the effects of dilation on other geometric shapes and write a one page summary about their findings.
- Allow students to look at USA TODAY for a week and find additional articles that relate to aviation. Write a one-page summary.
- Encourage students to explore the internet for related information about changes to the design of airplanes. For information about the changes that Boeing is making to their airplane go to www.boeing.com/commercial/737family/technical.html. Write a one-page summary.
- To find out more about the mathematics of cartography explore the following site math.rice.edu/~lanius/pres/map/maphis.html.

Curriculum Connection:

- Physics
- Art classes
- Drafting

Assessment and Evaluation:

Activity 1: Q. What should the dimensions be for a scale model of the airplane in the USA TODAY Infograph “Wing tabs save fuel”?

Step 1 and 2.

- A. Length: 59 mm and Width (wingspan): 46 mm (measuring the infograph)
 Length: 110.3 ft. and Width (wingspan): 117.4 ft. (reading the infograph)

Step 3.

What is the scale factor used for the infograph? Scale factor: Length: 1.87 feet=1mm and Wingspan: 2.55 feet=1mm

Step 4.

You are going to build a scale model of the airplane shown in the infograph. The scale model will be 100 mm long. What is the wingspan on your model?

Wide (wingspan): 187 mm (rounded to the nearest mm).

Activity 2: Q. What is the relationship between the lengths of corresponding sides formed by the dilation (size change) to a figure?

Step 3.

- A. DC measurement: 1
 Corresponding side measurement: 1.5

Determine the ratio of the corresponding side to DC: 1.5:1

Teacher Notes:

Wing tabs save fuel

Step 4.

Repeat Step 3 using the different dilation factors listed below.

- | | |
|-----------------------|---------------|
| A. Dilation factor: 2 | Ratio: 2:1 |
| Dilation factor: 1 | Ratio: 1:1 |
| Dilation factor: 0.5 | Ratio: 0.5:1 |
| Dilation factor: 0 | Ratio: 0 |
| Dilation factor: -0.5 | Ratio: -.05:1 |
| Dilation factor: -1.5 | Ratio: -1.5:1 |

Step 5.

What are the differences between the image and pre-image when the dilation factor is greater than 1, equal to 1, between 0 and 1, and negative?

- A. The corresponding sides will have the same ratio as the dilation factor. When the dilation factor is greater than 1 the image will be larger than the pre-image, when the dilation factor is equal to 1 the pre-image and image are congruent, and when the dilation factor is between 0 and 1 the image will be smaller than the pre-image. If the dilation factor is negative the image and pre-image are on opposite sides of E, the center point.

Activity 3: Q. Is there any relationship between the areas of the image and pre-image as the dilation factor changes?

Step 1.

- A. Image area: 4 Pre-image area: 1

Step 2.

Repeat Step 1 for two different dilation factors.

- A. Dilation factor: 3 Image area: 9 Pre-image area: 1
 Dilation factor: 4 Image area: 16 Pre-image area: 1

Step 3.

Explain the relationship between the areas as the dilation factor changes.

- A. The ratio of the areas will be the square of the dilation factor.

Activity 4: Q. How many gallons of fuel will be saved using winglets?

- A. Using the information from the USA TODAY Infograph "Wing tabs save fuel" determine the fuel savings expected for a plane with winglets on a flight that used 5060 gallons of fuel without winglets.

Gallons saved per plane 253

- A. If you had a fleet of 5 airplanes that made the trip listed in **Step 1** 48 times per year, what is the total expected number of gallons saved?

Total gallons saved per year 60720

Teacher Notes:

Wing tabs save fuel

Reading the article

1. How much has the federal government directly invested in grants, loans and tax waivers to keep the big airlines going?
 - A. \$9.5 billion
2. What are the motives for Congress and executive agencies to absorb and help airlines?
 - A. The motivation is the need to maintain the air service, workers' retirement security, and the 1 in 12 U.S. jobs tied to commercial aviation.
3. What is the name of the support agency that was created after 9/11 that has issued about \$1.6 billion in loan guarantees?
 - A. The Air Transportation Stabilization Board, the industry support agency created after 9/11.
4. What is the name of the federal agency that insures corporate defined-benefit retirement plans that already has a \$2.3 billion bill for US Airways' failed plans?
 - A. The Pension Benefit Guaranty Corp.
5. What did American Express do to help Delta during these difficult times?
 - A. In another key concession to a struggling airline, American Express paid Delta \$750 million in advance for frequent-flier miles it buys from the airline for its SkyMiles charge card users. That gives the credit card company strong incentive to keep the cash flowing to the airline even before payment is due.
6. What are two factors that Adam Pilarski, head of the aviation consulting firm Avitas, says may put the airline carries over the edge?
 - A. The cash-generating capabilities are being strained and oil prices at \$50-plus a barrel.

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.