

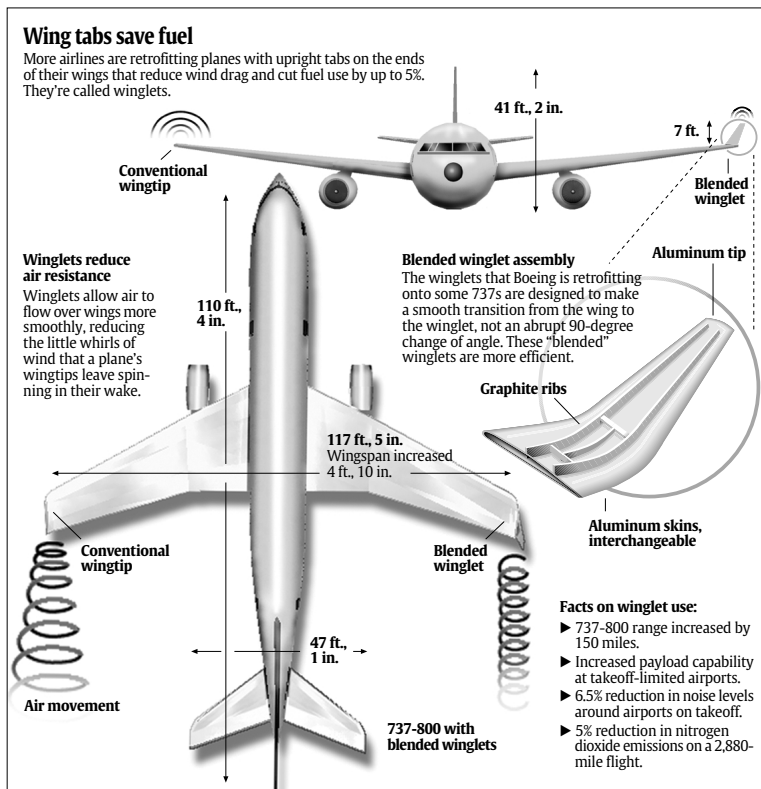
# Math Challenge<sup>®</sup> Student Edition



NO. 1 IN THE USA



## Wing tabs save fuel



Source: Aviation Partners Boeing

By Bob Laird, USA TODAY

### Focus Questions:

Q. What should the dimensions be for a scale model of the airplane in the USA TODAY Infograph "Wing tabs save fuel"?

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

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

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

### Activity Overview:

How can you use proportions to change the actual dimensions of the airplane shown in the USA TODAY Infograph, "Wing tabs save fuel," so that the dimensions of a scale drawing/model are proportional to the actual dimensions? 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 be explored. You will also learn what happens to the corresponding sides and areas of a quadrilateral as the dilation factor increases and decreases. In addition, the effects of winglets on fuel savings for the Boeing 737 will be explored.

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## Wing tabs save fuel

### Procedure:

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

**Step 1.** Measure the length and wingspan in the scale drawing of the airplane in the Infograph to the nearest mm and record your results below.

Length: \_\_\_\_\_mm      Width (wingspan): \_\_\_\_\_mm

**Step 2.** Find the actual length and width (wingspan) from the Infograph “Wing tabs save fuel.” Change the measurements (measured in feet and inches) to feet.

Length: \_\_\_\_\_ft.      Width (wingspan): \_\_\_\_\_ft.

**Step 3.** What is the scale factor used for the Infograph?

Scale factor for Length: \_\_\_\_\_

Scale factor for Width (wingspan): \_\_\_\_\_

**Step 4.** Imagine that 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): \_\_\_\_\_mm (rounded to the nearest mm)

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

**Step 1.** Press **2** and select Cabri Jr.

**Step 2.** Press **⊥** ( $\pi$ ), (Y= key) select Open..., and press **⏏**. Highlight **Dilation** and press **⏏**.

**Step 3.** Observe the relationship between the pre-image, ABCD, and the image formed. Use the measurement tool  $\beta$  ( $\bullet$ ), highlight Measure and choose **Distance and Length** to explore the relationship between the measurements of the corresponding sides as the dilation factor changes. Grab point F and move it right until the number in the lower right corner is 1.5 (dilation factor) and then measure  $\overline{DC}$  and the corresponding side of the image. Note: Point E is the center of dilation.

$\overline{DC}$  measurement: \_\_\_\_\_

Corresponding side measurement: \_\_\_\_\_

Determine the ratio of the corresponding side to  $\overline{DC}$ : \_\_\_\_\_

### Data Source:

Aviation Partners Boeing

### Materials:

- TI-83 Plus family or TI-84 Plus family

### Additional Information:

- Statistics about the Boeing 737 family were found at [www.boeing.com/commerical/737family/technical.html](http://www.boeing.com/commerical/737family/technical.html)

**Wing tabs save fuel**

**Procedure:**

**Step 4.** Repeat Step 3 using the different dilation factors listed below.

Dilation factor: 2      Ratio: \_\_\_\_\_

Dilation factor: 1      Ratio: \_\_\_\_\_

Dilation factor: 0.5      Ratio: \_\_\_\_\_

Dilation factor: 0      Ratio: \_\_\_\_\_

Dilation factor: -0.5      Ratio: \_\_\_\_\_

Dilation factor: -1.5      Ratio: \_\_\_\_\_

**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?

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

**Step 1.** Use the measurement tool  $\beta$  ( $\bullet$ ), highlight Measure and choose **Area** to explore the relationship between the areas as the dilation factor changes. Grab F and move it right until the dilation factor is 2 and then measure the areas of the image and pre-image.

Image area: \_\_\_\_\_ Pre-image area: \_\_\_\_\_

**Step 2.** Repeat Step 1 for two different dilation factors.

Dilation factor: \_\_\_\_\_ Image area: \_\_\_\_\_ Pre-image area: \_\_\_\_\_

Dilation factor: \_\_\_\_\_ Image area: \_\_\_\_\_ Pre-image area: \_\_\_\_\_

**Step 3.** Explain the relationship between the areas as the dilation factor changes.

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**Student Notes:**

## Wing tabs save fuel

### Procedure:

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

**Step 1.** 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 5,060 gallons of fuel without winglets.

Gallons saved per plane \_\_\_\_\_

**Step 2.** 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 \_\_\_\_\_

#### Activity 5: Reading the Article (see below).

1. How much has the federal government directly invested in grants, loans and tax waivers to keep the big airlines going?
2. What are the motives for Congress and executive agencies to absorb and help airlines?
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?
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.
5. What did American Express do to help Delta during these difficult times?
6. What are two factors that Adam Pilarski, head of the aviation consulting firm Avitas, says may put the airline carries over the edge?

### Student Notes:



## Lots of factors keep struggling airlines aloft

MONEY SECTION - Wednesday - May 4, 2005 - PAGE 7A

By Dan Reed  
USA TODAY

How in the world do these guys stay in business?

The USA's big airlines have lost \$35 billion since 2000, yet not a single one of them has gone away.

No. 2 United continues in its third year of operating under bankruptcy protection. No. 7 US Airways, likewise, is

operating under bankruptcy protection and is seeking a merger with a more solvent, but struggling, America West.

No. 3 Delta registered a record loss of \$5.2 billion last year — a staggering \$41.07 a share — and continues to slide toward a liquidity crisis.

Yet the USA's roster of big airlines continues nearly unchanged since the beginning of a devastating industry downturn that began nearly five years ago, and accelerated with a plunge in

travel following the Sept. 11 terrorist attacks.

Not even the most financially fragile carriers appear to be in imminent danger of shutting down. No large U.S. airline has simply ceased operations since Pan American World Airways shut down in December 1991, although TWA disappeared after American bought it in 2001.

“It takes a lot and a very long time to

kill an airline,” says Tom Plaskett, who as Pan Am CEO from 1988 until 1991 juggled furiously to keep the grand dame of the U.S. airline industry afloat.

He compares it to the way many people manage their own finances. Says Plaskett: “They live from paycheck to paycheck, always scrambling to find a little extra cash here or there.”

But airlines don’t face the same limitations as people. They don’t even face the same limitations as most failing businesses. If they did, the industry would look a more like Big Steel, where changing economics have washed away former industry stalwarts such as Bethlehem, LTV and Weirton.

Big airlines can’t simply close their doors when the losses pile up. Creditors, government, employees, politicians and the public have too much at stake. The result: For terminally ailing airlines, the demise can be played out over years, maybe decades.

“This business has extremely high barriers to exit,” complained Continental President Jeff Smisek at an investors conference in February. Smisek said essentially failed carriers are permitted to hang on, dragging down the rest of the industry with their excess capacity and too-low fares.

How government, creditors, organized labor and the carriers themselves are able to extend the lives of financially ailing airlines:

An army of powerful and wealthy outside parties is dedicated to keeping even the most economically dysfunctional big airline alive. Foremost among them is Uncle Sam. The federal government now has at least \$9.5 billion directly invested in the survival of the nation’s big airlines in grants,

loan guarantees and tax waivers. An additional \$30 billion-plus in underfunded airline pensions could also fall to the government.

Congress and executive agencies have shown a willingness to absorb even more of the load. Their motivation: the need to maintain the USA’s far-flung air service, workers’ retirement security, and the 1 in 12 U.S. jobs tied to commercial aviation. Rather than letting airlines go broke after 9/11, Congress delivered \$7.5 billion in emergency aid. It waived collection of certain taxes and fees for four months in 2003 to help the airlines survive, saving them \$350 million. The Air Transportation Stabilization Board, the industry support agency created after 9/11, has issued nearly \$1.6 billion in loan guarantees to carriers.

In 2003, for example, the ATSB backed a \$900 million guarantee that helped US Airways emerge from Chapter 11 bankruptcy. Then, last September, when the carrier entered Chapter 11 a second time, the ATSB agreed to allow it to use some of the cash it had pledged as collateral for that first loan to keep it flying.

“US Airways has the very best lender-of-last-resort known to man — the U.S. government,” Smisek says. “Your and my tax dollars are being (frittered) away daily there.”

Nor is the ATSB the only government agency with a stake in the airlines’ survival. The Pension Benefit Guaranty Corp., the federal agency that insures corporate defined-benefit retirement plans, already has been stuck with the \$2.3 billion bill for US Airways’ failed plans.

And Tuesday, a bankruptcy judge in Chicago is scheduled to consider a tentative deal in which PBGC would assume \$6.6 billion in liabilities from four underfunded United pension

plans. The deal would relieve United of \$645 million a year in pension costs. And it could get worse for the PBGC as rival carriers seek to level the playing field with United by dumping their pension plans on the government insurer. Already facing a \$23 billion deficit, PBGC could end up covering an estimated \$31 billion in underfunded airline pensions if United rivals dump their plans too.

Banks, aircraft-leasing companies, airplane and engine makers and other vendors have lots of skin in the game, too. To protect their investments, they’ve been accommodating to struggling airlines.

In the current downturn, General Electric has been the most accommodating of all. GE makes about half of the commercial jet engines in use. Another GE unit provides major maintenance and aircraft overhaul services to airlines. And its General Electric Commercial Aviation Services is the world’s largest aircraft-leasing company, with about 1,300 jets. A shutdown of a major carrier could create a sudden glut of planes on the leasing market.

That’s largely why GE has lent more than \$8 billion to struggling airlines since 9/11. It has propped up, among others, US Airways — to which it has \$2.9 billion of exposure on leases, loans and services contracts — Delta and Air Canada.

The airlines, with their huge debts, have a ton of leverage on the largest of their lenders, says David Butler, an Atlanta attorney and former U.S. bankruptcy trustee. When an airline owes hundreds of millions, lenders “are not creditors, they’re partners,” Butler says.

In another key concession to a struggling airline, American Express paid Delta \$750 million in advance for fre-

quent-flier miles it buys from the airline for its SkyMiles charge card users. A Delta failure could drive loyal AmEx customers to rivals' mileage cards. That gives the credit card company strong incentive to keep the cash flowing to the airline even before payment is due.

Partly because Bank One had a similar credit card deal with United, its investment banking arm in December 2002 stepped in with more than \$300 million in financing to allow the No. 2 airline to operate while in bankruptcy protection. Through various business relationships, Bank One had more than \$1.4 billion in financial exposure to the carrier at the time of its 2002 Chapter 11 filing. Bank One since has been acquired by J.P. Morgan Chase, which is maintaining the relationship with United.

Three times since 9/11, US Airways workers have agreed, after great outcries, to big pay and benefits cuts, the outsourcing of thousands of jobs and the shutdown of their pension plans. In some cases, workers approved concessions only to pre-empt more painful concessions that might have been imposed by a bankruptcy judge. In March, Continental pilots and ground workers approved \$249 million a year in concessions that management said were necessary to avoid a cash crunch, shrinkage and potential bankruptcy filing. Combined with management and non-union worker pay and benefit cuts, Continental has cut its employee costs by \$418 million a year, and it wants to push the total to \$500 million.

Flight attendants there narrowly turned down similar concessions. But the pilots and ground workers unions, who had the right to walk away from the deal if any of the carrier's unions rejected it, immediately waived their rights to walk away to keep

Continental from defaulting on several loan covenants. Management has resumed negotiations with the flight attendants.

Two years ago, employees at American voted at the last minute to accept concessions worth \$1.6 billion a year to keep their carrier out of Chapter 11.

The last time of note when that didn't happen was in 1989. Machinists union workers refused to grant concessions sought by management at Eastern Airlines. A strike put the carrier into bankruptcy reorganization and, two years later, out of business.

It's a lesson that labor, much to its dislike, has taken to heart, says Adam Pilarski, head of the aviation consulting firm Avitas.

"If I'm a pilot who ... was earning \$300,000 a year and living a very comfortable lifestyle, I would be angry over a 20% pay cut. That's \$60,000. I'd scream," he says.

And the pattern is likely to continue. Sometime soon, perhaps this month, the bankruptcy judge handling United's Chapter 11 case is expected to impose further cuts that mechanics there have been resisting — unless the machinists union agrees to such cuts first.

Also, Northwest is turning up pressure on all its unions. The pilots already have taken a temporary cut and are urging other unions to share the pain. In recent weeks, the sense of urgency has increased, with management demanding that deals be reached this year.

Pan Am went repeatedly to the pawnshop. Among assets sold, prolonging its time in business: its namesake Manhattan skyscraper, its Intercontinental Hotels unit, its subsidiary that serviced the Space

Shuttle, its lucrative rights to serve London's Heathrow Airport, its European division, its Latin American routes, even its crown jewels — the historic Pacific Division.

Chronic money-loser TWA, acquired out of Chapter 11 by American in 2001, survived for 20 years in much the same way. It sold itself twice, once to investor Carl Icahn, and then back to the public. In an arrangement dubbed "the light bulb deal," TWA once raised \$300 million in cash by selling bonds secured by spare airplane parts, mechanical equipment and office furnishings, right down to the light bulbs at its headquarters.

"People think airlines run on jet fuel, but they're wrong," Plaskett says. "They run on cash, and as long as they can keep raising cash, they can stay in business."

Big airlines today are reluctant to do that, says consultant Jon Ash of InterVistas-ga2. It would "start a downward spiral toward the ultimate liquidation" of the enterprise.

But the temptation may build as they continue losing money. Consider that Pan Am manufactured 20 years of extra life by selling assets, and TWA bought perhaps 15 extra years. Assuming buyers could be found, Ash estimates that:

- ▶ United could raise up to \$2 billion through the sale of its Pacific Division, bought from Pan Am nearly 20 years ago.

- ▶ Northwest, likewise, has Pacific and Asian routes worth as much or more.

- ▶ Delta's two regional carriers, ASA and Comair, could net perhaps as much as \$1 billion total.

► American's Latin American division and its rights to serve Heathrow might fetch \$3 billion or more.

Plus, most carriers have real estate, airport-gate leases, service subsidiaries, spare parts and equipment, and, yes, even light bulbs, that can be used to generate cash.

Ultimately, Pilarski says, the big airlines have shown they don't have to make actual profits to remain in business.

Through most of industry history, they've survived downturns by finding ways to generate the cash that is their lifeblood. They then repaired their balance sheets during cyclical peaks. But this downturn is the deepest and longest ever, and it is accompanied by a fundamental shift in industry economics toward low everyday pricing. The big carriers' cash-generating capabilities are being strained like never before. And oil prices continuing at \$50-plus a barrel may be what "puts them over the edge," Pilarski says.

Even now, Pilarski adds, most of the big carriers have well over \$1 billion in cash. "If they can't pay their employees, or for their fuel or airplanes, then they will shut down. Not before."