INTRODUCTION TO A FLIGHT COMPUTER

INTRODUCTION

This series of lessons focuses on exposing high school math students to relevant applications in the aviation industry. Students will explore the use of a Flight Computer (E-6B) to solve Time-Speed-Distance (TSD) problems.

This is the first in the series for Integrated Math 2 and can be taught alone or in conjunction with Unit 1 Lesson 2 – Reading Airline Maintenance Graphs.

LEARNING OUTCOMES

- Students will be able to solve one- variable Time-Speed-Distance problems using a Flight Computer (E-6B).
- Students will be able to explain how and why the Flight Computer (E-6B) is used in the aviation industry.

CURRICULUM ALIGNMENT

COMMON CORE STANDARDS - MATHEMATICS

Standard 1: Make sense of problems and persevere in solving them.

Standard 5: Use appropriate tools strategically.

Standard 4: Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

CLASSROOM TIME REQUIRED

One 90-minute block class or two 45-minute classes

TEACHER PREPARATION

The teacher will need to put together the pieces of a "cockpit" ahead of time. A step-by-step tutorial can be found at the end of this lesson.

Sit down and work through all the problems with the E-6B ahead of time. It is intuitive but needs practice.

MATERIALS NEEDED

For the cockpit:

- Four paper towel rolls
- 2 yard sticks
- Books or some kind of support for the rudder
- Two cardboard pedals for the rudder
- Duct tape

For the investigation:

- A Flight Computer (E-6B) for each student or student pairs can share.
- Notecards (2 for each group of students)
- Copies of the Tutorial Worksheet for each student
- Copies of the Practice Worksheet or Teaching Activity.

TECHNOLOGY RESOURCES

A document camera and projector are helpful but not necessary. The students will need at least a four-function calculator for the beginning of the activity.

PRE-ACTIVITIES FOR STUDENTS

Before you begin the lesson, it is helpful if students have been introduced to direct variation equations and can manipulate them.

ACTIVITIES

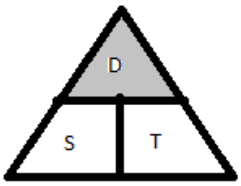
PART 1

Students can work the 5 problems in groups as a warm-up. These problems are a review of solving one- variable equations algebraically. Have a representative from each group write the answers on a notecard and bring it to the teacher to check. Have students re-work any problems that they got wrong until the entire class has correctly solved all the problems. These problems can be found on the Part 1: Group Work Problems worksheet.

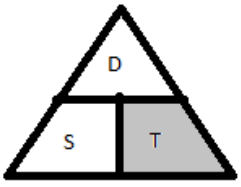
PART 2

Once you are convinced the students are proficient at solving for distance, time and speed then they are ready to move on to the triangle.

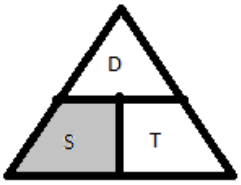
In the formula Distance=Speed x Time, if two of the three variables are known students can very easily solve for the missing one. One neat trick is to draw a triangle to help decide if you need to multiply or divide your variables.



Distance = Speed x Time



Time = $\frac{\text{Distance}}{\text{Speed}}$



Speed = $\frac{\text{Distance}}{\text{Time}}$

Instead of having to memorize three formulas or manipulate one to isolate a variable, students can just look at the triangle.

Model the first 1 -2 problems for the class and then let them practice within their groups. The difficulty of these problems increases as you go on. These problems can be found on the Part 2: Group Work Problems worksheet.

PART 3

When you are convinced that the students all understand how to use the triangle, ask for a volunteer. (See the script below) Tell the volunteer that you are going to have him/her work a problem in front of the class and he/she can bring up whatever they would like to help them solve the problem. Have them sit in a chair turned perpendicular to the class. Once the volunteer is seated, build the cockpit around him/her. He/she must hold onto the yoke with at least one hand and must have both feet on the rudder at all times.

Once the volunteer is settled in, tell him/her to solve the problem in Part 3: Class Demonstration. Hopefully, things will start to fall to the ground as the volunteer tries to write down the problem and punch the numbers into the calculator. Even if they manage to hold on to all of their things, it should still prove difficult. Recruit the class to help you check to make sure that they have both feet on the rudder and one hand on the yoke.

After the class finishes laughing at their classmate, lead a discussion about what would make that calculation easier for a pilot in mid-air.

Optional Teacher Script:

> "I need a volunteer; someone who feels really confident with solving these problems."
>
> "You can bring up whatever you would like to help you solve a problem. I recommend at least paper, something to write with, and your calculator."
>
> "Have a seat in this chair." Make sure the chair is perpendicular to the room and all the students can see the student.
>
> "I'm going to build the cockpit of an airplane around you. You have to keep both feet on the rudders and at least one hand on the yoke at all times, otherwise the plane will be pilotless. Your passengers wouldn't appreciate that! The rest of you need to help me out. Make sure that he doesn't try to crash his plane. Call out if you see him lose control of the plane."

"Now that we have you all set up, here's your problem: If you are flying from Greensboro to Charlotte, NC which are 82.98 miles apart, what is your average speed if you arrive in 24 minutes? Okay, go!" At this point, start humming the Jeopardy theme, pace around them, and encourage the class to watch his feet and hands. Basically, distract them as much as possible. Recruit a "flight attendant" to come up and ask him questions.

After they come up with an answer or give up ask them, "How hard was that? Would you want to be making those calculations while flying a plane?"

To the entire class, "If you were designing some device to help a pilot do those calculations in midair, what things would you look for?"

If the kids don't bring them up on their own, mention one-handed operation, ease of operation, multifunction capabilities, easy to store, no writing involved, no buttons to push.

"Well, guess what? Pilots aren't up there with calculators and notebooks. They use something called a Flight Computer. But it's not what you think." Hold up a Flight Computer (E-6B).

PART 4:

After the brainstorming session, pass out the Flight Computers (E-6B) and the Flight Computer (E-6B) Tutorial Worksheet. Lead them though tutorial problem 1a. If you have a document camera in your classroom, project E-6B so the students can see you manipulate the bezels.

GUIDED PRACTICE

Have the students work 1b and 1c on the Tutorial Worksheet. Use the same method to check their work as during the warm-up. For homework, choose between the Practice Worksheet and the Flight Computer Teaching Activity. The Practice Worksheet is more problems similar to the ones covered in class and what will be on the quiz. The Teaching Activity has the students teach someone else how to use the E-6B. Decide what will be more useful to your students. Both options require the students to take the E-6B home overnight. Decide if this is a feasible option for your students. If it is not, have them solve the Practice Worksheet problems using the triangle method instead of the E-6B.

ASSESSMENT

The students will be assessed on both this lessons in the unit together, therefore the assessment can be found at the end of the "Reading Airline Maintenance Graphs" lesson. Alternately, if you are only doing this lesson, you could assign the Teaching Activity for homework and use the Practice Worksheet as the assessment.

ALTERNATIVE ASSESSMENTS

In place of a formal assessment, use the group notecard check method or a ticket out of the door to determine whether or not the students have mastered the TSD problems using the Flight Computer (E-6B).

MODIFICATIONS

To save time, you can cut out the cockpit demonstration and class discussion but are both valuable in establishing personal relevance for the students. You could also do Parts 1 & 2 on one day and Parts 3 & 4 on a second day if you are teaching a 45-minute class or are trying to squeeze this in at the end of two block classes.

To modify for special needs students, pair them up with a buddy, or allow them to complete the Tutorial Worksheet one-on-one or in small groups in a station format. You can also shorten the Practice worksheet to suit your individual students.

CRITICAL VOCABULARY

Flight Computer (E-6B): a handheld, three-bezel device used by pilots.

WEBSITES AND RESOURCES

Wikipedia entry on the E-6B: http://en.wikipedia.org/wiki/E6B
Background on the history and development of the E-6B.

E-6B for purchase at http://www.mypilotstore.com/MyPilotStore/sep/2233
There are many purchasing options available online or seek out your nearest flight school.

AUTHOR INFORMATION

Allison George has taught Mathematics at RJ Reynolds High School since 2003. Allison is a graduate of Meredith College in Raleigh. She is a member of the Kenan Fellows Class of 2012 and her mentor is Audrey Floyd.

Audrey Floyd is the Department Chair of the Aviation Management / Career Pilot Technology Program at Guilford Technical Community College. She was an Air Force pilot with over 2600 hours of flight time. Audrey was also a high school physics teacher in Davidson County before she began at Guilford Tech.

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KENAN FELLOWS PROGRAM

North Carolina Science, Mathematics, and Technology Education Center

PART 1: GROUP WORK PROBLEMS

1. If you are driving for two hours at 50mph, how far did you travel?

2. If you are driving for 45 minutes at 50mph, how far did you travel?

3. If it took you 4 hours to drive 300 miles, how fast were you going?

4. If it only took you 3 hours and 20 minutes?

5. If you were driving 500 miles at 75mph, how long would it take you to arrive at your destination?

PART 2: GROUP WORK PROBLEMS

1. If you were travelling for 2 hours at 120mph, how far did you travel?

2. If you travelled for 6 hours?

3. If you drove 350 miles in 4 hours and 45 minutes, how fast were you going?

4. If you drove 427 miles at 112 mph, how long would it take you to arrive at your destination?

5. What is your speed if you travelled 100 miles in 18 minutes?

6. What is your speed if you travelled 622 miles in 4 hours and 38 minutes?

PART 3: CLASS DEMONSTRATION

If you are flying from Greensboro to Charlotte, NC, a distance of 82.98 miles, what is your average speed if you arrive in 24 minutes?

FLIGHT COMPUTER (E-6B) TUTORIAL WORKSHEET

Flight Computer or E-6B

For TSD problems, the A scale represents distance in miles (miles), the B scale represents the time in minutes and the speed index (large black triangle) always points to the rate of speed (mph).

1. You covered the 35 mi between two checkpoints in 20 minutes. Put the distance over the time and the speed index will point to your speed.

a) What is it?

Is your speed 10.5 mph or 105 mph? Which one makes more sense? The Flight Computer will give you the numbers of your answer but it cannot give you the decimal places. It's up to you to use your number sense to figure that part out.

Check it with your triangle and calculator, do they match?

b) If you are traveling at that same speed, how long will it take you to fly 90 miles? Don't move your flight computer. Just look for 90 on the A scale, then look right below it on your B scale. That is your time.

c) If you flew for 85 minutes at this same speed, how far would you have flown? Don't move your dials. Just look for 85 on the B scale, then look right above it on the A scale.

Remember to think about your decimal places!

PRACTICE WORKSHEET

Units: all distances should be given in miles; all speeds should be given in mph, and all times should be given in minutes and hours.

1. If you fly 24 miles in 9 minutes, how fast were you flying?

2. How long would it take to fly 120 miles at a speed of 100 mph?

3. If you were in the air for 43 minutes at a speed of 150 mph, how far have you flown?

4. If you fly for 6 hours at a speed of 400 mph, how far have you flown?

5. How long would it take to fly 450 miles at a speed of 250 mph?

6. If you flew 65 miles in 20 minutes, how fast were you flying?

7. If you are flying from Greensboro to Charlotte, NC which is 82.98 miles apart, what is your average speed if you arrive in 24 minutes?

FLIGHT COMPUTER TEACHING ACTIVITY

Teacher Directions: Use the Flight Computer Tutorial from class to help you explain to an adult how to use the Flight Computer. Work through the three examples on the Tutorial with them and then have them attempt the two problems below. Make sure they sign the bottom of this sheet to get credit and make sure you answer the teacher question.

Student Directions: Please listen to your student's explanation of the Flight Computer. Then attempt the two problems on this sheet. Don't be afraid to ask if you need help. Your student is an expert in this now! Please sign the bottom of this sheet so your student will receive credit.

1. If you flew 24 miles in 9 minutes, how fast were you flying?

2. If you fly for 6 hours at a speed of 400 mph, how far have you flown?

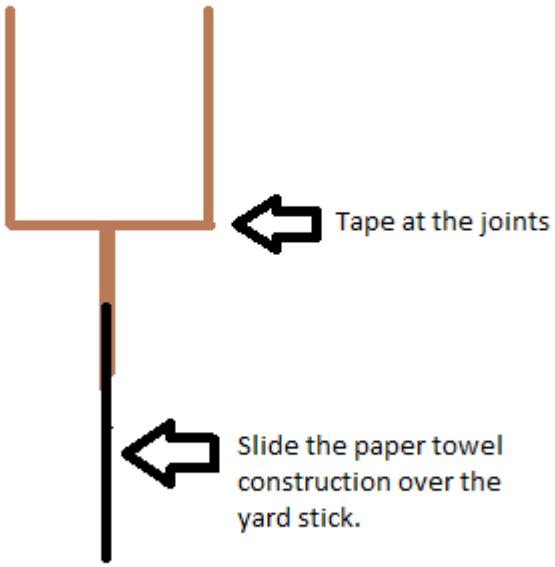
Teacher: What was the hardest part of teaching your student how to solve a problem using the E-6B?

Student Signature: _____

COCKPIT TUTORIAL

Rudder:
Place a yardstick across two stacks of books so that the yardstick is approximately on foot off of the ground. This will be placed on the ground in front of the chair so that the "pilot" can place both feed on the yardstick rudder.

Yoke:
Using the four paper towel tubes and the duct tape, construct a shape that resembles a set of football field goal posts. Slide the bottom tube of the goal posts over a second yardstick to form the yoke structure. The yardstick will rest on the floor and the "pilot" must hold the yoke handles (field goal posts) with at least one hand.



STUDENT WORK ANSWER KEY

PART 1 GROUP WORK PROBLEMS

1. D = 100 mi

2. D = 37.5 mi

3. S = 75 mph

4. S = 90 mph

5. T = 6 hours 40 minutes

PART 2 GROUP WORK PROBLEMS

1. D = 240 miles

2. S = 50 mph

3. S = 73.7 mph

4. T = 3 hours 49 minutes

5. S = 333.3 mph

6. S = 134.2 mph

PART 3 CLASS DEMONSTRATION

207.45 mph

FLIGHT COMPUTER TUTORIAL WORKSHEET

a) 105 mph

b) 51.5 minutes

c) 149 miles

PRACTICE WORKSHEET

1. S = 160 mph

2. T = 1 hours 12 minutes

3. D = 108 miles

4. D = 2400 miles

5. T = 1 hour 48 minutes

6. S = 195 mph

7. S = 208 mph