Title: ***Are You At The Control?***

Grade Level: 9 - 11

Florida Sunshine State Standards:

Description/Abstract of Lesson: This activity introduces the students to aerodynamics and the air traffic control system. An air traffic controller's job is to keep all planes safely separated, on time, and arriving safely at their destinations. To do this they must accurately solve distance-rate-time problems quickly. This activity provides an exciting, challenging, and meaningful context for understanding and utilizing multiple representations to solve a real-world problem.

Student Learning Goals:
After this lesson the student will

- Describe the job of an air traffic controller
- Measure Determine the distance between two objects
- Graph linear equations
- Use multiple representations of data to solve a real-world problem
- Describe aerodynamic principles of flight
- Demonstrate, describe, and present methods discovered that will keep a bubble in the air

Teacher Materials/Technology Connection:

- Masking Tape
- Marking Pens
- Yard Stick or measuring tape
- Stopwatch
- Digital camera
- Video http://www.smartskies.org/LearningCenter/video.htm
- Projector

Student Materials/Technology Connections:

- Student Learning Journal (notebook)
- Graphing calculator
- Graph paper

Duration: 180 minutes

Essential Questions/Key Vocabulary:

Essential Question: How do air traffic controllers keep planes safely separated in the air?

Key Vocabulary: distance, rate, time, merge point

SSS: MA.A.4.4.1, MA.B.2.4.2, MA.D.1.4.2, MA.D.2.4.2, MA.E.1.4.1

Lesson Lead/Opening:

1. Place the day's agenda on the overhead projector. Have the teams copy the agenda in their notebooks.

2. Place pictures of planes in the sky, an air traffic control booth, and a radar screen on the overhead. Ask the students to discuss the job of an air traffic controller.

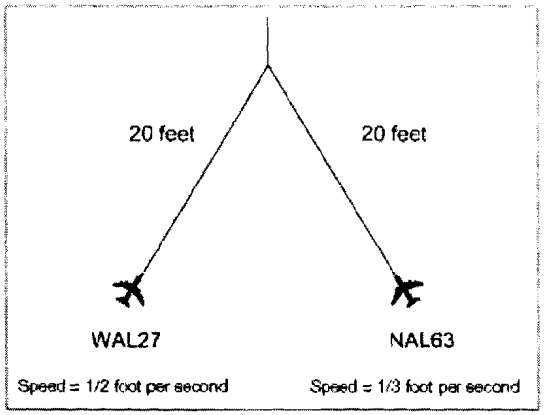
3. Introduce the distance-rate-time activity by having the students view the following video about the federal air traffic control system. The video can be found at the following site: http://www.smartskies.org/LearningCenter/video.htm

4. Have the teams discuss what they learned from the video. What was neat? What was interesting? What did they learn that they did not know before?

Steps to Deliver Lesson (Guided Practice/ Independent Practice/Differentiated Instruction):

5. Present the students with the following scenario:

   Two planes are flying at the same altitude on merging routes. Each plane is 20 feet from the intersection. One plane is flying at a rate of ½ foot per second. The other plane is flying at a rate of 1/3 foot per second. Each plane is the same distance from the merge point.



6. Pose the following questions:
   - Question 1: Will the planes meet at the point where the routes intersect?
   - Question 2: If not, which plane will arrive first?
   - Question 3: How many seconds will it take the first plane to arrive at the intersection?
   - Question 4: At that time, how far away is the second plane?

7. Send the teams to work discussing each of the above questions. Allow 5 minutes for the team discussions. Encourage the teams to draw diagrams and justify their responses

8. Return the teams to the full class to share approaches and solutions. The students will have a pretty good idea of the answers to the first 3 questions, but the 4th question will provide an opportunity for further exploration.

9. To ensure the deeper understanding, have the students perform the following investigation.

    a. Using masking tape lay out two jet routes, each 20 feet long on the floor.
    b. Using tape measures and markers, place a mark every 6 inches along one route and every 4 inches along the other route. These are speed-control markers that will allow the pilot to walk down the jet route at a speed of ½ foot per second or 1/3 foot per second.
    c. Using a stopwatch, count the seconds aloud and have one team member (represents each plane) walk down each of the jet routes, advancing ½ foot or 1/3 foot each second.
    d. Continue this process until one of the team members arrives at the intersection of the routes. Record the number of seconds that has elapsed.
    e. Measure and record the distance between the team member at the intersection and the team member that has not reached the intersection
    f. Repeat the experiment two more times.
    g. Analyze: What value best represents the separation distance between the two team members (planes).

10. Explore and analyze the data from the above problem using a computational approach. Each team will
    a. Plot the points on two vertical lines
    b. Plot the points on a distance versus time grid
    c. Determine the line of best fit for each distance vs time plot.
    d. Graph the system of equations and use the system to compare the progress of each plane

11. Conclude the discussion by having the teams compare the experimental data with the mathematical results. If the results differ, explain why this might exist.

12. Return the teams to the full class to discuss their findings.

Lesson Closure:

13. Have the students reflect on the mathematics learned in this activity. Have the students create a written reflect that includes how they might have improved their experimental results and how their results could be generalized.

Performance Assessment: Each plane started the same distance from the merge point. Suppose the difference in the plane speeds is twice as great. That is, instead of losing 2 inches per second, the slower plane loses 4 inches per second. Predict what would happen to the separation distance at the merge point.

Assessment:

The students will be assessed on the

- Quality of the student discussions
- Contribution and participation in the discovery activity
- Quality of the solution of the original posed problem.