



Principles of Flight



Lesson Plan: Balsa Wood Airplane Flight and Speed Correlation

Grade level: 9

Subject: Physical Science

Time Required: *Preparation:* 50 minutes
Activity: 3-4 class periods

National Standards Correlation:

Science (grades 9-12)

- Science as Inquiry Standard: Abilities necessary to do scientific inquiry.
- Unifying Concepts and Processes Standard: Evidence, models, and explanation.
- Unifying Concepts and Processes Standard: Change, constancy, and measurement.
- Physical Science Standard: Motions and forces.

Math (grades 9-12)

- Algebra Standard: Use mathematical models to represent and understand quantitative relationships.
- Number and Operations Standard: Compute fluently and make reasonable estimates.
- Measurement Standard: Apply appropriate techniques, tools, and formulas to determine measurements.
- Data Analysis and Probability Standard: Develop and evaluate inferences and predictions that are based on data.

Summary:

The purpose of this lesson is to test the flight of model airplanes built by the students. This is a cumulative activity to summarize the facts and applications learned about flight. Students will construct a balsa wood airplane and correctly identify the main parts of the plane and the purposes of each. They will then test fly their models and make adjustments by adding elevators, ailerons, and rudders for a straight flight path. Finally, students will record time and distance data for their plane, and use it to calculate the speed of the airplane.

Objectives:

Students will:

- Apply the scientific method to solve a problem.
- Relate flight path with the parts of an airplane.
- Display data through graphs.
- Interpret data as individuals and as a class.
- Learn the relationship of time to distance and speed.
- Relate flight to Newton's Third Law (action-reaction pairs).
- Relate flight to Bernoulli's principle (air pressure).

Background:

The rudder on the vertical fin steers the plane right or left. This is referred to as yaw. An elevator points the nose of the plane up or down. This is the pitch of the plane. Ailerons help to keep the plane steady and assist in banking when making a turn. This is called roll.



Materials:

Each student will need:

- Balsa wood propeller airplane kits
- Cardboard squares (18" x18")
- Cutting knives
- Wood glue
- Clear tape
- Mini sticky notes
- Tape measure
- Stopwatch (per group)
- 2 ground stakes (to mark runway distance)

Safety precautions:

Please remind students of the cautions needed when working with knives. Do not fly model planes directly at another person. Use caution when flying the models. Create a single direction flight zone. Have all students stand behind the "takeoff" line. Give an "all clear" signal when it is time to fly the planes, and do not allow students to cross the "takeoff" line to retrieve airplanes that have already landed until a "retrieve all planes" signal has been given.

Procedure:**A. Warm-up**

Explain the activity to the students.

1. Review the four forces of flight (lift, drag, thrust, and gravity).
2. Review Bernoulli's Principle using the wing of an airplane.
3. Review the functions of the ailerons, elevators, and tail.
4. Review the terms Pitch, Roll, and Yaw.
5. Review the distance formula. (distance = rate x time)

B. Activity I

Each student should receive a building kit, cardboard, and a cutting knife.

1. Tape the pattern to the cardboard, and write names on all materials.
2. Follow the instructions for cutting out and assembling the airplane.
3. Store airplanes in a very safe, undisturbed area overnight to allow the glue to dry.

C. Activity II

The students will do their test flights either inside (gymnasium) or out on a field. Stress to students that observations of the flight path must be accurate in order to make the proper modifications necessary to make it fly straight.

1. Rotate the propeller clockwise 50 turns, and hold it there.
2. Hold the plane level.
3. When the "all clear" signal is given, students will release their planes. The Observers will watch to see if the plane flies straight.
4. Record observations of the flight path of the plane in the flight log.
5. Repeat the trial flight with the propeller rotated clockwise 75 times and 100 times. Record observations about the plane's flight in the flight log for each test flight.



D. Activity III

1. Look at the observations in the flight log. Did the plane fly straight? Curve left or right? Dive down or up?
2. Determine which type of control modification will be needed to correct the flight problem.
3. Use stick-back notes to add the controls necessary (elevators, ailerons, and rudders) in order to correct the control problem.
4. From the same pre-determined spot, allow each student 3 test flights to get a straight flight pattern.
5. Students should indicate on their data page, with a sketch, what modifications they made to their airplane.

E. Activity IV

1. Have a pre-measured runway of 10 meters for the students to line up behind.
2. Students should work in pairs for this portion of the unit.
3. One student will be the Timer and the other will fly the plane.
4. Wind the airplane 100 times.
5. On a count of 3, simultaneously throw the plane and start the watch. When the plane passes the 10-meter marker stop time.
6. Record the time in the data table.
7. Repeat the experiment for a total of three test flights.
8. Calculate the average speed and the average distance for the three flights.
9. Use the distance formula to calculate the speed (rate) of the plane.
10. Graph the results and compare with the rest of the class.

F. Wrap-up

1. Discuss the significance of adding ailerons, elevators, and rudders.
2. Explain the relationship between time, distance, and speed.
3. Discuss how the adjustments to the airplanes relate to Bernoulli's principle.
4. Compare speeds of the different airplanes and make a class data table of results.



**Assessment/
Evaluation:**

Ask students to explain the function of time and distance when calculating speed. Students should be able to apply their experience and find the speed of other objects.

Extensions:

Observe the flight of other objects.



Balsa Wood Airplane Flight and Speed Correlation

Name: _____

Flight Log

Observations:

In the space below, make a diagram of where you added tabs for ailerons, elevators, and rudders. Properly label each part.

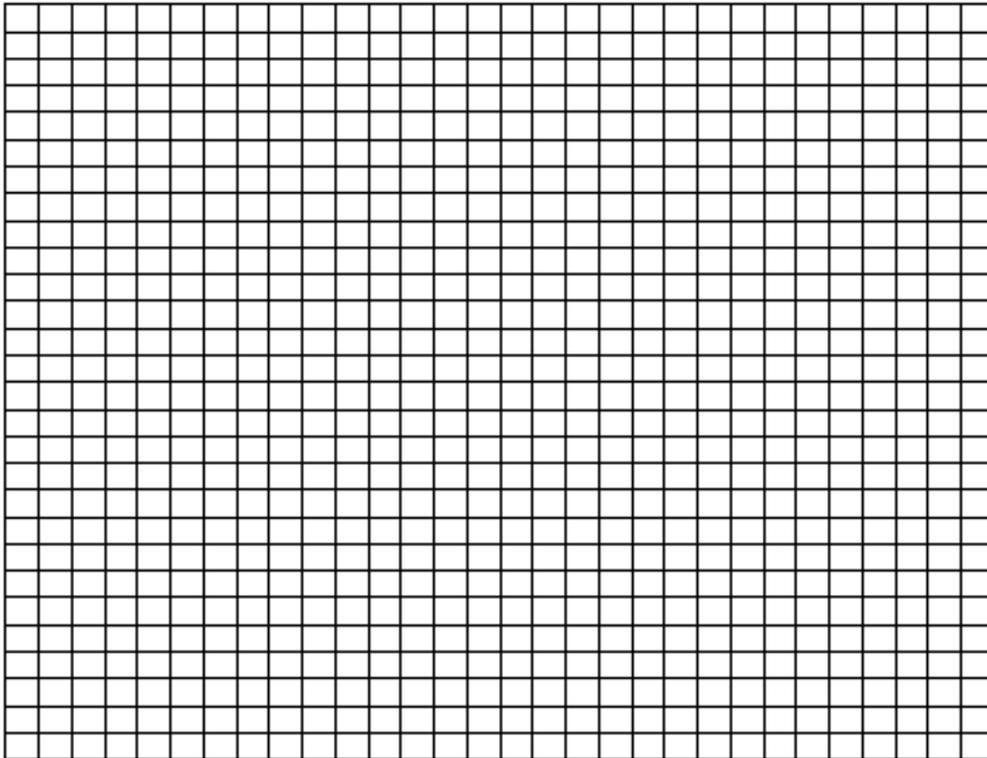
Distance of Flight (m)	Time Aloft (seconds)

In the grid below, create a bar graph of your data.

X-axis: time (seconds)

y-axis: Distance

Title: Airplane Speed



4. Calculate the average speed of your airplane:

Average Distance (d): _____

Average Time (t): _____

Speed = d / t _____ / _____ = _____ m/s

