Principles of Flight

Lesson Plan: Aircraft and Scale

Grade Level: 7

Subject Area: Science and Math

Time Required: ***Preparation:*** 15 minutes
Activity: 2-3 hours

National Standards Correlation:

Science (grades 5-8)

- 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.

Math (grades 6-8)

- Numbers and Operations Standard: Compute fluently and make reasonable estimates.
- Algebra Standard: Use mathematical models to represent and understand quantitative relationships.
- Measurement Standard: Apply appropriate techniques, tools, and formulas to determine measurements.

Summary:

Students will use toy models of aircraft to explore the concept of scale. They will measure the dimensions of the model, compare those dimensions to the actual size of the aircraft, and then determine the scale. They will make an outline of the actual aircraft and compare it to the model. Finally, they will make an enlargement of an outline of their toy and give the scale factor.

Objectives:

Students will:

- Make observations, make measurements, and collect data using model aircraft.
- Understand the meaning of scale.
- Use the scale factor and the toy to make an outline of the life-size aircraft.
- Use proportional reasoning to make an enlarged drawing of their toy.
- Work cooperatively in groups.

Materials:

You will need:

- Rulers and calipers for measuring
- Toy airplane or model for each group
- String
- Graph paper

Background:

A ratio is a comparison of two quantities that tells the scale between them. Ratios may be expressed as quotients, fractions, decimals, percents, or given in the form a:b. An example of a ratio like we use in this activity would be the ratio of the length of a side of a small figure or model to the corresponding side in a large figure where the large figure or real-life figure is 1/2. The ratio of the length of a side in the large figure to the corresponding side in the small figure is thus 2/1 or 2. The scale is the number a ratio is multiplied by to find an equivalent ratio. Scaling a ratio produces any number of equivalent ratios, which all have the same units and the same average distribution. The scale factor is the factor by which a picture or object is enlarged or shrunk. The scale factor may be expressed as a fraction, decimal, or percent.

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Procedure:

A. Warm-up

1. Conduct a discussion about scale. Use maps or various toys that have the scale marked on them.

2. Discuss what scale means and how they would find out the size of the real-life objects or how far a place is in real life compared to a map.

B. Activity

1. Give each group a die cast metal model of an airplane. Have students make any observations about the writing on their toy and what it means. (You may not find the scale on models of airplanes that are diecast metal models.)

2. Have students measure the critical dimensions of their aircraft. These include length, wingspan, and height. They could also include any other distinguishing dimensions for their toy, such as tail width, propeller length, wheel diameter, and any other part the group agrees to measure. Students may need guidance in getting accurate measurements. Inexpensive calipers may be helpful to use to get accurate measurements. Record the data.

3. Students should predict what the actual dimensions are for the things that they measured on their aircraft. Then they need to determine the size of the life-size aircraft by doing research. The museum's Web site (see http://www.nationalmuseum.af.mil) will be helpful in finding some of this information.

4. Students should determine how many times bigger the toy would need to be to become life-size or how many times bigger the life-size aircraft is than the toy (scale factor). Have students see if the scale factor is the same for all dimensions.

5. Give each group string and go to a big enough space so that students can use what they have learned to make an outline of the life-size aircraft. They can use actual measurements or they can use the toy by laying it end to end the scale factor number of times.

6. Provide students with graph paper. Have them make an outline of their toy on the graph paper. Tell them that they need to figure out a way to enlarge their outline by 2, 3, 4, times, or whatever you determine it should be. You might let the groups decide how much to enlarge it.

C. Wrap-up

1. Make a comparison of the collected data from each group. Compare the scale for each toy.

2. Display each of the enlargements. Have each group show their toy and give the scale factor that they used.

Assessment/ Evaluation:

Ask students to explain the following:

- What procedure did you use for making your enlargement?
- What is meant by the scale factor?
- How did you use the scale factor in this project?

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Extensions:

1. Students could research their aircraft and be ready to share with the class interesting facts such as when it was used and what missions this type of aircraft participated in.

2. Have a discussion about weight and scale. If you know the actual weight, could you calculate what the model should weigh using the scale? (No, scale is linear and weight includes volume.) If you weigh the model and you know the actual weight, can you figure out a scale factor? (No, you have to consider materials used. They would not be the same for the toy and the real-like aircraft.)

3. Taking the height of an average man or woman, figure out how tall a model of a person would be to be a pilot for the toy.

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