Building Wings
Mechanical Engineering

Objective

- Introduce students to the theory of Conservation of Mass
- Discuss Bernoulli's Principle
- Learn the concept of lift & how aircraft fly

Standards and Objectives

- 8th Grade Standard 4, Objectives 2 and 3
- Physics Standard 2, Objective 1

Learning Outcomes

Students will learn:

- About conservation of mass
- Bernoulli's Principle
- Aerodynamics

Essential Questions

- What are the physics and scientific principles behind aircraft design?
- What is an effective airplane wing design?

Time Required (Itemized)

- Design introduction – 25 minutes
- Student design planning & drawing – 15 minutes
- Build wings – 120 minutes
- Test wings in wind tunnel – 45 minutes

Assessments

- Students write 1 – 2 paragraphs detailing why their design was or was not effective.

Materials

- Balsa wood blocks (2" x 2" x 4")
- Saw
- Cutting & carving tools (Xacto Knives work well)
- Sand paper
- Wind Tunnel
- Screwdriver (the wind tunnel we used had a small screw to attach items to the testing platform)

Lesson Description

Airplanes are engineered to generate lift. Lift is a mechanical force generated by a solid object as it moves perpendicularly through a fluid. Air is a fluid. How is lift created in airplanes? It is created from a combination of conservation of mass and Bernoulli's Principle. The top of a wing is typically arched creating a longer surface for air to flow over. The air moves faster over the longer top of wing to meet the lower air stream at the same time at the end of the wing. The faster moving air lowers the air pressure. The higher pressure under the wing pushes the wing up. This is the basic concept of lift. There are many other factors that contribute to life and can affect how a wing flies. This is why not all airplane wings are shape with an arched top. Some airplanes wings have equal lengths on the top and bottom of the wing. Some people spend their entire lives studying all the factors of lift and aerodynamics. For the sake of simplicity, these additional factors will not be covered. Be aware that the basic concept of Bernoulli's Principle and Conservation of Mass is not the entire explanation of lift.

Questions to ask students:

- What mechanical force helps planes fly?
- How is lift created?
- How are most airplane wings shaped? Why?

The Wright Brothers designed the first successful airplane. Each wing on the Model B only weighed 17 pounds. The plane was constructed of wood, metal, and stretched canvas. In order to develop the best wing shape, the Wright Brothers created a wind tunnel to test wing prototypes.

Using a wind tunnel to test wing designs is common practice. It is a good idea to examine the shape and scaled weight of a wing design before spending the money to create a full-size wing. This particular engineering lesson mirrors the basic wing desing process.

Questions to ask students:

- Who were the Wright Brothers? What were they famous for?
- How did they test their wing designs?

Lesson Procedure:

- Give students presentation and/or background information on wing design.
- Explain some of the physics principles used to design wings and make airplanes fly.
- Students can work individually or in pairs
- Have students cut their wood blocks into four inch segments
- Students should draw their basic wing concept on the shortest side of their balsa wood block
- Help the student saw their block to about their wing shape
- Instruct students to use wood carving or cutting tools to get the shape of their wing precise
- Use sandpaper to smooth the balsa wood wing into the exact shape

- When students are ready to test, attach the wing to the wind tunnel testing platform. Gradually increase wind speed to see how efficiently the wing design is for flying. The lower the speed when flight was obtained, the more efficient the wing design

Notes from the College of Engineering:

- There is a great new clip of the Wright Brothers available on PBS. It is only a couple minutes, but gives a glimpse into the Wright Brothers plane design. http://www.pbs.org/wgbh/nova/wright/
- The larger the balsa wood planks you use, the more successful the activity will be. You can use other types of soft wood used for making models if that is easier to find. See the "Alternative Resources" page for balsa wood resources.