Flight

Subject: Biomimicry

Grade Level: 5-8

Topic: Flight

Time: 60 minutes

Learning Objectives

Students will:

- demonstrate knowledge of basic elements of flight.
- use the scientific method to predict, observe, and conclude.
- explain the relationship between the force of air and the amount of lift created.

Materials

images of airplanes and birds' wings: Wing Photos document, duck mount, large sticky notes, model airplane, Flight Worksheet, Flight Definitions, air mattress pump or blow-dryer, small beach ball, wide ribbon (approximately 4" wide by 24" long), ribbon wand toy, water catch basins, water, clear plastic cups, index cards, push pins.

Procedure

Engage: To promote student curiosity, *Ask: What is the function of wings? How do they perform that function?* Show different images of types of wings – include wings with different functions. The goal is to have the students match the form of the wing to its function. For example: owl = broad with fringed edges for silent flight; albatross = very long, very narrow with smooth edges for lots of lift and long distance soaring; duck = elliptical for fast take-off, quick bursts, and twisting flight; bat = maneuverability; eagle = broad with spread out primary feathers to reduce drag for passive soaring on thermals; hummingbird = small and fast for hovering; falcon = long, thin, and tapered for high speed flapping. Consider the shape of airplane wings. *Ask: Which birds are most like which planes?*

Explore: Help students build understanding by discussing how birds and planes fly through air. *Ask: What is air?* Air is made up of matter. Like all matter, air takes up space, has mass, can move, exerts pressure, and can do work. Air weighs almost 15 lbs. per square inch at sea level. Air stacks up like lasagna and gets heavier at lower elevations because there are more layers stacked up. We don't notice it because our bodies are pressurized and push back against the air. High-pressure systems push down on the air, forcing all the water vapor in it toward the ground, leading to clear skies. Low pressure systems cause air and water vapor to rise and condense into clouds. This leads to cloudy days.

Explain: Have students begin to show what they have learned by having each group supply definitions for one of the following words: weight, mass, gravity, lift, thrust, drag. Have them explain the word in general knowledge terms as they relate to flight. Have groups write their definitions on a large sticky note and tape on board. Briefly go over (and correct) the definitions see **Flight Definitions Worksheet**.

Elaborate: Have students use what they have learned by having the students perform the following two experiments together.

Paper Lift - before you get started, explain what they will be doing. *Ask: What do you think will happen to the paper when air is blown over it?*

· Tape a piece of paper or wide streamer to the edge of a desk.

· Using an air mattress pump set on the desk, direct the stream of air OVER the piece of paper/steamer. Note the increased air speed over the top of the paper creates a low-pressure zone. The higher pressure under the paper will then push up on the paper, creating lift.

Ask: Did the paper do what you thought it would do? Why did it do what it did?

Beach Ball Float

· Angle the air mattress pump so the air flows at about a 45° upward angle.

· Ask a student to help hold a ball in the right position to get it to float.

· *Ask: Why do you think the ball is floating?*

·Students will likely incorrectly guess that the air is pushing it up from underneath

· Have another student come up and use the ribbon wands to demonstrate that there is no air flowing under the ball. In fact, the air is flowing OVER the ball creating a low-pressure zone. The higher pressure underneath is pushing up on the ball creating lift.

Assessment

Evaluate: Evaluate student learning by having the groups perform the following 3-trial experiment and fill out their **Flight Worksheet**. Give each table a catch basin with water, a clear plastic cup, an index card, a push pin, and a worksheet.

· Students will perform 3 separate trials using this set up.

o **Trial 1**: fill the cup to the rim with water. Record prediction for what you think will happen when you turn the cup over (over the basin). Turn the cup over. Record what happened.

o **Trial 2**: Fill cup to the rim with water. Cover the mouth of the cup with an index card. Record prediction for what you think will happen when you turn the cup over. Carefully flip the cup and index card over. Record what happened.

o **Trial 3**: Fill the cup to the rim with water. Cover the mouth of the cup with an index card. Record prediction for what you think will happen if you turn the cup over and poke a hole in the base of the cup. Carefully flip the cup and index card over. Carefully make a hole in the bottom of the cup and remove the push pin. Record what happened.

Ask students to come up with theories about what they observed. *Ask: Why did the water stay in the upside-down cup? How did an index card hold it in?* (Hint: it didn't! The air pressure was pushing up against the index card, and the air pressure inside the cup was a bit lower, so the high pressure outside held the card in place.) *Ask: Why did the pinhole cause the card to fall off?* The pressure inside the cup regulated and equalized with the pressure outside. Since the pressures were equal, there was nothing to hold the card in place.

Extension Activities

- Tour your local airport or ask a local pilot to come speak to students about the elements of flight.
- Build and fly paper airplanes and discuss where how the forces of gravity, lift, thrust and drag affect the airplanes.

NGSS Alignment

Middle School

MS-PS2-2 - Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object.

MS-PS2-4 - Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on mass.

MS-ETS1-1 - Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution.

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