activity two

AMA FPG-9 Glider

OBJECTIVES – **Students will learn about the basics of how flight works by creating a simple foam glider.**

– Students will be introduced to concepts about air pressure, drag and how aircraft use control surfaces to climb, turn, and maintain stable flight.

Activity Credit: *Credit and permission to reprint – The Academy of Model Aeronautics (AMA) and Mr. Jack Reynolds, a volunteer at the National Model Aviation Museum, has graciously given the Civil Air Patrol permission to reprint the FPG-9 model plan and instructions here. More activities and suggestions for classroom use of model aircraft can be found by contacting the Academy of Model Aeronautics Education Committee at their website, buildandfly.com.*

MATERIALS

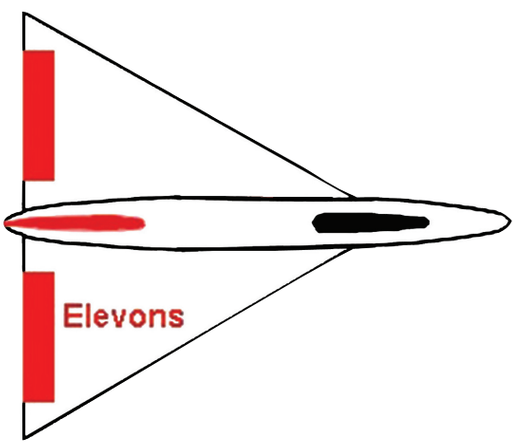
- FPG-9 pattern
- 9” foam plate
- Scissors
- Clear tape
- Ink pen
- Penny

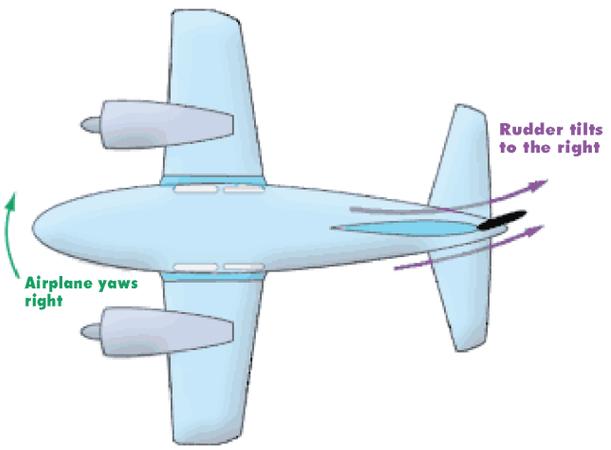
BACKGROUND

Control surfaces on an airplane help determine the movement of the airplane. The FPG-9 glider demonstrates how the elevons and the rudder work.

Elevons are aircraft control surfaces that combine the functions of the elevator (used for pitch control) and the aileron (used for roll control). Thus, elevons at the wing trailing edge are used for pitch and roll control. They are frequently used on tailless aircraft such as flying wings.

The rudder is the small moving section at the rear of the vertical stabilizer that is attached to the fixed sections by hinges. Because the rudder moves, it varies the amount of force generated by the tail surface and is used to generate and control the yawing (left and right) motion of the aircraft.





NATIONAL STANDARDS

Science Standards:

Content Standard A: Science as Inquiry
- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

Content Standard B: Physical Science
- Motions and forces

Content Standard E: Science and Technology
- Abilities of technological design
- Understandings about science and technology

Content Standard G: History and Nature of Science
- Science as a human endeavor
- Historical perspectives

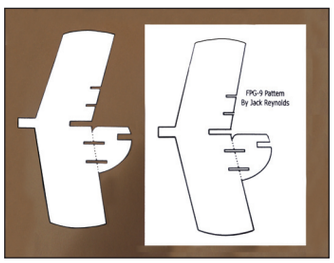
Unifying Concepts and Processes
- Evidence, models, and explanation

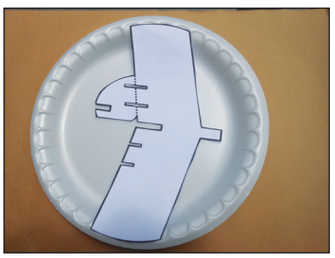
Technology Standards:

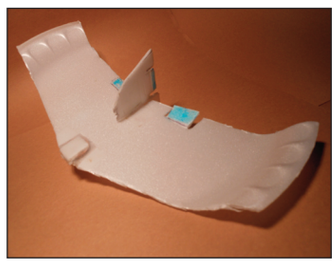
Standard 20: Students will develop an understanding of and be able to select and use construction technologies.

Lockheed 117 *Nighthawk* Stealth Fighter – this tailless aircraft called a flying wing uses elevons as control surfaces for pitch and roll control. The elevons are not part of the main wing but instead are a separate tail surface.

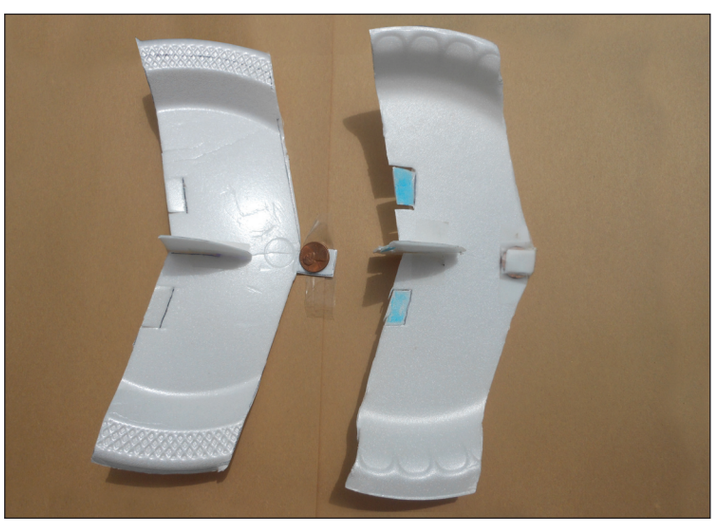
PROCEDURE







1. The instructor will create the FPG-9 pattern for students/cadets to trace by copying the pattern found in this lesson onto cardstock. This will make a sturdier template to trace onto the 9" foam plate.
2. Students/cadets should cut out the FPG-9 glider pattern. Tell students/cadets not to cut along the dotted line on the paper pattern. Have them only cut along the bolded lines.
3. Students/cadets should then place the paper pattern in the center of the foam plate ensuring that the tail of the pattern stays inside of the curved portion of the plate bottom. (The tail must remain on the plate's flat bottom.) The tab on the front of the pattern may rest on the curved portion. The ends of the wings should spill over the curved edge of the plate.
4. Students/cadets should trace around the pattern with an ink pen remembering to mark the scissor slits A and B.
5. Students/cadets then cut the foam template out by following the pen lines that were drawn. Students/cadets need only make one line. These lines will create the elevons and rudder.
6. At this time, students should cut along the dotted line to separate the tail from the wing of the FPG-9. It works better if students/cadets make cuts from the outside of the plate towards the center of the plate.
   Remember: When cutting out the slots, make them only as wide as the thickness of the foam plate. If the slots are cut too wide the pieces of the plane will not fit together snuggly.
7. The wing and the tail each have slits drawn on them. Have students/cadets make a cut along each of these lines as drawn.
8. To attach the tail to the wing, students/cadets will slide Slot 1 into Slot 2. They will use two small (2") pieces of tape to secure the bottom of the tail to the bottom of the wing. They will also ensure the tail is perpendicular to the wing before adding the tape.



9. In order to make the plane fly successfully, the students/cadets must attach a penny on top of the wing right behind the square tab. Then they will fold the tab back over the penny and tape it down to secure the coin.
10. Next, have students/cadets bend the elevons on the wing upward. This will provide for a flatter glide. If the students/cadets want the plane to turn, they can adjust the rudder on the vertical fin.
11. The FPG-9 is now ready to fly. Have students gently toss the plane directly in front of them. The FTP-9 should perform a big loop and have enough speed for a glide of 20'-25' after the loop.
12. Have students/cadets use the worksheets at the end of this lesson to experiment with the FTP-9.

SUMMARY

The FPG-9 illustrates how some of the flight surfaces work on an airplane. Students learn how to use the inquiry method to experiment with these surfaces and determine how they effect the flight of the airplane.

EVALUATION

Teacher will observe experimentation and use the FPG-9 data sheet as proof of experimentation and understanding.

ENRICHMENT

1. Have a contest to see who can adjust their FPG-9 gliders to hit a target such as a hoola hoop.
2. See which student/cadet's glider goes the farthest.
3. Have students/cadets prepare a lesson to teach younger students about control surfaces on the FPG-9.

RESOURCES

- Video from AMA on how to make the FPG-9 glider — http://www.youtube.com/watch?v=pNtew_VzzWg

FPG-9 Control Activity Data Sheet

by Jack Reynolds

http://www.modelaircraft.org/education/fpg-9.aspx

Name_____

Directions: Answer the questions below. Draw pictures to aid each response. You should draw the plane from a rearview perspective, as though the plane is flying away from you and in to the paper. Remember to launch your plane with the same amount of force and at the same angle for each step in this activity.

1. How would you position both elevons so the plane will loop? Draw the elevons on the picture below: (You are looking at the back of the plane.)

2. What happens when the elevons are neutral (they are even with the wing) and the rudder is moved to the left? (You are looking at the back of the plane.)

3. Place the rudder in a neutral position for the following experiment: How would you arrange **both** elevons to get your plane to fly to the left? Draw the position of the plane's elevons.

4. How can you get your plane to fly to the right? There are at least 3 possible answers. Draw a picture of the back of each plane and show the position of its control surfaces. Feel free to use combinations of the rudder and the elevons.



Collect data for these two different elevon configurations:

Elevon Configuration	Flight Time (Seconds)				Average Flight Time (Seconds)
	Trial 1	Trial 2	Trial 3	Trial 4	
A) 					
B) 					

5. Which configuration (A or B) is better at keeping the nose of the plane in the air? Which plane flew longer? Why did it fly longer?

6. Which configuration (A or B) has more drag? Why? What do you think drag is?

7. Refer to the following picture to answer this question: Which wing has higher pressure under it when the plane is flying? Circle your answer below:

*The **left wing** has higher pressure under it.*

*The **right wing** has higher pressure under it.*