# Glider Characteristics

*Lesson 1 of 2*

**Grade Level:** 5-8
**Subject(s):** Science
**Prep Time:** < 10 minutes
**Activity Duration:** One class period
**Materials Category:** Special requirements

| National Education Standards | | | | |
|---|---|---|---|---|
| Science | Mathematics | Technology | | Geography |
| | | ISTE | ITEA | |
| 2a, 2b | | | | |

**Objective:** To build a glider, and to conduct an experiment to learn how to change the flight characteristics of a glider.

## Materials:

- Plastic foam food tray, about 28 cm X 23 cm (Size 12)
- Cellophane tape
- Paper clips
- Binder clips
- Ballpoint pen
- Plastic knife or scissors
- Toothpicks
- Goggles (eye protection)
- Emery boards or sandpaper

## Related Links:

*NASA Site used for derivation of lesson plan*
Spacelink – X Gliders
http://spacelink.nasa.gov/Instructional.Materials/Curriculum.Support/Technology/Models/X.Gliders/.index.html

# Glider Characteristics

*Teacher Sheets*

## Background

A look at the research aircraft flown by NASA and its predecessor, the National Advisory Committee for Aeronautics (NACA), since the 1940s reveals an evolution of wing designs. In fact, each of the first series of NACA experimental research aircraft ("X-planes") used different wing and tail configurations to tackle the problems of supersonic flight.

These early jet aircraft had straight wings (X-1), wings that angled (swept) toward the tail (X-2), triangular (delta) wings (XF-92), and wings that could be moved in flight to change the angle of backward sweep (X-5). Each design added to our knowledge of high-speed flight.

More recently, aircraft designs have incorporated wings that sweep forward (X-29) and even wings that sweep forward and backward at the same time (AD-1 oblique wing aircraft). The X-29 and X-31 also made use of small wing-like control surfaces called canards, which are located ahead of the main wings. The X-36, which was flown during the late 1990s, used canards and swept-back wings but had no vertical tail.

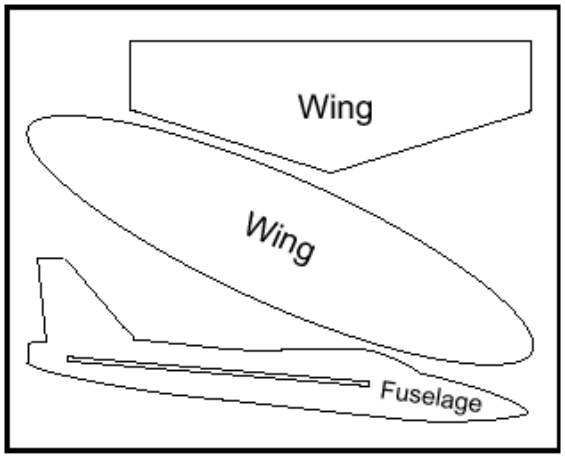
The templates supplied with this activity allow educators and students to build and experiment with all of these basic wing/tail/canard configurations. Eight different foam "X-gliders" can be built using these templates (see illustrations on Student Sheets), but the total number of variations is only limited by the imagination of the "designer."

Materials for building airplanes must be lightweight, strong, and readily available. These qualities make plastic foam a good material for the construction of flying models. Introduce the X-Glider Activity by discussing with the students some reasons for using plastic foam in the construction of a model glider. Most real airplanes are made from another lightweight, strong, and readily available material called aluminum.

## Guidelines

1. Read the 5-8 NASAexplores article, “After The Shuttle.”
2. Go over the parts of an airplane, and have the students label the parts on their templates.
3. Have students cut out parts and build gliders.
4. Encourage students to come up with their own combinations of parts to build and test a glider.
5. Have them design tests to see if one design performs better than another. These tests could include distance, stability, or accuracy.

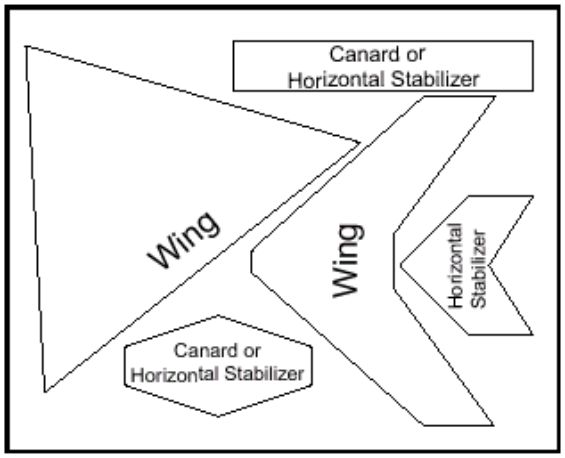
**template 1 key**




## Discussion / Wrap-up

- What design worked best? Why?
- What could the students do to make their tests more scientific?
- What could they do to improve the flight of their gliders?

**template 2 key**




## Extensions

- An airplane’s weight must be properly balanced for it to fly safely. The same "weight and balance" principles apply to models. The students can determine the proper weight and balance by attaching a paper clip or binder clip to the fuselage. Students should vary the position of the clip with each flight until the glider flies the greatest distance in a straight line. Additional clips might be needed to improve the glider’s flight performance.
- Weight and balance are also determined by the position of the wings, canards, and other surfaces along the fuselage. Have the students move the wings, stabilizers, and canards to different positions in the fuselage to determine the settings that make the glider fly best.
- Have students measure and record the distance of each flight, and compare the results with each change in the glider’s weight and balance.

# Glider Characteristics

*Student Sheet(s)*

## Materials

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## Procedure

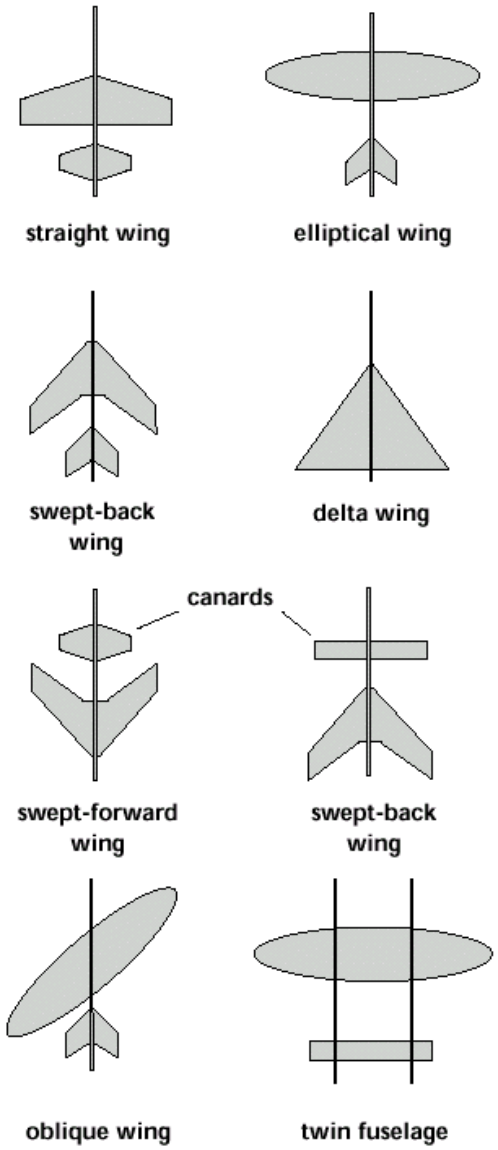
1. Write the name of each airplane part on the template.

2. Tape the glider template to the food tray.

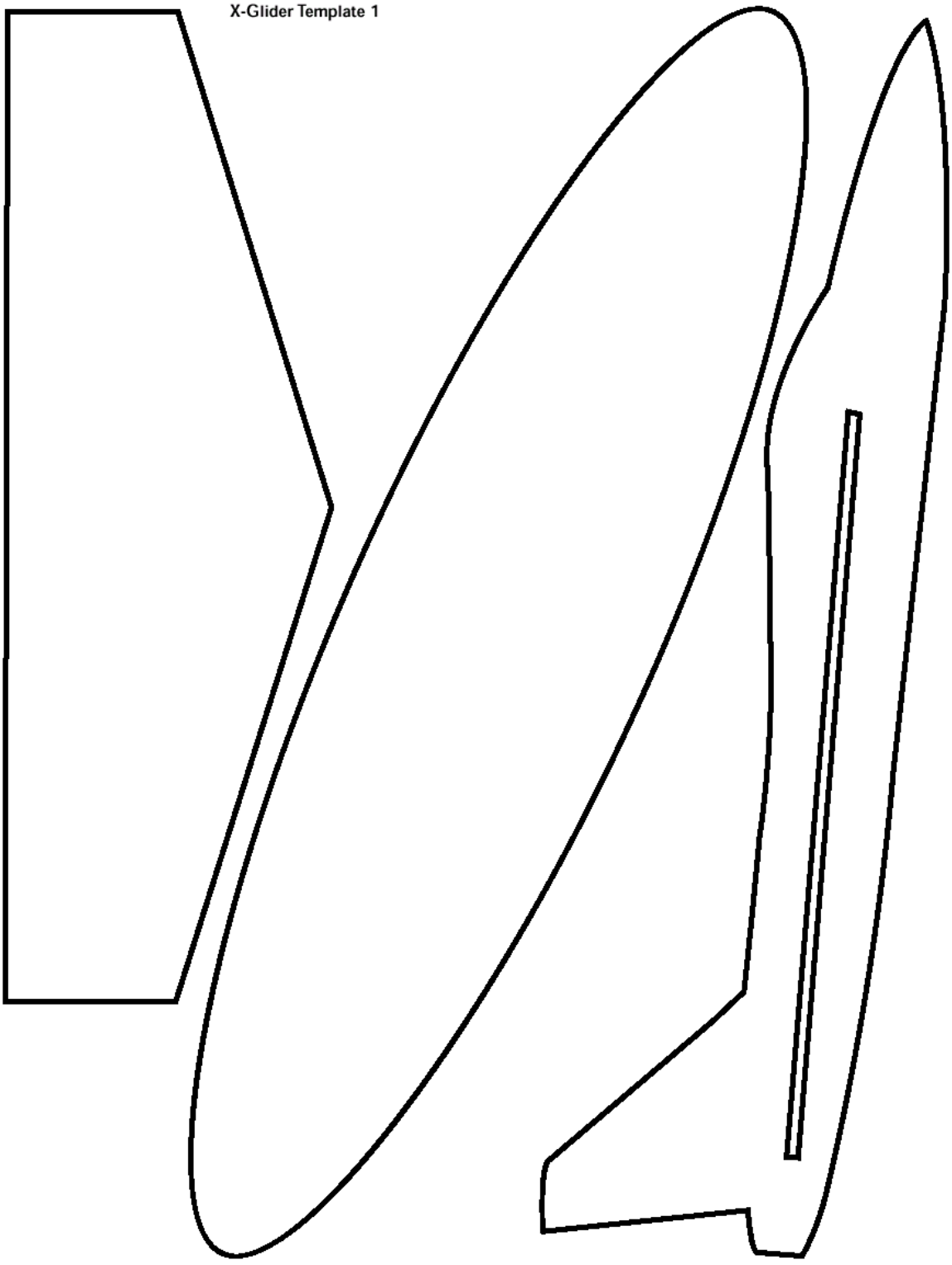
3. Cut out the airplane parts using the templates. Plastic foam can be cut using scissors, a razor knife, or a serrated plastic knife. It can also be cut using a sharp pencil or round toothpick to punch a series of holes approximately 2 mm apart around the outside edge of the part. The part can then be pushed out from the tray.

4. If there are any rough edges around a part, they can be smoothed using sandpaper or an emery board.

5. Carefully cut a slot in the fuselage. Slide other parts into it to finish the glider (refer to the X-glider silhouettes for the basic designs; another fuselage is needed to make the "twin fuselage" glider).



X-Glider Template 1



X-Glider Template 2