

How Far Can A Monarch Glide?

Objective

Students will create paper gliders using the provided template and then adjust this template to make the most efficient glider that they can. They will test how changing certain factors, like throwing style, throwing position, wing position and shape, affect monarch butterflies' ability to fly long distances.

Background

This activity is inspired by the *Flight of the Butterflies* IMAX® film Educator Guide. Watching butterflies fly in nature is fascinating to watch. With their erratic twists, turns and dips, their flight pattern may appear random, but it is actually very precise. Observe a butterfly aim to land on a flower. Butterflies have muscles that help them do this. Scientists are trying to study butterflies, using high speed cameras, to learn more about the physics of flight.

Monarch butterflies can travel about 50-55 miles per day during their migration. This trip is only possible because monarchs are expert gliders; they can fly for long periods of time without actually flapping their wings or using energy. They are one of the few insects that can glide so well. This allows them to take advantage of thermals (updrafts of warm air) and favorable winds, limit damage to their wings, and conserves energy. Only butterflies and moths have scales on their wings, which helps in flight. Observing gliding flight in birds and insects led humans to invent ways to glide themselves, using aircraft similar to airplanes but without engines.

In this lesson, students will experiment with paper glider designs that mimic the monarchs' shape and the angle of their wings when gliding. If possible, students watch monarchs during migration to view their gliding patterns (alternatively, watch videos). Have the students concentrate on the angles of the wings so they can work at reproducing these angles.

At first, students should use the design provided. They can then try to modify and improve this design to increase flight distances. Their goal should be to make the champion butterfly glider — the one that can glide the longest distance.

Grades: 3—6

Key Concepts:

- Monarchs use both powered flight (flapping wings) and gliding as they migrate.
- Powered flight takes more energy than gliding, so monarchs take advantage of favorable wind conditions that allow gliding whenever possible.
- A paper glider can be used to show how the structure of butterfly wings make gliding both possible and more efficient.

Materials:

- Monarch Glider Pattern (provided)
- Monarch Glider Data Table (provided)
- Stiff paper for each student (old file folders work well, or construction paper)
- Measuring tape or stick
- Scissors
- Glue
- Tape
- Ruler
- 2 pennies per glider
- Extension: provide additional paper of varying weight and stiffness; small paperclips, wax, play dough or other substances for weight

Activity

1. Before students arrive, gather supplies and set up an area for them to assemble their gliders.
2. Before students arrive, create a launch site. Using tape on the floor or other kinds of markers, create starting lines.
3. Optional, to make it a group activity. Create teams of 4 who will work together to create 1 glider. Assign roles:
 - Thrower: throws the glider
 - Recorder: writes results on data table
 - Spotter: marks the landing
 - Measurer: measures flight distance
4. Have students construct their gliders, following the directions below. be sure they write their names on the wings. They can also color their gliders to decorate them.
5. Go to launch site. Allow enough room between students/groups to prevent in-air crashes.
6. Students should take turns launching their glider. Individual Activity: have student launch 5 times. Group Activity: have each student launch five times for a group total of 20 launches. Each Thrower should complete all of their flights before switching duties. The number of throws per student can be adjusted to fit activity time frame. Before they start recording data, each student should take a few practice flights.
7. After all flights have been recorded on the Monarch Glider Data Table, have each group determine the flight distance averages.
8. Have the students experiment with different modifications (to their throwing style or to their glider.) Discuss what changes made a difference to how far the glider traveled. Extension activity: have students design their own monarch glider, testing different wing sizes, shapes, and weights.
9. Encourage students to compare their gliders to real monarchs, paying attention to the angles of the wings.

Monarch Glider Data Table

Student Handout

Prediction: How far do you think your glider will travel? _____

Directions: Throw your glider and measure the distance where it lands.

Launch #	Student 1	Student 2	Student 3	Student 4
1				
2				
3				
4				
5				
Average (add #s in column, divide by 5)				

Overall average: (add up all the average and divide by 4): _____

Time to Experiment!

What changes can you make to how you throw the glider to make it go further?

What happens when you throw it harder?

What happens when you try to throw it more gently (float it)?

What happens when you aim high?

What happens when you aim low?

What happens when you throw it from a higher surface?

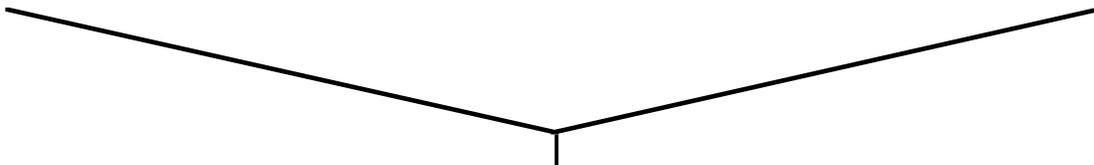
Extension: What changes can you make to the glider design to make it go further? (try changing wing size and shape, wing position, the weight of the paper, etc.)

Make a Monarch Glider

Student Handout

Construction

1. Cut out body/wing and fuselage patterns, then trace them onto stiff paper and cut them out.
2. Fold fuselage on all creases. Fold center crease of fuselage section so that flaps point up, then fold outside creases A and B down.
3. Place a penny on each side of fuselage front and tape them in place. This should also seal the front of fuselage.
4. Cover the entire top of both fuselage flaps with glue. (*short on time? use tape*)
5. Put the body/wing section on top of the fuselage section, and press together to glue/tape them together.
6. Allow glue to dry.
7. Align the fuselage with body/wing section and press together.
8. Crease body/wing section into this shape, to make a dihedral:



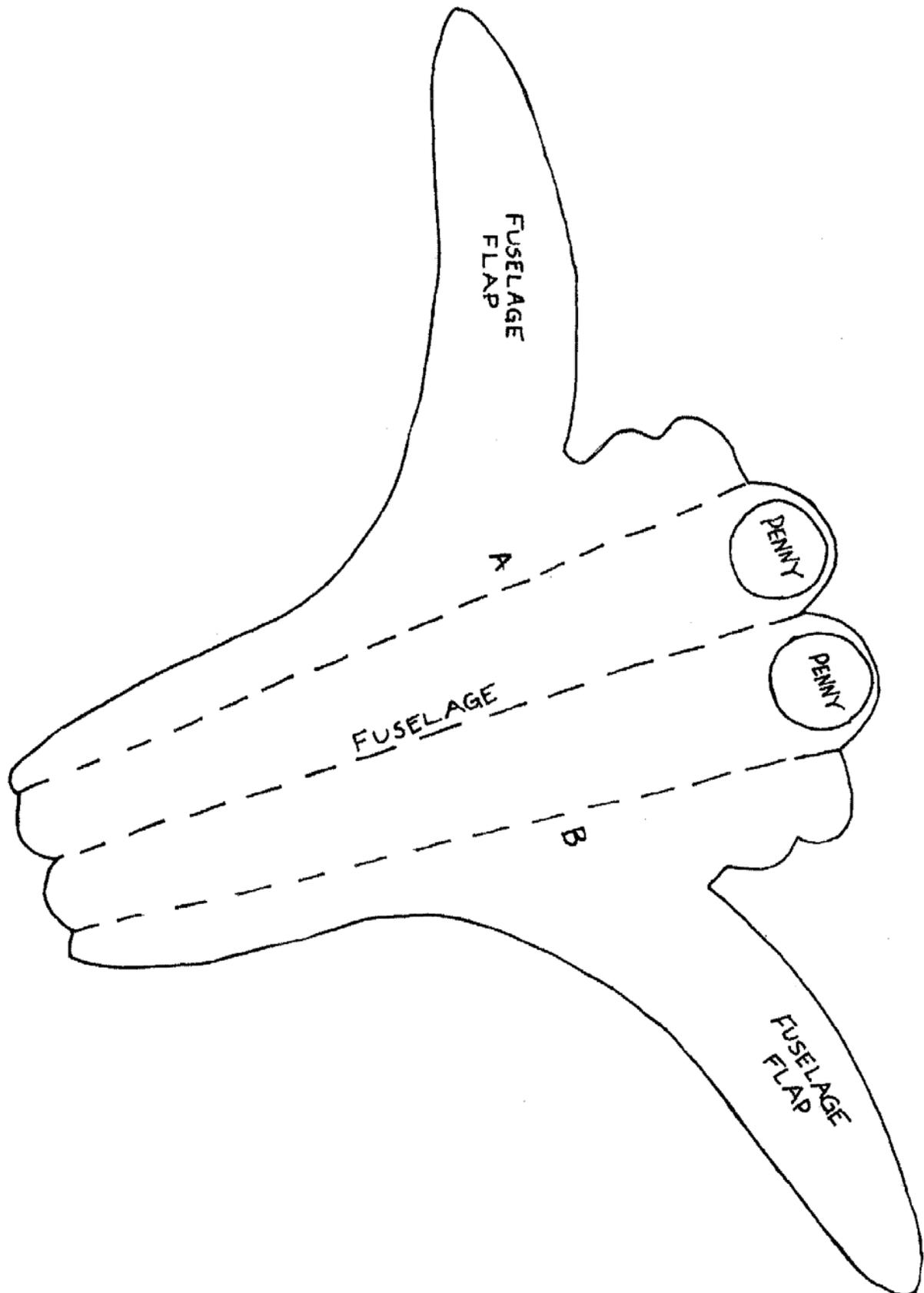
9. Crease wing elevons up.

Learn More About Monarchs in Texas

- Texas Department of Transportation (TxDOT) Perpetuating Pollinators video: https://www.youtube.com/watch?v=NbDbvshHpvU&ab_channel=TxDOT
- TxDOT Planting for Pollinators video: https://www.youtube.com/watch?v=pDjRF026HAI&ab_channel=TxDOT
- Monarch Joint Venture:
 - <https://monarchjointventure.org/get-involved/i-am-a/departement-of-transportation/monarch-highway>
 - <https://monarchjointventure.org/faq>
 - Look at "For Kids" <https://monarchjointventure.org/resources/downloads-and-links#education>

Monarch Glider Pattern: Fuselage

Student Handout



Monarch Glider Pattern: Body/Wing

Student Handout

