

# Convergent Evolution in Animal Locomotion

## Introduction

It's hard to think of two animals that are more different than a moth and a fish. One flies through the air, and the other swims through water. But if you can look beyond these big, obvious differences, you'll find that they're much more similar than they seem.

Swimming and flying animals like our moth and fish use structures called **propulsors** to move. Any body structure that the animal uses to propel itself through its environment is a propulsor. Propulsors can be fins, wings, and tails, and, sometimes, even the animal's entire body. Although these propulsors can be very different, they have one important thing in common—they all bend. In this activity, you'll uncover common features of propulsors and explore where these features came from.

## What To Do

- Step 1.** Look at the five animals shown in **Figure 1** (on page 5 of this handout) and identify the propulsor in each (options: fin, body and tail, or wing). Identify the propulsor in the appropriate column in **Table 1**.
- Step 2.** Look at **Figure 1** and find the dots marked on each animal. You can see the real images of animals these outlines were based on in **Figure 2**, but use **Figure 1** for the measurements.
- Point 1: at the beginning of the propulsor, closest to the animal's body
  - Point 2: in the middle of the propulsor, at the point of bending
  - Point 3: at the end of the propulsor, furthest from the animal's body
- Step 3.** Using a ruler, measure the lengths between points in mm. Record your data in **Table 1**.
- Length A (mm): Length from Point 1 to Point 2
  - Length B (mm) : Length from Point 2 to Point 3
- Step 4.** Add Length A and Length B to obtain Length C. This distance gives you the length of the propulsor when it is not bent. Record Length C in **Table 1**.

Our goal is to compare data across all of our animals, and we can't do this with the raw measurements we just made. This is because the photographs are not to scale. The picture of a moth and a whale are about the same size, in real life, a moth is tiny and a whale is huge! Even if we were measuring from the real animal, we still can't compare things that have such big size differences, since a few millimeters is a large distance for a moth but barely noticeable for a whale.

To help make comparisons across different size scales, scientists use **ratios**. Ratios are relative values, which means the one measurement is divided by another to give a standardized value. In the next step, you will use ratios to describe how far along the propulsor bending occurs, relative to the propulsor's total length. You can think of taking ratios as a method for ensuring you're comparing "apples to apples." Ratios can be written in many different ways. For example, the ratio one-to-two can be written as: 1:2,  $\frac{1}{2}$ , or 0.5.

- Step 5.** Find the ratio of Length A to Length C for each animal in **Table 1** by dividing Length A by Length C (A/C). This ratio is the percentage of the propulsor's total length (Length C) at which the bending happens. Write the ratio as a decimal, rounded to two decimal places. Fill in your answers in **Table 1**.
- Step 6.** Answer the analysis questions, reading the Bite when instructed.

Animal	Propulsor (fin, body and tail, or wing)	Length A (mm) Point 1 to Point 2	Length B (mm) Point 2 to Point 3	Length C (mm) Point 1 to Point 3	Ratio A/C
Shark					
Sea Butterfly					
Moth					
Eagle					
Dolphin					

**Table 1. Animal Propulsor Length Data.**

### Analysis Questions

1. Look at your data in Table 1. Describe the ratio data. Is there a wide range of values present, or are the data clustered within a small range?
2. Were you surprised by your results? Why or why not?



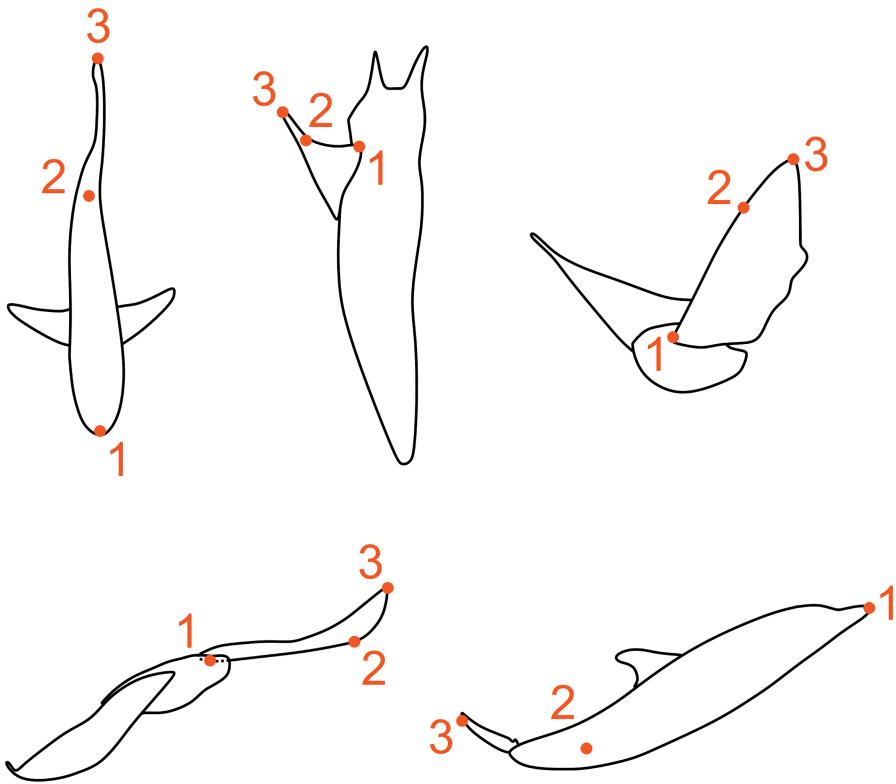
STOP & read Science Bite:  
Fins, Wings, and...Fractions?

3. Based on the reading and your data, answer the following questions.
  - a. What is the primary conclusion that the researchers drew from their data?
  - b. Which of the six groups of animals had the most variation in bending ratio? Which group had the least? How do you know?
  - c. How are their results similar or different from yours?
  - d. Where do you think differences (if there were any) between your results and theirs could have come from?

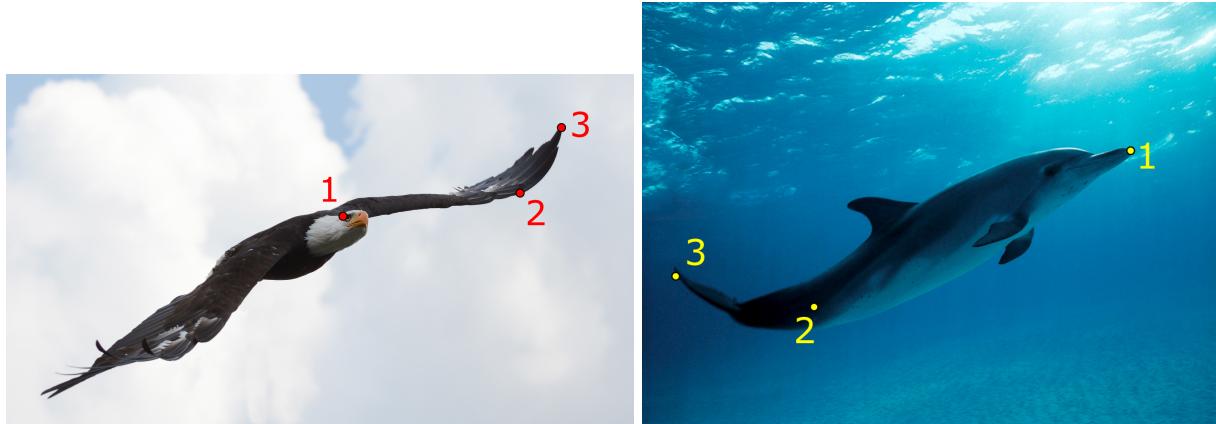
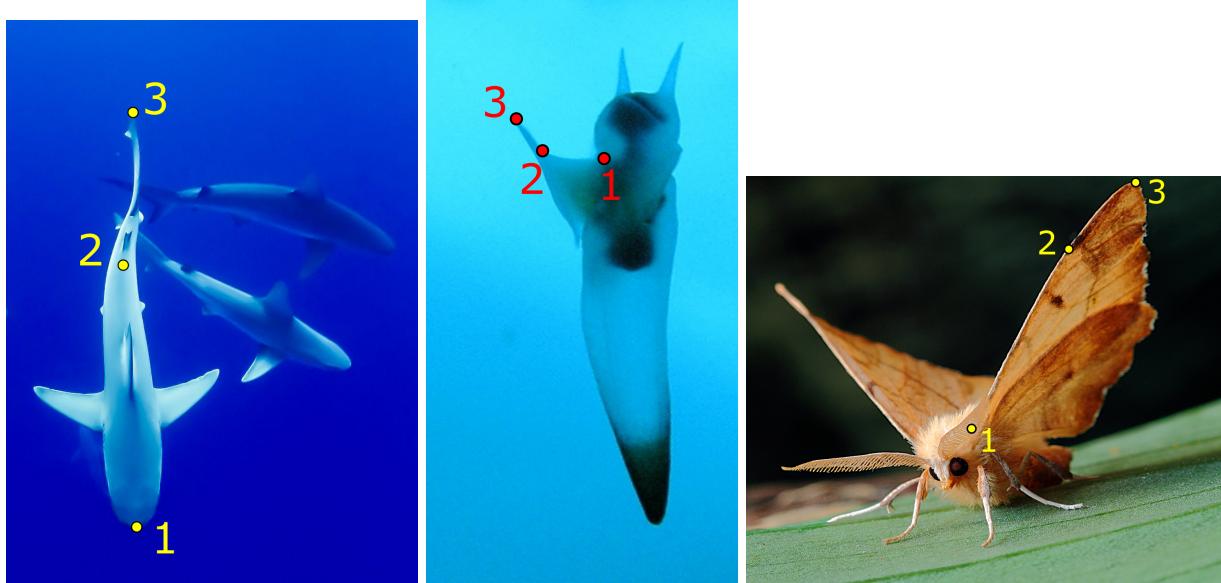
4. In your own words, explain convergent evolution.

An **adaptation** is a trait that increases an organism's fitness in their environment. **Fitness** is defined as the likelihood that an individual will successfully pass on their genes to offspring.

5. Given the definition of adaptation and fitness, explain why the researchers describe the bending pattern they uncovered as an adaptation.
6. **Connect to the Big Question.** Suppose that you are a scientist using computer models to study how the earliest birds might have flown. You enter all of the data available from fossils into the computer program and discover that according to your models, some of them were good fliers, but others aren't. Based on your evidence, the birds had bending ratios of 0.4–0.9. The poor fliers had ratios outside of the 0.6–0.7 range we see in modern birds.  
Explain the process that may have led to the 0.6–0.7 ratio range we see in birds today.
7. Explain how convergent evolution strengthens the core principle of biology that life has evolved by descent with modifications from common ancestors by processes such as natural selection.



**Figure 1. Animals With Propulsors.** Top row, left to right: shark, sea butterfly, moth. Bottom row, left to right: eagle, dolphin. See Figure 2 for full images of animals.



**Figure 2. Animals With Propulsors.** Full images for the animals in Figure 1. Top row, left to right: shark, sea butterfly, moth. Bottom row, left to right: eagle, dolphin. Sources: Public domain ([sharks](#), [sea butterfly](#), [moth](#), and [eagle](#)), [Flickr](#).