November 20, 2021
Why Baby Ducks Swim in a Line

Student Discussion Worksheet

Directions: Read the online *Science News* article "Here's the physics of why ducklings swim in a row behind their mother" and answer the following questions as directed by your teacher. A version of the article, "Why baby ducks swim in a line," appears in the November 20, 2021 issue of *Science News*.

What a drag
1. Define and explain drag force.

2. The formula $F_D = \frac{1}{2} \, p \, v^2 \, C_D \, A$ is a simple mathematical model of drag force. Define the variables and explain how each variable relates to the amount of drag on an object.

3. What additional factors may impact the amount of drag on a duckling swimming behind its mother?

4. Draw a simple diagram of a single duckling swimming in a particular direction. Include a force vector to show the overall direction of drag on the duckling relative to the duckling's motion.

5. Draw a simple diagram of one duckling swimming behind a parent duck. Draw a force vector for the parent duck indicating its drag direction relative to the parent duck's motion, and relative to the magnitude of drag shown in the first diagram. Finally, draw the force vector indicating the relative direction and magnitude of drag on the duckling swimming behind its parent.

Get in formation
1. What benefit do ducklings get from swimming in a line behind mom? How might this travel formation be advantageous from an evolutionary standpoint? Explain.

2. What aspects of the travel formation might reduce drag in other watery situations? Make sure your answer includes examples.

3. Brainstorm examples of large formations on land or in the air that might reduce drag for individuals within them. Choose one formation and draw a diagram to think about how the individuals are positioned relative to each other within the larger system.

4. What does the formation you diagrammed have in common with the ducklings' travel formation? How might those commonalities reduce drag? What is different about the two formations, and how might those differences affect the amount of drag on individuals? (Hint: consider the equation $F_D = \frac{1}{2} p\, v^2\, C_D\, A$)

5. The *Science News* article explains the science behind why ducklings swim in a row behind their mother.