

# ScienceNews

## EDUCATOR GUIDE



ANNIE OTZEN/MOMENT/GETTY IMAGES

### **September 10, 2022**

### **Why Spiraling Footballs**

### **Sometimes Miss the Mark**



**About this Guide**

Engage your students in science using sports! In this Guide, students can explore the physics of football throws and apply the scientific method to a sport of their choice.

**This Guide includes:**

**Article-based Comprehension Q&A** — Students will answer questions about the online *Science News* article "[Spiraling footballs wobble at one of two specific frequencies](#)," which describes how researchers figured out why spiraling footballs sometimes drift sideways. A version of the article, "Why spiraling footballs sometimes miss the mark," appears in the September 10, 2022 issue of *Science News*. Related standards include NGSS-DCI: HS-PS2.

**Student Comprehension Worksheet** — These questions are formatted so it's easy to print them out as a worksheet.

**Cross-curricular Discussion Q&A** — Get your students exploring the scientific method by applying scientific problem-solving to their favorite sport. Learning outcomes: Scientific method. Related standards include NGSS-DCI: HS-ETS1; HS-PS1; MS-ETS1.

**Student Discussion Worksheet** — These questions are formatted so it's easy to print them out as a worksheet.

**Article-based Comprehension, Q&A**

**Directions for teachers:** Ask students to read the online *Science News* article "[Spiraling footballs wobble at one of two specific frequencies](#)," which describes how researchers figured out why spiraling footballs sometimes drift sideways, and answer the following questions. You may want to have students pair up to answer the first two questions as not all students are familiar with throwing a football. A version of the article, "Why spiraling footballs sometimes miss the mark," appears in the September 10, 2022 issue of *Science News*.

**1. Describe how footballs move through the air when they are thrown by football players.**

A football is thrown so that it spins around its own axis as it travels through the air.

**2. What does a wobbling football look like? What can happen to the football pass when a ball wobbles?**

As a football spirals along its own axis when it's traveling through the air, sometimes the nose of the ball sways from its direction of flight. That sway is considered a wobble. Wobbles can cause a football to drift sideways, away from its intended target.

**3. What physical forces cause a football to wobble?**

A football wobbles when its spinning momentum interacts with a twisting force.

**4. How did scientists determine the rate of a football's wobble? Make sure your answer includes the speed at which the ball traveled and its spiral and wobble rates and their appropriate units of measurement.**

The scientists used computer simulations to find the wobble rates. Their football model traveled at about 27 meters per second, spiraled at a rate of about 600 rotations per minute and wobbled at a rate of either one or five times per second.

**5. What did this new research find about football wobbles?**

The wobble rates vary. A spiraling football can wobble fast or slow.

**6. What makes a football's wobble rate fast or slow? Explain.**

How the ball is thrown determines the rate at which it wobbles. Faster wobbles occur when the player throwing the football moves in such a way that extra energy is applied to the ball.

**7. How does wobble rate contribute to footballs drifting sideways? How far off course can a football drift due to wobbling?**

A wobble rate of five times per second generates lift, which can cause the football to drift off course by several meters.

**8. What other factors can contribute to a spiraling football getting off course?**

Earth's rotation and differences in air pressure.

**9. How far off course can those factors cause the ball to drift? How does the amount of drift compare with that caused by wobbling?**

Earth's rotation and effects of air pressure can cause the ball to drift by centimeters. That amount of drift is very small compared with the amount caused by wobbling — a centimeter is two orders of magnitude smaller than a meter.

**10. Do you think this information could be helpful to football players? Explain your answer.**

Yes. Knowing more about why a football veers from its intended course could help athletes adjust how they throw the ball.

**Student Comprehension Worksheet**

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**10. Do you think this information could be helpful to football players? Explain your answer.**

### Cross-curricular Discussion, Q&A

#### Directions for teachers:

Ask students to read the online *Science News* article "[Spiraling footballs wobble at one of two specific frequencies](#)" and discuss the first set of questions with a partner. A version of the article, "Why spiraling footballs sometimes miss the mark," appears in the September 10, 2022 issue of *Science News*. Next, use the questions to run a class discussion about the scientific method. Have students answer the second set of questions individually and then share their answers with a partner. You may find that the topic of STEM careers in sports is either a good hook or a possible extension for some students. Check out the *Science News Explores* article "[Cool Jobs: Sports science](#)" to integrate it into your lesson.

**Want to make it a virtual lesson?** Post the online *Science News* article to your virtual classroom. Discuss the article and questions with your class on your virtual platform.

#### Step by step

1. What is a recent problem you solved? For example, did you fix something that didn't work, mend tensions with a friend or family member or figure out how to get to the next level in a video game?

*Student answers will vary.*

2. Break down how you solved the problem into steps. How did you know there was a problem to solve? How did you decide to take the action you did, etc.? List the steps.

*Student answers will vary. They should include at least some of the following steps: noticing something was off and wondering why, determining a way to try to resolve it, trying something to resolve it and deciding whether it worked or not.*

3. The scientific method is a systematic way to solve problems and answer questions in science and engineering. List the steps of the scientific method. Use an external resource if necessary.

*Make observations. Analyze your observations and develop a measurable, testable question, or a hypothesis. Develop a procedural method to test your hypothesis, while collecting appropriate data. Analyze your data to determine your results and new hypotheses.*

4. Read the *Science News* article "[Spiraling footballs wobble at one of two specific frequencies.](#)" Using the steps of the scientific method from your answer to the previous question, give an example of each step from the article.

*Make observations: When a football is thrown it wobbles and veers away from its intended target.*

*Analyze your observations and develop a measurable, testable question, or a hypothesis: What forces cause a football to wobble?*

*Develop a procedural method to test your hypothesis, while collecting appropriate data: Create a computer simulation to determine wobble rates based on the football's speed and spiral rate.*

*Analyze your data to determine your results: Footballs wobble at rates of one or five times per second when the spinning momentum interacts with the twisting force.*

*Develop new hypotheses or questions: How much does the wobble rate affect the football's path?*

### **Science in sports**

1. What is your favorite sport? Do you like to play it? Do you watch it on TV? Have you ever watched it played professionally? Do you have a favorite professional team?

*Student answers will vary.*

2. Choose a position in your favorite sport. What are some skills required to be successful in the position? For example, a soccer player that takes free kicks needs to be able to angle their foot correctly to put spin on the ball to get it over a wall of players.

*Student answers will vary.*

3. Search for your sport in the [Science News Explores archive](#) and choose an article to read. What is the article about? What scientific question does it ask? If you can't find an article about your chosen sport, check out these examples:

[Why sports are becoming all about numbers – lots and lots of numbers](#)

[Let's learn about the science of the Winter Olympics](#)

[These young researchers take aim at sports](#)

*Student answers will vary.*

4. Come up with a testable, measurable question you'd like to explore about the sport of your choice. When brainstorming a question, it might help to think about things related to your sport such as skills, health and physical abilities, performance, statistical averages etc.

*Student answers will vary. For instance, questions could explore equipment use, like how the weight of a baseball bat relates to the distance the ball is hit; a skill, like whether the height of where a ball is hit affects the number of aces served in tennis; or statistics, such as whether a batter's RBI (runs batted in) score is correlated to their place in the lineup in softball. Questions could also be about the health and physical abilities of athletes. For example, does the amount of sleep the night before a race impact a swimmer's time?*

5. Explain how you would attempt to answer the question using the steps of the scientific method. What would you do for each step?



*Student answers will vary. As an extension, students could develop a full testing procedure and perform the experiment.*

### Student Discussion Worksheet

**Directions:** Read the online *Science News* article "[Spiraling footballs wobble at one of two specific frequencies](#)" and answer the questions as instructed by your teacher.

#### Step by step

1. What is a recent problem you solved? For example, did you fix something that didn't work, mend tensions with a friend or family member or figure out how to get to the next level in a video game?
2. Break down how you solved the problem into steps. How did you know there was a problem to solve? How did you decide to take the action you did, etc.? List the steps.
3. The scientific method is a systematic way to solve problems and answer questions in science and engineering. List the steps of the scientific method. Use an external resource if necessary.
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