STEM NEWS
The Science, Technology, Engineering and Math of Golf

TEACHER GUIDE

E D U C A T I O N A L  S P E C I A L  F E A T U R E
# Table of Contents

<table>
<thead>
<tr>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTRODUCTION</td>
</tr>
<tr>
<td>STANDARDS</td>
</tr>
<tr>
<td>LESSON 1  SPEED IN THE STEM ZONE</td>
</tr>
<tr>
<td>LESSON 2  ENGINEERING THE GAME OF GOLF</td>
</tr>
<tr>
<td>LESSON 3  HISTORY OF THE GOLF CLUB</td>
</tr>
<tr>
<td>LESSON 4  AERODYNAMICS: IT’S ALL AROUND YOU</td>
</tr>
<tr>
<td>LESSON 5  FRICTION: A FORCE THAT OPPOSES MOTION</td>
</tr>
<tr>
<td>LESSON 6  BOUNCE! IT’S ABOUT ENERGY</td>
</tr>
<tr>
<td>LESSON 7  BREAKING ON THE GREEN</td>
</tr>
</tbody>
</table>

This teacher guide and the student supplement were created by Kid Scoop. For more about Kid Scoop go to [www.kidscoop.com](http://www.kidscoop.com).

The Teacher Guide was written by Elena Toscano. “STEM ZONE and the World of Golf” student supplement was written by Vicki Whiting. The supplement was designed by Jeff Schinkel. The guide was designed by Eli Smith with production management by Vivien Whittington.

Special thanks go to the partners of this project, Chevron and the United States Golf Association. Special appreciation goes to Steven Quintavalla Ph.D. for his assistance with curriculum development and fact checking.
Letter to Teachers:

Dear Educator,

Science, technology, engineering and mathematics—known as STEM—are as important to the game of golf as tees, clubs, balls and a good swing. Engineers and scientists use STEM to generate new ideas and improve old designs—making the game more interesting, more competitive and more fun!

The United States Golf Association (USGA) has a world-renowned Equipment Standards Department housed in a special Test Center where scientists and engineers review all new equipment to ensure that skill, not technology, determines success in golf.

This teacher guide and its companion student magazine are part of a multi-media educational extravaganza fueling hands-on, minds-on STEM learning experiences that investigate the exciting science behind the game of golf.

To drive home the value of STEM in a student’s education and its potential impact on a career choice and our nation’s future, the USGA and Chevron have formed a partnership to encourage and excite students using golf as the medium for the message. Often the study of math and science seems disconnected from a student’s “real” world. Yet, a closer look at something fun—like golf—from a scientific perspective, reveals connections to life and career that are instructive and engaging. In this supplement students will be introduced to scientific concepts, explore the engineering behind the game of golf, do the same kinds of experiments done at the USGA Test Center while meeting real engineers, mathematicians and scientists and gaining first-hand knowledge of careers that are more like a game than work.

Activities in this supplement are designed to introduce and reinforce both national common core standards and 21st century skills of communication, collaboration, critical thinking and creativity. We know you and your students will enjoy this unique combination of golf and STEM.

Sincerely,

John Spitzer, Managing Director of Equipment Standards

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STEM plays a critical role in helping the United States compete in a global economy. Business leaders have voiced concerns over the supply and availability of STEM workers. Over the past 10 years, demand for STEM jobs was three times greater than demand for non-STEM jobs. If the U.S. is going to create the kind of workforce our country needs for a healthy future, STEM careers must be nurtured and encouraged in today’s youth.

• In 2010, there were 7.6 million STEM workers in the United States, representing about 1 in 18 workers.

• STEM occupations are projected to grow by 17 percent from 2008 to 2018, compared to 9.8 percent growth for non-STEM occupations.

• STEM workers command higher wages, earning 26 percent more than their non-STEM counterparts.

• More than two-thirds of STEM workers have at least a college degree, compared to less than one-third of non-STEM workers.

• STEM degree holders enjoy higher earnings, regardless of whether they work in STEM or non-STEM occupations.

Source: U.S. Department of Commerce, Economics & Statistics Administration
### Anchor Standards for Reading

<table>
<thead>
<tr>
<th>Language Arts</th>
<th>LESSONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Read closely</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>2. Cite textual evidence to support answers and inferences</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>3. Understand words used in context</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>4. Write arguments to support claims citing evidence</td>
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<tr>
<td>5. Determine the central idea of a text</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>6. Understand origins of words</td>
<td>1 2 3 4 5 6 7</td>
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<td>7. Cause and Effect</td>
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<td>8. Fact and Opinion</td>
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<td>9. Main idea and supporting details</td>
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<tr>
<td>10. Problem and Solution</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>11. Use the newspaper to locate information</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>12. Uses the Internet to locate information</td>
<td>1 2 3 4 5 6 7</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Science</th>
<th>1 2 3 4 5 6 7</th>
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</thead>
<tbody>
<tr>
<td>1. Distinguish between fact and speculation</td>
<td></td>
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<tr>
<td>2. Follow the steps of scientific process</td>
<td></td>
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<tr>
<td>3. Conduct multiple-step investigations</td>
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</tr>
<tr>
<td>4. Draw conclusions; summarize findings</td>
<td></td>
</tr>
<tr>
<td>5. Graph or chart data</td>
<td></td>
</tr>
<tr>
<td>6. Understand Newton’s Laws</td>
<td></td>
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<tr>
<td>7. Understand concepts of aerodynamics</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Mathematics</th>
<th>1 2 3 4 5 6 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Calculate ratio and percent</td>
<td></td>
</tr>
<tr>
<td>2. Use scale</td>
<td></td>
</tr>
<tr>
<td>3. Solve multiple-step problems</td>
<td></td>
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</tbody>
</table>

The pictures in the supplement are either from the Chevron STEM ZONE, by designer Jeff Schinkel, or are in the public domain unless listed here.

Page 2: Girl—iStockphoto/Zorani
Page 4: USGA/John Mummert, USGA/Matt Rainey
Page 5: USGA/John Mummert, USGA/Leonard Kamsler
Page 6: Boy—iStockphoto/paulaphoto,
         USGA/John Mummert, USGA/Matt Rainey
Page 7: USGA/Matt Rainey
Page 8: Dog—iStockphoto/Tomwang
Page 9: USGA/John Mummert
Page 10: Match iStockphoto/joebelanger,
         USGA/Matt Rainey
Page 11: Clubs—Shutterstock/gwycech,
         Girl—iStockphoto/SerrNovik
Page 12: USGA/Steve Gibbons, USGA/Matt Rainey
Page 14: USGA/Steve Gibbons, USGA/Steve Gibbons,
         USGA/Matt Rainey

Times-News
INTRODUCING THE TOPIC:

SAY: 100 years ago, there were no televisions, rocket ships, computers, solar-powered cars, cell phones or thousands of other items in use today. Science, technology, engineering and math (STEM) workers have changed the way people live, play and work by developing new ideas and products. Certain courses you study at school can lead to exciting and fun careers and new inventions. In this supplement, we will take a closer look at STEM in golf and learn how science and engineering are often more like a game than work.

Review Vocabulary: Tell students they will be on a “word hunt” to locate vocabulary as they read.

Distribute The STEM ZONE student supplement, pp. 2-3, drawing paper and pencil/markers.

Before Reading: ASK: How fast is fast? Make a T-chart and brainstorm objects that can move faster than a car traveling 60 mph (e.g., airplanes, rockets, baseballs). List the objects and the estimated speed. ASK: Which do you think is fastest when hit—a baseball, a golf ball or a tennis ball? Direct students to read Which is Faster?

The Science of Speed: Newton’s First Law of Motion is simple! An object (like a soccer ball) will stay at rest, until a force (a foot kicking it) causes it to move. An object in motion (a soccer ball soaring through the air) will stay in motion, until a force (gravity) causes it to stop. Have students quickly sketch Newton’s First Law of Motion.

Just For Fun: How many words of three or more letters can students make from the letters in S-I-R  I-S-A-A-C  N-E-W-T-O-N?

Scientist’s Notebook: Form teams of 2-4. Read the experiment before distributing supplies. Allow time to test, observe and record. Compare results and discuss conclusions. SAY: Experiments can illustrate the concept of cause and effect very clearly. Identify the “cause” and “effect” in the experiment. If students need scaffolding, ASK: What was the cause of the ball moving farther? What was the effect of pulling the pendulum back farther?

STEM Follow Up: Write the letters S-T-E-M. Ask students to summarize the science, technology, engineering or math concepts in this part of the supplement. (S = Newton’s First Law of Motion; swing of a golf club; T = machines that measure the speed of objects; E = design of length of golf club; M = ratio of pendulum swing to distance)

USE THE NEWSPAPER!

Distribute today’s newspaper—one per person and the Lesson 1 Worksheet.

The experiment students conducted is an example of cause and effect. The length of the swing (“cause”) changed the speed of the ball (“effect”). Create golf teams. Ask teams to locate articles in the newspaper and identify cause and effect.
EXTENSIONS

1. **STEM in Your Future?** Look through the newspaper want ads to identify careers in science, technology, engineering or math. Count different careers. Graph results.

2. **STEM Search:** Find articles in the newspaper connected to STEM. Label articles S, T, E, or M. Which branch of STEM has the most coverage in today’s news?

3. **Recycle:** Make a set of golf balls and clubs of different lengths using newspaper and tape. Does the length of your golf club affect the distance the ball travels?
Scientists draw conclusions based on the results (**effect**) of a variable (**cause**) in experiments.

- Locate articles in different sections of today’s newspaper.
- Identify examples of cause and effect.

**Critical Thinking:** What makes these **causes** and **effects** newsworthy?

<table>
<thead>
<tr>
<th>Section</th>
<th>Headline</th>
<th>Cause</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>World News</td>
<td></td>
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<td></td>
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<tr>
<td>Local News</td>
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<td></td>
<td></td>
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<tr>
<td>Sports</td>
<td></td>
<td></td>
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<tr>
<td>Entertainment</td>
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<td></td>
<td></td>
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<tr>
<td>Business</td>
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</table>
INTRODUCING THE TOPIC:

- **Before Reading, ASK:** What ideas do you associate with the word “engineer”?
  Today we are going to learn more about the cool career of engineering at the USGA Test Center and learn about the connection between engineers and golf.

- **Review Vocabulary:** Ask students to connect the word origin to the meaning.

- **Open The STEM ZONE student supplement, pp. 4-5**

- **Equipment Rules: ASK:** Why is it important that equipment “conform” to rules in competition? What are specific rules about golf balls?

- **Robot Golfer: ASK:** What evidence infers that the USGA Test Center takes the rules of golf seriously? (A: They test more than 30,000 golf balls a year; use a robot for accuracy as they test equipment)

- **Career Corner: ASK:** How does Dr. Quintavalla protect the integrity of the game of golf? What evidence can you cite?

- **Golf Ball History:** Distribute construction paper. Have students fold in half and then in thirds to make six sections. Label each section with a date. Illustrate changes over time with a quick sketch and main idea. What will happen in the future?

<table>
<thead>
<tr>
<th>Early 17th Century</th>
<th>1618</th>
<th>1848</th>
<th>1898</th>
<th>Today</th>
<th>Future?</th>
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- **STEM Follow Up:** Write the letters S-T-E-M. Ask students to summarize the science, technology, engineering or math concepts in this part of the supplement. (S = understanding how golf balls work; T = inventing the robot golfer; E = creating new equipment; M = use of precise metric and standard measurement)

USE THE NEWSPAPER!

- **Distribute today’s newspaper—one per person and the Lesson 2 Worksheet.**

- **Explain:** *Mechanical engineers have opinions (ideas or “hypotheses”) about how golf equipment should be designed. They conduct experiments to test their ideas and to discover facts to make improvements. Learning the difference between fact and opinion is an important skill for STEM careers.*

EXTENSIONS

1. **Branch out with STEM:** Select an ad from the newspaper. Think about the engineering that might have been part of the design. What kinds of experiments may have been conducted to test this product?

2. **De-TECH-tive:** Cut out a photo from the newspaper and glue in the center of a piece of paper. Draw arrows and label as many items in the picture that link to TECHnology. How many can you find in one photo?
3. **Equipment Mart:** Look through the sports section for photos of equipment such as helmets, cleats, clubs, etc. Cut out one example and write a brief summary about the object’s purpose and importance to the game. Complete the sentence: Engineering may have been used to ________________________________.
TEAM NAME

Mechanical engineers have opinions (ideas or “hypotheses”) about how golf equipment should be designed. They conduct experiments to test their ideas and to discover facts to make improvements. Learning the difference between fact and opinion is an important skill for STEM careers.

One place in the newspaper where people share facts and opinions is in letters to the editor. Often their passionate feelings about a topic lead them to express strong opinions along with the facts. Look through the editorial section for letters addressing different issues. Underline the facts, circle the opinions.

1. Use the graphic organizer to record the topic of the letters and list facts and opinions.

<table>
<thead>
<tr>
<th>Letter topic:</th>
<th>Facts</th>
<th>Opinions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

2. Write a letter to the editor about a topic in the news that concerns you. Include both facts and opinions to express your position.

Dear Editor:

__________________________________________________________________________________________________
__________________________________________________________________________________________________
__________________________________________________________________________________________________
__________________________________________________________________________________________________
__________________________________________________________________________________________________

_________________________________
Your signature
INTRODUCING THE TOPIC:

- Before Reading, SAY: Golfers have different clubs in their bags called “irons” and “woods”. What’s the difference? Why are some called “woods” when they are made from metal?

- Review Vocabulary: Ask students to turn to their elbow partner and use each word in a sentence. Link meaning to word origins.

- Open The STEM ZONE student supplement, pp. 6-7

- History of the Golf Club: Draw a chart. Ask students to identify three important details about each type of club.

<table>
<thead>
<tr>
<th>Wood</th>
<th>Steel “Woods”</th>
<th>Titanium</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>1.</td>
<td>1.</td>
</tr>
<tr>
<td>2.</td>
<td>2.</td>
<td>2.</td>
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<tr>
<td>3.</td>
<td>3.</td>
<td>3.</td>
</tr>
</tbody>
</table>

- Golf Club Rules: Using the ruler, have students draw two rectangles that show the dimensions of the head of a golf club, using inches for one drawing and metric for the other. Compare. SAY: STEM workers typically use metric measurement because it is internationally accepted and understood. Interestingly, The USGA uses the Imperial System of measurement—which includes inches, feet and yards—because of golf’s history and tradition, after all, the game got its start in the British Isles.

- Volume is a 3-D Measurement: Have students draw a 1 cm. x 1 cm. square to demonstrate one- and two-dimensions. Demonstrate three-dimensions using the solid cube. ASK: What happens when you see a movie in 3-D compared to a regular film?

- Scientist’s Notebook: Displacement: Form teams of 2-4; distribute cylinders, tubs, objects. Fill cylinders half with water and place in tub. Have students immerse different objects one at a time, being careful not to dip their fingers into the water. Have students note displacement volume by subtracting the beginning water level from the level with an object inside. Refill water in cylinder using a plastic cup.

- Career Corner: What evidence from the text tells you that Dr. Pringle enjoys his career?

- STEM Follow Up: Write the letters S-T-E-M. Ask students to summarize the science, technology, engineering or math concepts in this part of the supplement. (S = Archimedes’ Displacement Theory; T = changes to golf clubs over time; E = study how clubs and balls work to write rules for equipment; M = measuring volume, dimensions)

USE THE NEWSPAPER!

- Distribute today’s newspaper—one per team of two and the Lesson 3 Worksheet.

- Explain: STEM careers require close attention to detail. Use an article to identify main idea and five important details.
LESSON 3
HISTORY OF THE GOLF CLUB

EXTENSIONS
1. Meter Readers: Measure and label the metric length and width of columns on one page of the newspaper.
2. Sports Math: Identify ten different ways math is used in the sports section.
3. STEM Newsmakers: Find articles related to STEM careers.

TOOLS NEEDED
- The STEM ZONE student supplement, pp. 6-7
- Ruler with metric and standard measure, piece of paper, 1 cm x 1 cm cube
- Metric cylinders, objects of different weights, water, flexible plastic cup
- Lesson 3 Worksheet, one per team
- Today’s newspaper, one copy per team
TEAM NAME

Changes in the design of golf clubs happened because someone had a **big idea** and paid attention to **important details** to create something better, faster, sleeker and more lightweight!

Find an article in today’s newspaper with a “catchy” headline. The headline usually gives a clue to the main idea. Now read the article carefully. Like a scientist, locate and underline important details that tell about the main idea. Choose five details that are **MOST** important and list below.

<table>
<thead>
<tr>
<th>Headline</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Idea</td>
<td></td>
</tr>
<tr>
<td>Detail 1</td>
<td></td>
</tr>
<tr>
<td>Detail 2</td>
<td></td>
</tr>
<tr>
<td>Detail 3</td>
<td></td>
</tr>
<tr>
<td>Detail 4</td>
<td></td>
</tr>
<tr>
<td>Detail 5</td>
<td></td>
</tr>
</tbody>
</table>
INTRODUCING THE TOPIC:

- **Before Reading:** SAY: What design features do rocket ships, airplanes, and race cars have in common? (A: sleek, narrow up front, rounded, some kind of force to get them moving, etc.) Why do you think they are designed this way? (A: to move efficiently through the air with the least amount of resistance) Scientists and engineers are problem solvers! They must know how air moves around things in order to make their designs work. In other words, their designs are solutions to the problems that air creates as an object moves through it.

- **Vocabulary Chart:** Distribute white paper. Direct students to fold paper into four sections or “boxes.” Holding lengthwise, write AERODYNAMICS across the top. In each of the boxes, write one vocabulary word (resistance/drag, weight, lift and wake) and its definition. As students read this section of the supplement, sketch an example of each word. Later, they will add a sentence.

- **Open The STEM ZONE student supplement, pp. 8-9**

- **Drag:** Ask students to swish their hand from side-to-side to feel resistance. Next have them move it back and forth with the palm of their hand parallel to the ground to feel less resistance.

- **Dimples = Distance:** SAY: A golf ball with “dimples” is a better design than a golf ball with a smooth surface. What information or evidence would you use from this section to explain why to a younger student?

- **Sidebar:** Use the Internet to locate a video of Alan Shepard’s golf shot on the moon or use this link: http://www.youtube.com/watch?v=KZLl3XwlAIE

- **Scientist’s Notebook:** Daniel Bernoulli was a Swiss mathematician and physicist born in 1700. Bernoulli’s principle states that an increase in speed causes a decrease in pressure. Review directions for the investigation.

- **STEM Follow Up:** Write the letters S-T-E-M. Ask students to summarize the science, technology, engineering or math concepts in this part of the supplement. (S = aerodynamics; Bernoulli’s Principle; T = landing on the moon; machine with infra-red sensors; E = designing things that fly; creating 70 foot long tunnel at USGA Test Center; M = measuring speed)

USE THE NEWSPAPER!

- Distribute today’s newspaper—one per team and the Lesson 4 Worksheet.

- Explain: STEM works to find solutions to problems. Find two articles in today’s newspaper that identify a STEM solution to a problem or challenge. Summarize the article using newspaper format: Who, What (Problem), When, Where, Why and How (Solution).
EXTENSIONS

1. **Funny How it Happens**: Collect comic strips that illustrate problems and solutions.

2. **Make It Up**: Locate a problem in the sports section that an athlete or team faced. Write about and illustrate an invention to solve it!

3. **STEM Scavenger Hunt**: Locate five news articles that identify the use of technology to solve problems or challenges.
Science, technology, engineering and math workers figure out solutions to problems. Find two articles in today’s newspaper that identify a STEM solution to a problem or challenge. Summarize the article using newspaper format: Who, What (Problem), When, Where, Why and How (Solution).

<table>
<thead>
<tr>
<th></th>
<th>Article #1</th>
<th>Article #2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Headline</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Who</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>What (Problem)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>When</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Where</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Why</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>How (STEM Solution)</strong></td>
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</tbody>
</table>
INTRODUCING THE TOPIC:

- **Before Reading:** SAY: Rub your palms back and forth rapidly. What causes the heat you feel? (A: friction)

- **“Simon Says” Vocabulary:** Write or show words and definitions on the board. Have students (1) listen as you read word and definition while demonstrating a hand motion; (2) read in choral response with hand motions

- **Open The STEM ZONE** student supplement, pp. 10-11

- **Friction:** After reading, check for understanding. **ASK:** How can you increase friction? (A. By having a rough surface) **How can you decrease, or lessen, friction?** (A. By having a smooth surface) **What can we infer about friction and the surface of a golf club with and without grooves?** (A. The club with grooves will create more friction.)

- **Golf Ball Spins:** Draw the chart and write two questions on the board: **SAY:** As you read this section, underline evidence to answer these questions. What effect does the slant of the golf club have on the ball when hit properly? When not hit properly? (Answers included below)

<table>
<thead>
<tr>
<th>Hit Properly</th>
<th>Not Hit Properly</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. forces ball to roll up the club face</td>
<td>1. causes ball to spin clockwise</td>
</tr>
<tr>
<td>2. causes ball to spin counter-clockwise</td>
<td>2. causes ball to go towards the ground</td>
</tr>
</tbody>
</table>

- **How Much to Spin?** **ASK:** What does the right amount of spin help the ball do? (A: lift the ball to travel farther) **What is the effect of too little or too much spin?** (A: too little = won’t stay in the air; too much = slows down too fast)

- **Scientist's Notebook:** Students will use actual data from the USGA Test Center to create a bar graph. Review directions and have students complete the bar graph. What can they conclude from the graph?

- **Career Corner:** **ASK:** Why does John Spitzer love his job as Director of Equipment Standards? Why is it important that Spitzer and his team conduct tests that are accurate? (A. So none of the equipment gives a player an unfair advantage)

- **STEM Follow Up:** Write the letters S-T-E-M. Ask students to summarize the science, technology, engineering or math concepts in this part of the supplement. (S = friction; T = camera using video and slow motion photography to observe spin; E = design of a lofted club; M = measuring the force of friction and angle of impact)

USE THE NEWSPAPER!

- Distribute today’s newspaper—one per team and the Lesson 5 Worksheet.

- Explain: **Tests at the USGA Test Center produce data that is summarized and displayed in tables, charts or graphs. Use a section of today’s newspaper to gather data about advertising. How many ads sell products with a “spin” for women? For men? For both women and men? Chart your results and write a summary of your findings.**
EXTENSIONS

1. **Multiple Meanings:** Locate words in the newspaper that have multiple meanings like “head of a golf club” and “head of a body” and “being a member of a club.” Circle words, then sketch or write definitions to illustrate different meanings.

2. **Time Capsule:** Gather STEM related articles from today’s newspaper to place in a time capsule. What do the articles tell about our current technology?

3. **More Data:** Find articles related to STEM topics. Compare to the number of articles about non-STEM topics. Graph results.
TEAM NAME

While running tests at the USGA Test Center, engineers gather lots of information, or data, that is summarized and displayed in a table or graph. This makes it easy to see and understand the findings.

Look at the ads in one section of the newspaper. How many ads sell products with a “spin” for women? For men? For both women and men? Write a summary of your findings and graph results.

**Raw Data**

<table>
<thead>
<tr>
<th>Section of newspaper used</th>
<th>Number of ads with a “spin” for women</th>
<th>Number of ads with a “spin” for men</th>
<th>Number of ads for both men and women</th>
</tr>
</thead>
</table>

**Summary of Findings**

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**Graph**
INTRODUCING THE TOPIC:

Before Reading: SAY: When people say someone has a lot of energy, what do they mean? In physics, energy is defined as “the capacity for doing work.” So someone with a lot of energy should be able to get a lot of work done! What kinds of energy have you heard about? (A: electrical, mechanical, chemical, solar, nuclear, etc.) All energy can be divided into two main types: kinetic (moving) and potential (stored).

Review Vocabulary: Write or show words and definitions on the board. Use “I do. You do. We do” strategy. First you say the word and definition. Then students do the same without you. Finally, read all together.

Open The STEM ZONE student supplement, pp. 12-13

Conservation of Energy—Draw it: Distribute white paper and fold into four sections. Have students illustrate and label the physics of a ball dropping: 1. held above the ground (potential energy); 2. dropping (kinetic energy); 3. hitting the ground (friction and thermal energy); 4. bouncing back at a lower height (loss of kinetic energy and transformation of potential energy to thermal energy)

Scientist’s Notebook: Distribute ball and yard/meter stick to teams of four. Direct students to measure four bounces beginning at four different heights: head, shoulders, hip, knees. Use the yard/meter stick to measure the starting height and resulting bounce for each drop. Record results. SAY: What did you discover? What is the ratio of height to bounce?

The Rules of Golf: ASK: At 255 ft. per second (173.9 mph), how many feet could a ball travel in four seconds? How many yards is that? (A. 255 ft. x 4 seconds = 1,020 feet or 340 yards). Imagine a ball crossing almost four football fields in under four seconds. That’s fast!

Career Corner: ASK: Which branch of STEM did Mary Jane Rogers study in school? (A: Science — Anatomy and physiology are a division of biology. Anatomy is the study of the structure of organisms and physiology is the study of the function of those structures.)

STEM Follow Up: Write the letters S-T-E-M. Ask students to summarize the science, technology, engineering or math concepts in this part of the supplement. (S = energy; experiment with height and bounce; T = components of machine that measure ball speed; E = designing machine to test energy; M = formula to measure speed, calculate bounce)

USE THE NEWSPAPER!

Distribute today’s newspaper—one per team and the Lesson 6 Worksheet.

The Price is Right: SAY: Calculating percent is a skill needed in all walks of life including STEM careers. Look through the newspaper for items on sale for under $100. If each item were discounted 20%, what would be the final price? Determine 1. the discount; and 2. the final price. If you had $500 to spend, what could you buy on sale?
EXTENSIONS

1. **Ratio in Ads:** Select an ad with a picture. Measure and label the height of the ad. Measure the picture. Calculate ratio or percent. What percent of an ad is the picture?

2. **Font Math:** Measure the height of the headlines compared to other fonts in subtitles and articles. Calculate ratios.

3. **Measuring and Ratio:** Locate a picture of a full human body in the newspaper. Measure the length of the body from head to foot using centimeters; then measure the head, arm, leg and compare the ratio to the full body. Compare the hand to the full arm and the foot to the leg. What are the proportions?

**TOOLS NEEDED**

- *The STEM ZONE* student supplement, pp. 12-13
- White drawing paper, one per student
- Balls of different sizes, meter stick or yardstick
- Lesson 6 Worksheet, one per team, calculators
- Today’s newspaper, one copy per team
Calculating percent is a skill needed in all walks of life including STEM careers! Sharpening this skill can even save you money at the mall.

Look through the newspaper for items on sale for under $100. If each item were discounted 20%, what would be the cost? Determine 1. the discount; and 2. the final price. If you had $500 to spend, what could you buy on sale?

An example is shown.

<table>
<thead>
<tr>
<th>Item</th>
<th>Regular Price</th>
<th>20% Discount</th>
<th>Final Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>DVD player</td>
<td>$80.00</td>
<td>$80 x .20 = $16.00</td>
<td>$80 - $16.00 = $64.00</td>
</tr>
</tbody>
</table>

If you had $500, how many items from your list above could you buy? What would be the total cost? How much money would you have left? Use the space below to calculate.

<table>
<thead>
<tr>
<th>Item</th>
<th>Discounted Price</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Total</th>
<th>Change from $500</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
INTRODUCING THE TOPIC:
- **Before Reading:** SAY: Bob Jones, Jr. is still considered the greatest amateur in the history of golf. Jones dominated the “Golden Age of Sports” after World War I. From 1923 to 1930 Jones won thirteen national titles and became the first and only golfer to win the Grand Slam—four back-to-back tournaments that included the British Amateur, the British Open, the U.S. Open and the U.S. Amateur in the same year. SAY: What does Jones mean when he says golf “is played on a five inch course—the distance between your ears”?

- **Review Vocabulary:** Spelling Bee! Have students quiz each other on the correct spelling of the vocabulary words.

- **Open The STEM ZONE** student supplement, pp. 14-15

- **Breaking on the Green:** ASK: What is the objective when the golfer gets on the green? (A: hit the ball into the hole) What was the objective prior to getting on the green? (A: hit the ball for speed and distance to get to the green) What are two effects of gravity on the ball as it travels towards the hole? (A: pulls ball down and makes it break towards the hole)

- **Scientist’s Notebook:** Crossword Puzzle: Work with a partner to solve the puzzle. Make a Dictionary: Put the puzzle words in alphabetical order and writing a brief definition. Illustrate.

- **Career Corner:** ASK: What precise words and phrases tell us how James Hubbell feels about his job? How do we know that James is well-rounded in his interests?

- **STEM Follow Up:** Write the letters S-T-E-M. Ask students to summarize the science, technology, engineering or math concepts in this part of the supplement. (S = slope, gravity, force; T = improving golf balls and clubs; E = putting balls with different amounts of force and direction; M = formula to measure force)

**OBJECTIVES**

Students will:
- Read informational text
- Respond to questions with evidence
- Understand the effect of gravity and slope on a breaking ball
- Conduct a simple experiment
- Use scale

**VOCABULARY**

- **slope** – *n.* (Old English *aslopen* to move away) slant or curve
- **gravity** – *n.* (Latin *gravitate* weight, heaviness) the force by which objects tend to fall toward the center of the earth
- **monitor** – *v.* (Latin *monēre* to remind, advise, warn) oversee or regulate
- **spatially** – *adv.* (Latin *spatium* space) having to do with space

**USE THE NEWSPAPER!**

- **Distribute today’s newspaper**—one per team and the Lesson 7 Worksheet.

- **Do It Yourself:** SAY: STEM workers know it is not always possible to draw on paper the actual size of real-life objects such as the machines used at the USGA Test Center. Scientists use scale drawings to represent the size of larger objects. Today’s activity helps you understand the concept of scale. First, find a small photo or ad in the news. Glue it in the blank space. Next, use a pen and ruler to draw evenly spaced 1 cm x 1 cm lines over the entire photo. Now reproduce what is in each square centimeter in the larger boxes on the second worksheet.
EXTENSIONS

1. **Invent It!** The USGA Test Center has no machine to measure “breaking on the green.” You have been asked to create one. Design your machine and write a descriptive paragraph telling how it works.

2. **Golf Comics:** No comic strip about golf? Create one with your own characters, setting and dialogue!

3. **Look it Up:** Use the Internet and write a one-page research paper on one of the following topics: Bob Jones, the British Amateur, the British Open, the U.S. Open, the U.S. Amateur, the USGA Test Center, Sir Isaac Newton or mechanical engineering.

4. **Design a Course:** Engineers, technicians, mathematicians and scientists combine skills to be even more creative! Imagine you’ve been asked to join the team and design your own 9-hole golf course with bunkers (“sand traps”), holes that curve (“dog legs”), trees, slopes and water hazards. Use a piece of graph paper divided into 1 inch x 1 inch squares to lay out your design, labeling holes 1 to 9. If each 1 inch square = 100 yards, estimate the length of each hole. Create a brochure advertising your golf club and its unique layout.
STEM workers know it is not always possible to draw on paper the actual size of real-life objects such as the machines used at the USGA Test Center. Scientists use scale drawings to represent the size of larger objects.

Step 1: Select a small photo or ad from the newspaper. Glue it here. Draw evenly spaced vertical and horizontal lines (1 cm x 1 cm) over the entire photo.
Step 2: Scale up the photo using the grid lines below matching exactly what you see in the smaller grid lines on your photograph.
Across
4. a weight hung from a point so it can swing freely
6. oversee or regulate
8. a person who designs, constructs and uses engines
9. capable of being, energy stored
12. any force that slows motion or drags
19. a set of tools, devices or materials
20. a theory or idea to guide an investigation
21. relating to generating heat caused by raising temperature
22. related to motion or movement
24. the force by which objects fall toward the center of the earth

Down
1. a slanted club, when hitting a ball accurately, will generate this
2. a slanted club will lift the ball upward
3. to introduce something new
5. the volume of liquid pushed out of the way by an object that takes its place
7. slant or curve
10. a force that raises
11. measurement in length, width and/or thickness
13. the way air moves around objects
14. surface resistance when one object moves against another
15. a force that moves an object forward
16. relating to, or having the character of space
17. the region of slow-moving fluid immediately behind an object, caused by the faster flow around it
18. the distance or border around an object
23. a test to provide evidence for or against a hypothesis
25. the amount of space an object occupies