



# The College Football Hall of Fame Teacher's Playbook for High School Grades 9 – 12

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The College Football Hall of Fame: [www.cfbhall.com](http://www.cfbhall.com)

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# Welcome to the College Football Hall of Fame!

Game on! Your class has earned a coveted, all-access pass to the hallowed halls of college of football. On your class tour through the College Football Hall of Fame, you and your students will experience the science, history, rivalries, and pageantry that have made college football one of the most beloved sports in America.

The College Football Hall of Fame is a highly-immersive and engaging experience that blends historic college football artifacts with state-of-the-art, interactive, multimedia college football exhibits. Most recently located in South Bend, Indiana, The National Football Foundation (NFF) voted to relocate the Hall of Fame to downtown Atlanta in 2009, with the attraction opening in 2014. The Hall is located adjacent to the Georgia World Conference Center (GWCC), one of the largest convention facilities in the country. It is also just steps from Centennial Olympic Park, the World of Coca-Cola, the Georgia Aquarium, CNN Center, the Imagine It! Children's Museum, and the Center for Civil and Human Rights.

The National Football Foundation launched the College Football Hall of Fame in 1951 to stand as one of the nation's premier sports shrines, immortalizing the game's greatest players and coaches as positive role models for future generations. The Hall of Fame represents the

highest level of achievement for players and coaches and serves as a tribute to all of amateur football.

The National Football Foundation itself was founded in 1947 with early leadership from General Douglas MacArthur, legendary Army football coach Earl "Red" Blaik, and revered sports journalist Grantland Rice. It is a not-for-profit, educational organization with programs that use the power of amateur football to develop scholarship, citizenship, and athletic achievement in young people.

Through exhibits, programs, and special events, the Hall of Fame will provide your students with a vivid look into the rich tradition and excitement of college football. You will find that you can use the topic of sports, along with the interactive experiences at the Hall of Fame itself, to connect the educational themes of the exhibition to your national and local STEAM curricula and content requirements. This Teacher's Guide features a curriculum designed to offer a memorable learning experience that is interdisciplinary and applicable across several grade levels and areas of study. You are sure to score points with your students throughout the school year. Now let's blow the whistle and start the game!

## During Your Field Trip

This section of the Teacher’s Guide provides a brief overview of what your students will see and do during your field trip. As you kick off your class visit to the College Football Hall of Fame, the first thing you and your students will notice is a towering wall holding over 765 helmets, one from every college that has a football team. With each team averaging 90 players, these helmets represent almost 70,000 scholar-athletes! The excitement and adventure of a college football game day fills the air as your students make their way through the *Quad* and upstairs to *Why We Love College Football*. Here, they will find the annual awards honoring the most accomplished teams, players, and coaches in college football. These trophies include the Heisman Trophy for the most outstanding college player and the National Championship Trophy for the number one team at the end of each season.

Along with the trophies, a giant interactive wall will feature photos and videos of players, fans, cheerleaders, marching bands, college campuses, and stadiums where students will want to explore the themes and experiences yet to come at the College Football Hall of Fame. Follow the interactive wall to the *Game Day Theater* where the film, “The Game of Your Life,” is a one-of-a-kind look at the ultimate college football experience as told through the eyes of those who live it every season—the players, coaches, fans, media, cheerleaders, and bands. Get in the spirit!

Some of college football’s most compelling and colorful activities take place in the stands and outside the stadiums. Fans cheer, chant, chat, and chew their way to making their campus the only place to be on Saturdays in the Fall. The history of these uniquely American traditions is explored next, in *Fans’ Game Day*. Tailgating from its earliest years to today shows how changes in technology and society go hand-in-hand, from horse-drawn wagons in the late

1800s to modern-day mobile satellite TV systems and Game Day recycling challenges. Many of the interesting artifacts featured here reveal a unique connection between college football and Coca-Cola (another Atlanta institution). How refreshing!

Students should look carefully for some of the most beloved football traditions in history, such as the hound’s-tooth fedora worn by legendary Alabama coach Paul “Bear” Bryant. Keep an eye out for authentic marching band, cheerleading, and mascot uniforms that showcase the colors and creativity unique to each school. You won’t want to miss the interactives in *Fans’ Game Day* including a “Face Painting Station” to celebrate your team colors and “Fight Song Karaoke” to show your school spirit through music—educational and entertaining, just like the sport itself.

Your students may even have a chance to sit behind the ESPN GameDay Desk and play the role of an on-camera sports broadcaster predicting the results of a game. Stop at the *Fans’ Game Day* interactive table to test your trivia knowledge, search for your favorite tailgate food, and create your own marching band routine and cheerleading performances. Can you locate your favorite?

The next gallery, *Building a Champion*, highlights those college football coaches who molded the game into what it is today and helped shape the characters of countless student-athletes. Artifacts and objects of great interest to your students include an interactive version of a 1920s playbook from John Heisman (Rice, Georgia Tech) and personal items from coaches Bobby Bowden (Florida), Hayden Fry (Iowa), Tubby Raymond (Delaware), and Woody Hayes (Ohio State). Interviews with individual college football players found at the “Meet the Players” interactive reveal how these young men manage to successfully balance academics with

conditioning and practice, down time, media attention, and a social life. That's quite a schedule considering that there are only 24 hours in each day!

Football is more than just a game for players and coaches. It also relies on experts—men and women—who can provide advice on physical training, adequate nutrition, and mental preparation. And let's not forget the scientists and engineers! The significance of technology is at the forefront of the "Evolution of Equipment" section of *Building a Champion*. You can compare and contrast the kinds of gear, uniforms, and protection that have been used in well over a century of college football. Here, you will also find the "Touchdown Timeline," a copy of which is included in the Appendix to this Teacher's Guide. At the College Football Hall of Fame, this timeline is augmented with rare historic treasures such as the Yale-Eaton game program from 1873 and the first penalty flag, thrown at Youngstown State in 1941. So much to learn and see!

Every week, from coast to coast, great rivalries and matchups are staged in hallowed cathedrals before millions of loud and loyal fans. The next gallery, *Game Time*, brings it all to life—the greatest sights, sounds, stadiums, and singular moments from over a century of college football. "Rivalry Row" conveys the range of emotions, from agony to ecstasy, elicited by annual games between rivals. Did you know that the Yale-Harvard rivalry became so heated by the 1890s that Harvard President Charles Eliot called for a ban on football altogether? Scenes from these annual competitions are presented in the "ESPN Annual Theater," with a highlight reel that will either preview the upcoming season or review the previous season.

Your class will get really close to the action at the interactive stations in *Game Time*. There is an opportunity for some individual students to record their own play-by-play calls of some of college football's memorable moments from 1972 to today or to use cutting edge virtual video

technology to place themselves on the field at one of college football's iconic stadiums. The culmination of everything your students have learned thus far at the College Football Hall of Fame can be put to the test with an opportunity to take on the role of a Head Coach building his or her college football program from the ground up in the "Getting to the Championship" interactive station. Another feature found here that put you in the middle of it all is "Anatomy of a Play." This video breaks down all that happens between the end of a play, through the huddle, snap, and execution of the next play, as told by first-hand accounts from players and coaches.

Before leaving this level of the College Football Hall of Fame, you will pass a gallery that hosts a variety of related educational exhibitions on a rotating basis. Keep checking back to see what comes next! In this area, you will also find some of the most treasured items in the Hall of Fame's collection as well as a "Greatest Moments" film. This film is a timeline of notable events from the history of college football.

Only the most outstanding performers on and off the field are even considered for membership in the College Football Hall of Fame, and even fewer are voted in. In the *Hall of Fame* gallery on the third floor, your students can find Hall of Famers on glass panels on the perimeter and interact with stations to access information, images and videos about every inductee, many of whom are highlighted in the lesson plans and activities in this Teacher's Guide.

Your field trip continues in *Building Leaders*, which introduces your students to the achievements made by players after their college football careers. The vast majority of these men go on to pursue careers and occupations off the gridiron. The National Football Foundation's (NFF) highest honors are reserved for these remarkable people who have made contributions in many facets of their lives, whether they spend most of their time in a locker room or a classroom or a board room. Interactive stations focus on the themes of

“Character,” “Teamwork,” “Excellence,” and “Dedication.”

As the time clock winds down, the field trip ends for your students the same way most college

football games begin for its players, by walking through the *Touchstone Tunnel* and onto the field. It’s a moment that will stay with your students long after the final whistle blows.

## Using This Teacher’s Playbook

As a companion to your experience at the College Football Hall of Fame, this comprehensive Teacher’s Guide for High School has been created to complement your classroom instruction and make the most of your school field trip. This Teacher’s Guide contains original, assessable, STEAM-related classroom lesson plans with additional inquiry-based interdisciplinary activities and project ideas for you to use and share.

The Teacher’s Guide for High School contains dynamic activities and assignments for students in grades nine through twelve. There are also Teacher’s Guides for Elementary School and Middle School. Each of these Guides is created to be flexible; use them to best meet the needs and capabilities of your class. You know your students better than anyone else!

Following this Introduction, you will find a list of School Names and Nicknames that you and your students may encounter within this Teacher’s Guide, followed by an onsite activity that can be completed during your field trip to the College Football Hall of Fame. The list of school names also includes the states within which each school is located along with their team names based on their mascots. Use this information to assign a mapping activity, have your students create their own matching worksheet or play a round of GameDay Game Show. Your call, Coach!

The next section contains five Classroom Lesson Plans designed to correlate directly with your state curriculum standards. The lesson plans begin with the Teacher Instructions pages, which include the answer keys for those activities. At

the top of the Teacher instruction page, you will find the appropriate content areas and skills addressed by the activities in the lesson. Each lesson continues with complete, ready-to-copy, Student Activity worksheets that center on key topics featured in the exhibition. Depending on your schedule, these lesson plans can also be conveniently broken down and completed over a series of days.

In the first lesson plan, **The Round Football**, your students use the geometry of spheres and prolate spheroids to compare the surface areas and volumes of several common game balls. At the conclusion, they will calculate the specifications for a new game ball with the same volume and surface area of a football, except in the shape of a sphere.

The second lesson plan, **Breaking Barriers**, combines mathematics, statistics, US history, and college football in a unique way. Your students will use two data sets to assess the track record of college football in recognizing African American student athletes before, during, and after several key moments in the American Civil Rights Movement. Their objective will be to find out if the integration of college football reflected the pattern of segregation and integration that typified the United States in the early twentieth century.

For the third lesson, **Sustainable Stadiums**, your students begin by examining the scorecards for the first four college football stadiums to obtain Leadership in Energy and Environmental Design (LEED) certifications for the United States Green Building Council (USGBC). Your students will

compare and contrast the credits earned by these four LEED projects and look for the trends, challenges, and innovations involved in creating a sustainable stadium. The lesson concludes with a primary source analysis of an interview with the Sustainability Coordinator for the Georgia World Congress Center Authority, site of the College Football Hall of Fame.

The fourth lesson plan, **Technology Takes the Field**, reveals how technology and engineering originating with NASA, the US military, and Hollywood have made their way into college football. Your students will also investigate the feasibility of other up and coming inventions and innovations that may become a standard part of college football sooner rather than later.

The final lesson plan is **Football Family—A Logic Puzzle**. Your students will read a short story and use their critical reasoning skills to solve a logic puzzle that involves a debate amongst the four members of a family of dedicated college football fans. Your students will be making deductions and establishing equalities similar to those used in algebra, but without using numbers!

A field trip to the College Football Hall of Fame has connections to multiple content areas at the high school level. To round out your playbook, additional Interdisciplinary Activities and Inquiry-based Project Ideas follow the Classroom Lesson Plans and can be incorporated into a wide variety of departmental curricula, including Social Studies and English. The next section contains three Games and Puzzles related to the themes of college football and the College Football Hall of Fame. These are excellent activities for your bus ride to and from the Hall of Fame or to assign for extra credit PAT (“Points after Trip”) as you see fit.

Under Additional Resources, you will find a handy “Football 101” reference guide. Keep the guide within reach as you introduce your class to the basics of college football. Be prepared to tackle their questions about the field, the player

positions, the point system, and the College Football Hall of Fame itself. You may also find it helpful to copy “Football 101” and distribute it to your students for their own use. The second part of Additional Resources contains a “Recommended Reading” list. Before or after a class trip to the College Football Hall of Fame, you will want to use this list as a starting point to create your own “Literary Hall of Fame” exploring the science, math, history and fun of college football. This section also includes a copy of the “Touchdown Timeline” of American history and college football you will see displayed at the College Football Hall of Fame in *Building a Champion*.

We know how important it is to be able to justify field trips and document how instructional time is spent outside of your classroom. To that end, this Teacher’s Guide is directly correlated to the Common Core State Standards for Mathematics and English Language Arts along with the Next Generation Science Standards and the C3 Framework for Social Studies State Standards. In addition you will find specific state requirements for Alabama, Florida, Georgia, North Carolina, South Carolina, and Tennessee to assist with your planning needs. The correlations are organized by content and grade level. You can readily see how they fit into your required curriculum making it easier than ever to connect a field trip to the College Football Hall of Fame with your classroom instruction.

All of these education resources can be used before your visit to the Hall of Fame to help prepare students for the teachable moments found throughout the exhibition as well as when you return to school to further explore connections between the educational themes of the exhibition and your classroom STEAM instruction. We look forward to seeing you at the College Football Hall of Fame. Time for kick-off!

# College Names and Nicknames

This list contains the names and nicknames of the colleges and universities you may encounter in the College Football Hall of Fame Lesson Plans and Activities. The chart matches the official name of the school with its nicknames. You will see a few schools that are referred to by multiple names! The state in which the school is located is also included as well as the team names based on their mascots.

Official name	Also known as	Team	State
Amherst College	Amherst	Lord Jeffs	MA
Arizona State University	Arizona State, ASU	Sun Devils	AZ
Brown University	Brown	Bears	RI
Carlisle Indian Industrial School <sup>1</sup>	Carlisle	Indians <sup>1</sup>	PA
Clemson University	Clemson	Tigers	SC
Cornell University	Cornell	Big Red	NY
Drake University	Drake	Bulldogs	IA
Florida Agricultural & Mechanical University	Florida A&M, FAMU	Rattlers	FL
Florida State University	Florida State, FSU	Seminoles	FL
Georgia Institute of Technology	Georgia Tech	Yellow Jackets	GA
Grambling State University	Grambling, Grambling State	Tigers	LA
Harvard University	Harvard	Crimson	MA
Indiana University	Indiana, IU	Hoosiers	IN
Johns Hopkins University	Johns Hopkins	Blue Jays	MD
Kentucky State University	Kentucky State	Thorbreds	KY
Lincoln University	Lincoln (MO)	Blue Tigers	MO
Linfield College	Linfield	Wildcats	OR
Louisiana State University and Agricultural and Mechanical College	Louisiana State University, LSU	Tigers	LA
Marshall University	Marshall	Thundering Herd	WV
Michigan State University	Michigan State, MSU	Spartans	MI
North Carolina State University	NC State	Wolfpack	NC
Northwestern University	Northwestern, NU	Wildcats	IL
Ohio State University	Ohio State, OSU	Buckeyes	OH
Rutgers, The State University of New Jersey	Rutgers, Rutgers University, RU	Scarlet Knights	NJ
Springfield College	Springfield	Pride	MA
Stanford University	Stanford, Leland Stanford Junior University, The Farm	Cardinal	CA
Syracuse University	Syracuse, SU	Orange	NY
Temple University	Temple, TU	Owls	PA
Texas Christian University	TCU	Horned Frogs	TX
Tuskegee University	Tuskegee	Golden Tigers	AL

University at Buffalo	Buffalo	Bulls	NY
University of Alabama	Alabama, Bama	Crimson Tide	AL
University of California	Berkley, California, Cal	Golden Bears	CA
University of California, Los Angeles	UCLA	Bruins	CA
University of Chicago	Chicago	Maroons	IL
University of Colorado	Colorado, CU	Buffaloes	CO
University of Georgia	Georgia, UGA	Bulldogs	GA
University of Illinois	Illinois	Fighting Illini	IL
University of Iowa	Iowa	Hawkeyes	IA
University of Maryland Eastern Shore <sup>2</sup>	Maryland Eastern Shore, UMES	Hawks <sup>2</sup>	MD
University of Minnesota	Minnesota	Golden Gophers	MN
University of Mississippi	Ole Miss, Mississippi	Rebels	MS
University of North Texas	North Texas, UNT	Mean Green	TX
University of Oregon	Oregon	Ducks	OR
University of Pittsburgh	Pittsburgh, Pitt	Panthers	PA
University of Richmond	Richmond	Spiders	VA
University of San Francisco <sup>3</sup>	San Francisco, USF	Dons <sup>3</sup>	CA
University of Southern California	USC, Southern Cal	Trojans	CA
University of Tennessee	Tennessee, UT	Volunteers	TN
University of the Pacific <sup>4</sup>	Pacific	Tigers <sup>4</sup>	CA
University of Wisconsin	Wisconsin	Badgers	WI
Utah State University	Utah State, USU	Aggies	UT
Virginia Polytechnic Institute and State University	Virginia Tech	Hokies	VA
Wake Forest University	Wake Forest	Demon Deacons	NC
Westminster College	Westminster (PA)	Titans	PA
Wichita State University <sup>5</sup>	Wichita State	Shockers <sup>5</sup>	KS
Willamette University	Willamette	Bearcats	OR
Yale University	Yale	Bulldogs	CT

<sup>1</sup>The Carlisle Indian Industrial School closed in 1918.

<sup>2</sup>The University of Maryland Eastern Shore's football program ended in 1979.

<sup>3</sup>The University of San Francisco's football program ended in 1952.

<sup>4</sup>The Pacific Tigers' football program ended in 1995.

<sup>5</sup>The Wichita State Shockers' football program ended in 1986.

# First Down! A Student Field Trip Activity

## Teacher Instructions

This activity is for your students to complete during their field trip to the College Football Hall of Fame. The galleries inside the Hall of Fame are highly immersive and interactive. Your class will have a true fan experience with audio features, videos, games, and touchscreen interactives. This Field Trip Activity will help your students make the most of their time at the Hall of Fame, while highlighting some of the content they might not otherwise see or read.

In each gallery, your students will be able to direct their own learning by choosing questions about the topics and people that interest them most. Each list of questions comes with directions indicating how many need to be answered from that group. By the end of the field trip, your students will have answered a total of 20 questions. However, you can assign the number of questions that best fits the skill level and interests of your students. The five

galleries with questions on this Field Trip Activity are: *Why We Love College Football*, *Fan's Game Day*, *Building a Champion*, *Game Time*, *Hall of Fame*, and *Building Leaders*. Hall of Fame Fan Ambassadors will greet your group upon arrival and provide directions as to how and where your experience will begin.

During your preparations for the field trip, advise your students to read through the questions carefully ahead of time so they will know what to look for once they are inside the galleries. Upon returning to school after the field trip, have students share and compare their answers to the questions they chose. By working in groups or as a whole class, try to complete all of the questions from the Field Trip Activity. The Answer Key below gives specific answers where appropriate and provides the locations where the answers will be found within the galleries for those questions with answers that can vary.

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## Answer Keys

### *Why We Love College Football*

1. 25 lbs; Frank Eliscu
2. Coach of the year/most outstanding head football coach
3. Choices include national championships for Division I, II, and III, or FCS and NAIA; bowl games such as the Orange, Fiesta, Cotton, or Sugar; or the Heisman
4. The "Welcome to the Champions Archive" touchscreens are located in front of the trophy case. The menu allows students to navigate through national champions, bowl game winners, conference champions, and award recipients.

### *Fan's Game Day*

1. After WWII; gas was cheap and station wagons were popular
2. Yale's bulldog, Handsome Dan; 1899
3. A gorilla, two cats, a bulldog and a carrier pigeon
4. As an attempt to keep female fans from leaving a game that they were losing badly, 1907
5. Students will be able to choose from a list of over 50 colleges and universities.
6. 8,000 pizzas and 65,000 bottles of water; approximately 1 pizza to 8 bottles of water (1:8.1)
7. The Leland Stanford Junior University Marching Band has been student-run since 1963.

### ***Building a Champion***

1. Choices: Frank Beamer, Murray State, Virginia Tech, Special Teams; Glenn “Pop” Warner, Georgia, Cornell, Carlisle, Pittsburgh, Stanford, Temple, Single Wing; Bud Wilkinson, Oklahoma, 5-2-4 Defense; Clark Shaughnessy, Tulane, Loyola (LA), Chicago, Stanford, Maryland, Pittsburgh, Hawaii, T-formation; Jerry Claiborne, Virginia Tech, Maryland, Kentucky, Wide Tackle Six; Emory Bellard, Texas A&M, Mississippi State, Wishbone; Joe Gilliam, Sr., Kentucky State, Tennessee State, Nickel Defense and Bump & Run; Chris Ault, Nevada, Pistol Offense; George Perles, Michigan State, Stunt 4-3 Defense
2. It represents key components in Penn State’s drive for team unity, as well as a way to honor the program’s rich tradition.
3. Choices: Peyton Manning, LeBron James, Danny Wuerffel, Orlando Pace, Jonathan Ogden, Tony Gonzalez, Hines Ward, Eric Crouch
4. USAF: “Aim High...Fly! Win! Fight!” Army: “Duty, Honor, Country.” Navy: “Honor, Courage, Commitment.”
5. He incorporated yoga and karate into LSU player workouts to maximize the ability to focus for long periods of time. And he makes sure workouts are as much fun as possible.
6. She has a master’s degree in Exercise Science.
7. He earned a master's degree in special education from Utah and a doctorate in educational psychology from BYU.
8. He spent a decade helping Olympic athletes and Navy Seals deal with the psychological demands of their endeavors. He earned his bachelor's degree in pre-physical therapy at Eastern Washington, his master's in education from Sul Ross State (Texas), and his doctorate in psychology from Washington State.
9. His father’s
10. Choices: Ed Travis/Missouri from 1920; Dave Shreiner/Wisconsin from 1942; Don McPherson/Syracuse from 1987; University of Maryland from 2014
11. Tiny sensors in the mouthpieces
12. He was the first African American player to win the Heisman.
13. Marino Casem. Answers will vary but should address how racial prejudice, discrimination, and segregation limited their opportunities for many years.

### ***Game Time***

1. Too much violence; the rivalry with Yale was too intense
2. Kansas vs. Missouri
3. Wide receiver, right guard, left guard, running back, or tight end
4. He was one of the first players to ever wear a face mask.
5. It was freezing cold and he was sick.

### ***Hall of Fame***

1. Inductees are listed by year on the panels along the walls.
2. The “Legends of College Football” interactive touch screens are located in the center of the gallery. Students can select from a large number of Hall of Fame players and coaches.

### ***Building Leaders***

1. 60%
2. The nation’s top scholar-athlete
3. General Douglas MacArthur. He commanded Allied troops in the Pacific in World War II and was an early leader the National Football Foundation.

4. The four themes are Character, Dedication, Teamwork, and Excellence. (The stations are located along the wall opposite the glass windows overlooking the field.)

**Mathematics**

*Volume & surface area of an ellipsoid,  
Spheres & prolate spheroids, Ratios, Unit conversion*

## Lesson 1: The Round Football

### *Teacher Instruction Page*

What would it be like to play football with a round ball? Would it be like using a soccer ball? Would it resemble the game in its early years? Would it be like playing with the footballs that are part of the “Evolution of Equipment” in *Building a Champion* at the College Football Hall of Fame? And why isn’t a football round, anyway? The answers to all of these questions are found at the intersection of history, mathematics, and the competitive spirit.

Throughout history, football-type games have used many different kinds of balls. Some were leather balls stuffed with rags and some used an inflated pig bladder. The first college football used in 1869 was a round rubber ball. In the mid 1870’s the ball then began to become more egg shaped and varied in size from ball to ball. After the 1905 season new rules were implemented to make the game safer. One such rule change was the adoption of the forward pass.

Football shaped like a prolate spheroid gained ground quickly when players and coaches soon realized that a ball in that shape could be thrown farther than one shaped like a sphere, even if they were of a similar size and weight. In 1912, new rules called for a prolate spheroid ball that was slightly larger than today’s version. The rules changed again in 1935 and, since that time, the American football has been approximately the same size.

At the College Football Hall of Fame, you will see a variety of football shapes and sizes from the past on display in “Evolution of Equipment,” including one from 1873. Another comes from a

game played on November 6, 1918, between Wisconsin and Minnesota. Look closely at the rounded edges of these early balls, most notably on the one used in a 1919 game between Wake Forest and NC State. Compare them to the modern footballs we used at every college football game today.

In Part 1, your students will calculate the surface areas and volumes for six commonly-used game balls. Three of these games use spheres: soccer, volleyball, and basketball. The other three are prolate spheroids: Australian football, rugby, and American football. Circumferences are given for the spheres, from which your students will determine the radii to calculate the surface areas and volumes. For each prolate spheroid ball, the length and short circumference are given. Half of the length is the semi-major axis. The radius found via the short circumference becomes the semi-minor axis. Remind students to pay attention to the units of measurements. Sports in the United States do not traditionally use the metric system and will need their inches converted to centimeters.

In Part 2, your students will analyze their results to compare and contrast the six balls. They will also look for correlations among surface area, volume, and shape. In Part 3, they will “engineer” a new game ball with the same volume and surface area of a football, except in the shape of a sphere, to predict what football might be like today if played with a round ball.

Several assumptions are made for the sake of the exercise. The dimensions given are for the balls

used at collegiate and professional levels. If a sport is played by both men and women, the men's has been used. Assume that the thickness of the materials used to make the air bladders and covers for all the balls is negligible. The measurements given for each ball are averages because the governing bodies of these sports consider a ball legal if it falls within a certain range. A football, for example, can have small variations caused by the temperature outside, its inflation levels, or the fact that each one is crafted by hand.

Your students' answers may vary slightly depending on the tools they use for their

calculations. For example, using 3.14 as the value of  $\pi$  is not exactly the same as using the full value of  $\pi$ . Deviations within one or two centimeters can still be considered correct answers.

If they are available, bring a sample of each ball to provide students with a visual reference. Check with your school's Physical Education department. You can extend the activity by having students make their own measurements of each ball at the beginning of the lesson. You may never look at a football the same again!

### Student Supplies

- Calculator
- Graph paper

## ANSWER KEY

### Part 1

1. (a) 10.98 cm (b) 1515.01 cm<sup>2</sup> (c) 5544.92 cm<sup>3</sup>
2. (a) 10.50 cm (b) 1385.44 cm<sup>2</sup> (c) 4850.45 cm<sup>3</sup>
3. (a) 12.13 cm (b) 1848.98 cm<sup>2</sup> (c) 7476.03 cm<sup>3</sup>
4. (a) 8.75 cm (b) 13.75 cm (c) 1344.25 cm<sup>2</sup> (d) 4409.68 cm<sup>3</sup>
5. (a) 9.55 cm (b) 14.5 cm (c) 1557.81 cm<sup>2</sup> (d) 5539.41 cm<sup>3</sup>
6. (a) 8.49 cm (b) 14.28 cm (c) 1337.53 cm<sup>2</sup> (d) 4311.54 cm<sup>3</sup>

### Part 2

1.

Ball	Volume	Ratio
a) American football	4311.54	1:1
b) Australian football	4409.68	1:1.02
c) Volleyball	4849.05	1:1.12
d) Rugby	5539.41	1:1.29
e) Soccer	5544.92	1:1.29
f) Basketball	7476.03	1:1.73

2.

Ball	Surface Area	Ratio
a) American football	1337.53	1:1
b) Australian football	1344.25	1:1.01
c) Volleyball	1385.44	1:1.04

d) Soccer	1515.01	1:1.13
e) Rugby	1557.81	1:1.16
f) Basketball	1848.98	1:1.38

3. (a) American football (b) prolate spheroid
4. (a) Basketball (b) sphere
5. Australian football
6. Rugby & soccer
7. Answers will vary. Students may suggest that it is just coincidence prolate spheroids seem to be smaller, that perhaps spheres are easier to make in a larger format, or that the rules of a particular game are more of a determining factor in the shape of the ball used.

### Part 3

1.  $C = 63.44$  cm,  $S = 1281.07$  cm<sup>2</sup>
2. less
3.  $C = 64.82$  cm,  $V = 4603.92$  cm<sup>3</sup>
4. more
5. Sphere is shorter & wider ( $C \approx 64$  cm,  $r \approx 10$  cm). Answers may vary, but may include: less throwing, harder to tuck under the arm, more predictable kicking, etc.

**The Extra Point:** soccer ball; football

## Supplies

- Calculator
  - Graph paper
- 

## Part 1: Calculations

Use these variables and formulas to calculate surface areas and volumes for the three spheres and three prolate spheroids.

### Variables

C = Circumference

D = Diameter

r = Radius

V = Volume

S = Surface area

x = Semi-minor axis

y = Semi-major axis

e = Eccentricity

### Formulas

$$C = \pi D$$

$$D = 2r$$

$$S_{\text{sphere}} = 4\pi r^2$$

$$S_{\text{prolate}} = 2\pi x^2 \left( 1 + \frac{y}{xe} \sin^{-1} e \right) \text{ where } e^2 = 1 - \frac{x^2}{y^2}$$

$$V_{\text{sphere}} = \frac{4}{3}\pi r^3 \quad V_{\text{prolate}} = \frac{4}{3}\pi x^2 y$$

## Spheres

1. Soccer ball:  $C = 69 \text{ cm}$

a) Radius = \_\_\_\_\_

b) Surface area = \_\_\_\_\_

c) Volume = \_\_\_\_\_

2. Volleyball:  $C = 66 \text{ cm}$

a) Radius = \_\_\_\_\_

b) Surface area = \_\_\_\_\_

c) Volume = \_\_\_\_\_

3. Basketball:  $C = 30 \text{ in}$  ( $1 \text{ in} = 2.54 \text{ cm}$ )

a) Radius = \_\_\_\_\_

b) Surface area = \_\_\_\_\_

c) Volume = \_\_\_\_\_

Name \_\_\_\_\_

Class \_\_\_\_\_

Date \_\_\_\_\_

---

### Prolate Spheroids

4. Australian rules football: *short circumference = 55 cm, length = 27.50 cm*

- a) Semi-minor axis = \_\_\_\_\_ c) Surface area = \_\_\_\_\_  
b) Semi-major axis = \_\_\_\_\_ d) Volume = \_\_\_\_\_

5. Rugby union ball: *short circumference = 60 cm, length = 29 cm*

- a) Semi-minor axis = \_\_\_\_\_ c) Surface area = \_\_\_\_\_  
b) Semi-major axis = \_\_\_\_\_ d) Volume = \_\_\_\_\_

6. American football: *short circumference = 21 in, length = 11.25 in (1 in = 2.54 cm)*

- a) Semi-minor axis = \_\_\_\_\_ c) Surface area = \_\_\_\_\_  
b) Semi-major axis = \_\_\_\_\_ d) Volume = \_\_\_\_\_
- 

### **Part 2: Comparisons**

Use your answers from Part 1 to complete these charts and questions.

1. **Volume:** Rank the volumes from smallest (a) to largest (f). For the third column, create a ratio to compare the volume of the American football to the volume of each of the other game balls (for its row, the ratio will be 1:1).

Ball	Volume	Ratio
a)		
b)		
c)		
d)		
e)		
f)		

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

2. **Surface area:** Rank the surface areas from smallest (a) to largest (f). For the third column, create a ratio to compare the surface area of the American football to the surface area of each of the other game balls (for its row, the ratio will be 1:1).

Ball	Surface Area	Ratio
a)		
b)		
c)		
d)		
e)		
f)		

3. (a) Which of the six is the smallest, both in volume and surface area? (b) What is the shape of the two smallest?

\_\_\_\_\_

4. (a) Which is the largest, both in volume and surface area? (b) What is the shape of the two largest?

\_\_\_\_\_

5. Which ball is the most similar to the American football, both in size and shape?

\_\_\_\_\_

6. Which two balls appear to be very close in size, in spite of having different shapes?

\_\_\_\_\_

7. Do you think the shape of a ball is a determining factor in its size? Why or why not?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Part 3: Conjectures**

1. Calculate the circumference and surface area of a sphere with the same volume as the American football.

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2. To make a sphere ball with the same volume as an American football, would you need more or less leather to cover the outside of the ball than is currently used to make a football?

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3. Calculate the circumference and volume of a sphere with the same surface area as an American football.

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4. To make a sphere ball with the same surface area as the football, would it have greater or less volume than an actual football?

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5. What if footballs were round? Average the circumferences and radii you found in #1 and #3, above, for the dimensions of a new sphere football. On graph paper, plot both the actual prolate spheroid football, using the data in Part 1, and your new sphere football on the same graph. How do they compare? How do you think this new ball would change the game of football as we know it?

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Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

**The Extra Point**

According to mathematicians and scientists, which of the six balls might be more accurately called a...

...truncated icosahedron? \_\_\_\_\_

...vesica piscis rotated about its long axis? \_\_\_\_\_

**IT'S A FOOTBALL FACT!**

In addition to the footballs from games played over a century ago, you will see leather helmets that are over a hundred years old in the College Football Hall of Fame! Players first began wearing them in 1892, around the time the football itself had evolved into an egg-like shape.

## Lesson 2: Breaking Barriers

### *Teacher Instructions*

At the College Football Hall of Fame, you will notice the diversity of the accomplished players who have been honored by the National Football Federation. However, in the early and mid 20<sup>th</sup> century, the road to success was a long one for young African American athletes who wanted to play college football.

If they did not plan to attend an historically black colleges and university (HBCU), they had to be accepted at a predominantly-white institution. In some cases, several years passed between when African American students arrived on campus and when they first appeared on the playing field. For example, nine years went by between James Meredith's arrival at the University of Mississippi (Ole Miss) as their first African American student and when the school signed their first African American football player. Respect on the football field did, however, serve as a step towards the acceptance of African American students at some traditionally white schools.

It would be difficult to find the exact names and numbers of all of the college football players who were African American during the early and mid 20<sup>th</sup> century. However, we can look at two known, verifiable lists of African American college football players from the 1890s through the 1970s: (1) players from these decades who would be later inducted into the College Football Hall of Fame and (2) those named to the consensus All-American teams during that time. Consensus All-Americans are student athletes identified each year by the national media as the very best college football players in the country for their particular positions.

In this activity, your students will use these two sets of data to assess the track record of college football in recognizing these outstanding student athletes before, during, and after several key moments in the American Civil Rights Movement. Their objective is to find out if integration of college football reflected the pattern of segregation and integration that typified the United States in the early twentieth century.

The investigation begins in the 1890s when Amherst and Harvard student William Lewis became the first known African American college football player. The other end of the timeframe will be the 1970s when the University of Alabama, University of Georgia, Louisiana State, Clemson, and Ole Miss integrated their football teams. By the mid 1970s, all of the major college football programs were integrated.

They will first calculate the percentage of all College Football Hall of Fame members from the 1890s through the 1970s who were African American. Then they will find the percentage of consensus All American players in those same decades who were African American. By plotting both of these populations on the same graph, they will look for a pattern in African American participation in college football and place that trend within the timeline of the civil rights movement in the United States. Finally, they will compile a list of schools attended by these early players in order to see how the integration of college football aligned with the spread of integration, geographically.

## ANSWER KEY

### Part 1

#### College Football Hall of Fame Players

Decade	% African American
1. 1890s	2.22%
2. 1900s	2.38%
3. 1910s	3.45%
4. 1920s	2.04%
5. 1930s	2.54%
6. 1940s	3.45%
7. 1950s	13.08%
8. 1960s	24.79%
9. 1970s	44.35%

#### Consensus All-American Players

Decade	% African American
1. 1890s	1.49%
2. 1900s	0%
3. 1910s	2.25%
4. 1920s	0.98%
5. 1930s	0%
6. 1940s	1.09%
7. 1950s	9%
8. 1960s	20.00%
9. 1970s	42.29%

1. Although there is a cluster of plot points early on, there is a positive relationship between the two populations shown by the sloping line from the bottom left to the upper right. As African American representation increased in one, it also increased in the other.
2. They match, because when  $r = 1$ , it indicates a strong positive relationship.
3. Answers will vary, but should acknowledge that since the relationship between the two is so strong they are probably a valid representation of the population as a whole. If one set was notably different from the other, it would be difficult to know which one was more representative of all college football players.
4. (a) 1896, "separate but equal" schools were legal; (b) 1954, racial segregation in education was illegal; (c) 1957, President Eisenhower sent federal troops to protect nine students integrating a high school in Arkansas; (d) 1961, first African-American student admitted to the University of Mississippi, which was segregated at the time; (e) 1964, provided for the integration of schools and other public facilities
5. 1890s – 1940s
6. 1900s (2.38, 0) & 1930s (2.54, 0); there just weren't that many African American football players in general; it was going slowly because 30 years separate those decades but not much had changed in terms of the numbers of African American college football players
7. Yes, the ruling was made in 1954 and the participation rate increased significantly in the 1950s as compared to the previous 60 years.
8. 1961
9. 1960s and 1970s. Answers will vary but should include the Civil Rights Act being passed in 1964.

10. Answers will vary but should discuss how there was very little change in the participation rate of African American student athletes until it increased dramatically in the 1950s and 1960s, which were the decades with key moments in the civil rights movement. By the 1970s, African Americans made up over 40% of the total populations used in this analysis.

## Part 2

Player	School	State	Last Year
Lewis, William	Amherst & Harvard	MA	1893
Marshall, Bobby	Minnesota	MN	1906
Pollard, Fritz	Brown	RI	1916
Robeson, Paul	Rutgers	NJ	1918
Gordon, Walter	California	CA	1918
Slater, Duke	Iowa	IA	1921
Stevenson, Ben*	Tuskegee	AL	1930
Kendall, Joe*	Kentucky State	KY	1936
Holland, Brud	Cornell	NY	1938
Washington, Kenny	UCLA	CA	1939
Willis, Bill	Ohio State	OH	1944
Young, Buddy	Illinois	IL	1946
Taliaferro, George	Indiana	IN	1948
Younger, Tank*	Grambling State	LA	1948
Bright, Johnny	Drake	IA	1951
Coleman, Don	Michigan State	MI	1951
Matson, Ollie	San Francisco	CA	1951
Lewis, Leo*	Lincoln (MO)	MO	1954
Caroline, J.C.	Illinois	IL	1954
Jones, Calvin	Iowa	IA	1955
Davis, Harold	Westminster (PA)	PA	1956
Galimore, Willie*	Florida A&M	FL	1956
Brown, Jim	Syracuse	NY	1956
Parker, Jim	Ohio State	OH	1956
Thomas, Aurelius	Ohio State	OH	1957
Wooten, John	Colorado	CO	1958
Brown, Roger*	Maryland Eastern Shore	MD	1959
Burton, Ron	Northwestern	IL	1959

1. Iowa, Ohio State, Illinois, California; 3 of the 4 are considered midwest or north
2. south
3. west. Answers will vary but should discuss that those schools were much farther away from the other schools, and transportation wasn't as easy back then.
4. Very similar pathway, geographically, in terms of how they moved across the US
5. They all follow the same track of starting in the north and northeast, heading to the midwest, and jumping over to the west coast before taking hold in the south.

# Breaking Barriers

## *Student Activity*

At the College Football Hall of Fame, you will notice the diversity of the accomplished players who have been honored by the National Football Federation. However, in the early and mid 20<sup>th</sup> century, the road to success was a long one for young African American athletes who wanted to play college football.

If they did not plan to attend an historically black colleges or university (HBCU), they had to be accepted at a predominantly-white institution. In some cases, several years passed between when African American students arrived on campus and when they first appeared on the playing field. For example, nine years went by between James Meredith's arrival at the University of Mississippi (Ole Miss) as their first African American student and when the school signed their first African American football player. Respect on the football field did, however, serve as a step towards the acceptance of African American students at some traditionally white schools.

It would be difficult to find the exact names and numbers of all college football players who were African American during the early and mid 20<sup>th</sup> century. However, we can look at two known, verifiable lists of African American college football players from the 1890s through the 1970s: (1) players from these decades who would be later inducted into the College Football Hall of Fame and (2) those named to the consensus All-American teams in during that time. Consensus All-Americans are student athletes identified each year by the national media as the very best college football players in the country for their particular positions.

In this activity, you will use these two sets of data to assess the track record of college football in recognizing these outstanding student athletes before, during, and after several key moments in the American Civil Rights Movement. Your objective is to find out if integration of college football reflected the pattern of segregation and integration that typified the United States in the early twentieth century.

The investigation begins in the 1890s when Amherst and Harvard student William Lewis became the first known African American college football player. The other end of the timeframe will be the 1970s when the University of Alabama, University of Georgia, Louisiana State, Clemson, and Ole Miss integrated their football teams. By the mid 1970s, all of the major college football programs were integrated.

You will first calculate the percentage of all College Football Hall of Fame members from the 1890s through the 1970s who were African American. Then you will find the percentage of consensus All American players in those same decades who were African American. By plotting both of these populations on the same graph, you will look for a pattern in African American participation in college football and place that trend within the timeline of the civil rights movement in the United States. Finally, you will compile a list of schools attended by these early players in order to see how the integration of college football aligned with the spread of integration, geographically.

**Terms to Know:** *diversity, consensus, inducted, integration, media, verifiable*

Name \_\_\_\_\_

Class \_\_\_\_\_

Date \_\_\_\_\_

**Part 1**

Calculate the percentages for the last column in each chart and produce a bivariate data graph of your results. Ask your teacher whether you should plot your data using the graph provided below the charts or if you will enter it into an electronic spreadsheet program. Be sure to label the plot points with their decades in order to track changes over time.

**College Football Hall of Fame Players**

<b>Decade</b>	<b>African American Members</b>	<b>Total Members</b>	<b>% who were African American</b>
1. 1890s	1	45	
2. 1900s	1	42	
3. 1910s	3	78	
4. 1920s	2	98	
5. 1930s	3	118	
6. 1940s	4	116	
7. 1950s	14	107	
8. 1960s	29	117	
9. 1970s	51	115	

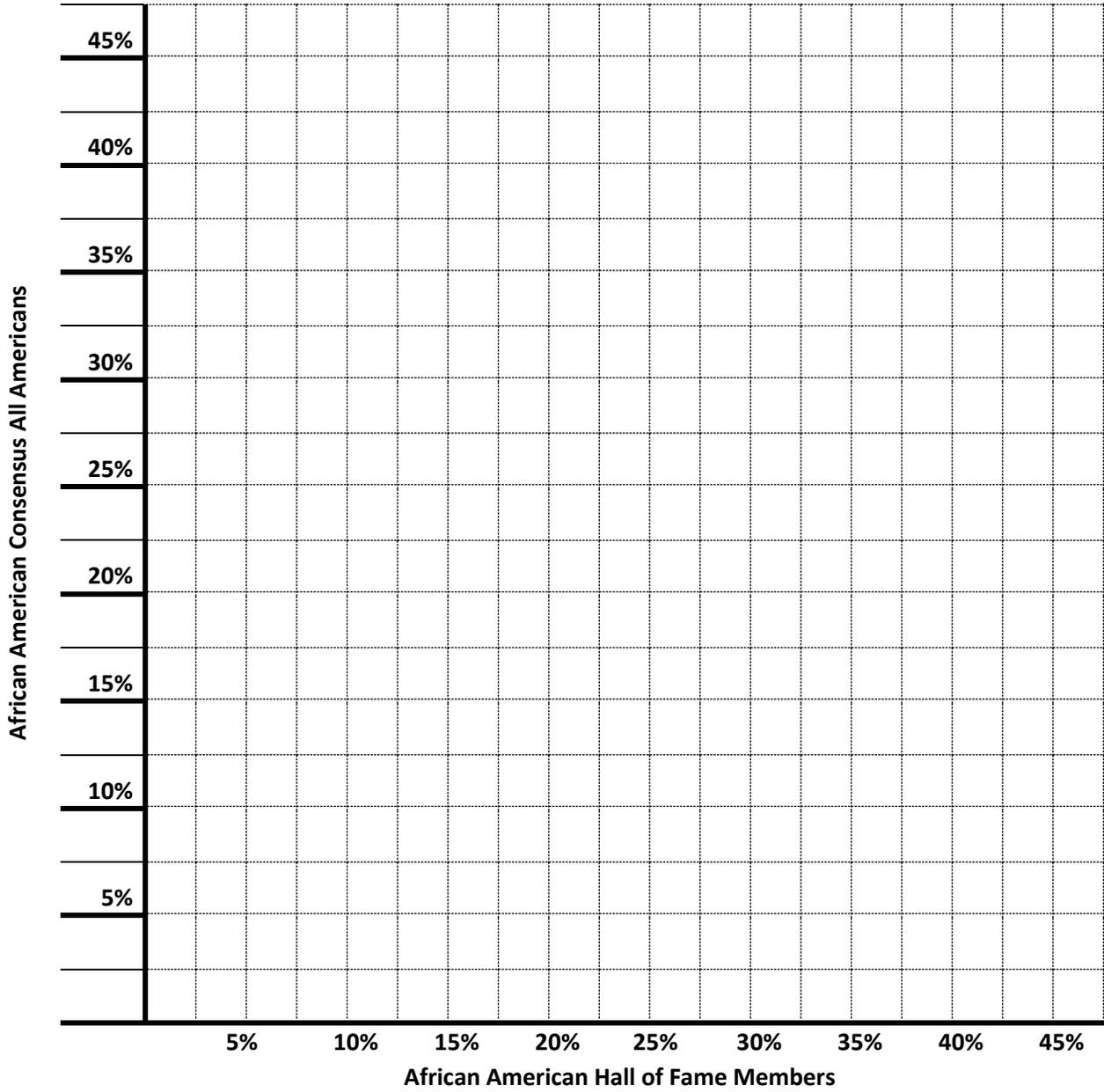
**Consensus All-American Players**

<b>Decade</b>	<b>African American Players</b>	<b>Total Players</b>	<b>% who were African American</b>
1. 1890s	1	67	
2. 1900s	0	87	
3. 1910s	2	89	
4. 1920s	1	102	
5. 1930s	0	102	
6. 1940s	1	92	
7. 1950s	9	100	
8. 1960s	30	150	
9. 1970s	82	194	

Name \_\_\_\_\_

Class \_\_\_\_\_

Date \_\_\_\_\_



Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

Now answer these questions based on the results of your graph in addition to pertinent information found in your US history book and through online research.

1. Describe the overall distribution of the graph and the correlation it reveals between the percentage of All American players who were African American and the percentage of Hall of Fame members who were African American.

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2. The correlation coefficient ( $r$ ) for the graph of these two data sets is 0.996. How does this compare with the results of your graph?

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3. Do you think this data is a reliable indicator for the overall participation rate of African American student athletes in college football within this timeframe? Why or why not?

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Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

4. Identify the dates for the following turning points in the American Civil Rights Movement and their significance to schools and education.

a) Plessy vs. Ferguson

\_\_\_\_\_

b) Brown vs. the Board of Education

\_\_\_\_\_

c) Little Rock Nine

\_\_\_\_\_

d) James Meredith attends Ole Miss

\_\_\_\_\_

e) The Civil Rights Act

\_\_\_\_\_

5. Which decades are grouped closely together on the graph?

\_\_\_\_\_

\_\_\_\_\_

6. Of the decades plotted closely together on the graph, which two are most similar? What conclusion can you draw about the overall numbers of African American students playing college football during those years? What does this indicate about the rate of integration in America at that time?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

7. Does the Supreme Court's ruling in Brown vs. Board of Education appear to have influenced the numbers of African American college football players at that time? How can you tell?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

8. Hall of Famer and All American Ernie Davis from Syracuse became the first African American to win the Heisman Trophy. During your field trip to the College Football Hall of Fame, look for a pin commemorating this important event in the "Touchdown Timeline." Davis won the Heisman in the same year James Meredith integrated Ole Miss. What year was it?

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9. Between which two decades do you see the greatest increase in African American college football players? To what do you think this growth can be attributed?

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10. Based on the results of your analysis with these population samples, explain how college football reflects some of the key education-related advances of the American Civil Rights Movement.

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**Part 2**

Identify the school, state, and last year played for the African American student athletes included in the chart below. They were among the leading college football players from the inception of the game up through the end of the 1950s, which was after the Brown vs. Board of Education ruling and before the Civil Rights Act of 1964.

The information you need to complete the chart is in the database of all members in the College Hall of Fame at [www.cfbhall.com](http://www.cfbhall.com). Search for the inductees by name to find the school they attended and the years they played college football. After you complete the chart, answer the following questions about the geographic trends in both college football and desegregation in the early twentieth century.

Name \_\_\_\_\_

Class \_\_\_\_\_

Date \_\_\_\_\_

<b>Player</b>	<b>School</b>	<b>State</b>	<b>Last Year</b>
Lewis, William			
Marshall, Bobby			
Pollard, Fritz			
Robeson, Paul			
Gordon, Walter			
Slater, Duke			
Stevenson, Ben*			
Kendall, Joe*			
Holland, Brud			
Washington, Kenny			
Willis, Bill			
Young, Buddy			
Taliaferro, George			
Younger, Tank*			
Bright, Johnny			
Coleman, Don			
Matson, Ollie			
Lewis, Leo*			
Caroline, J.C.			
Jones, Calvin			
Davis, Harold			
Galimore, Willie*			
Brown, Jim			
Parker, Jim			
Thomas, Aurelius			
Wooten, John			
Brown, Roger*			
Burton, Ron			

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

1. Which schools appear on this list more than once? In which geographical region of the United States are most of these states located?

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2. Players with an asterisk by their name went to an historically black college or university (HBCU). Founded to provide educational opportunities for the descendants of freed slaves, these institutions have produced some of the greatest players and most innovative coaches in college football. Hall of Fame coach Eddie Robinson, the son of a sharecropper, became head coach of Grambling State when he was only 22 years old, but he went on to win 408 games in 57 seasons. Coach Robinson did everything for his team from making sandwiches for bus rides to taping ankles. Based on the data in the chart, in what region of the United States were the HBCUs located?

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3. Which geographical region of the United States has the least number of schools on this list from the early years of college football? What reasons can you think of to explain this?

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4. The first game of college football was played in New Jersey in 1869. The game quickly spread to the surrounding states in the north and on the Atlantic coast before heading into the midwest and then appearing in the far west. Based on what you know about the history of the civil rights movement, how does the expansion of college football compare geographically with the expansion of integration?

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Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

5. Using data on the African American players from the 1890s through the 1950s listed in the chart above, how does the desegregation of college football compare geographically with both the spread of the game of football and the expansion of integration?

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**The Extra Point**

In addition to leveling the playing field for many African American students, college football provided opportunities for players from other ethnic backgrounds to participate in the sport in the 20<sup>th</sup> century. For example, Jim “Bright Path” Thorpe, who was Native American, joined the football team at the Carlisle Indian Industrial School (now closed) in 1907 and went on to be recognized as the greatest athlete of the 20<sup>th</sup> century. Now, the annual college football award for outstanding defensive back is named for Jim Thorpe. Hall of Famer Jim Plunkett, whose parents were Mexican-American, won the Heisman Trophy as Stanford’s quarterback in 1970. Hines Ward, a legend at the University of Georgia, was born in South Korea to a Korean mother and African American father.

Design and conduct an investigation to find out how participation by student athletes from Native American, Asian, and Latino backgrounds compares to the growth of their populations and acceptance in the United States during the first century of football. Report on any trends you find for each one and compare them to what you found for African American players.

What skills might these young men have learned while playing college football that could have helped them persevere in times of discrimination? Do you think identifying student athletes with their ethnicities when they are part of a minority group is still relevant or necessary today? Why or why not?

<p><b>IT’S A FOOTBALL FACT!</b> The University at Buffalo's football players voted unanimously to decline their first invitation to a bowl game in 1958 after learning that the two African-American students on their team would not be allowed on the field at the Tangerine Bowl in Orlando, Florida.</p>
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## Lesson 3: Sustainable Stadiums

### *Teacher Instructions*

The building that houses the College Football Hall of Fame was specifically constructed with the environment in mind. It was built to conserve energy and minimize water use. These efforts were recognized by the U.S. Green Building Council, or USGBC, which awarded the Hall of Fame a LEED certification upon its completion.

The USGBC uses rating systems for the design, construction, and operation of buildings in order to award LEED certifications, Leadership in Energy and Environmental Design. Certifications are given to different kinds of buildings that have been constructed in an environmentally responsible way. For example, there is a category of requirements just for school buildings, one for private homes, and yet another for healthcare facilities. Your students can see a list of all the projects at [www.usgbc.org/leed/rating-systems](http://www.usgbc.org/leed/rating-systems).

Buildings are awarded points based on how they meet specific requirements in areas such as Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, and Indoor Environmental Quality. The number of points, or credits, a project earns determines its level of LEED certification, starting with “Basic” certification and then moving up to “Silver,” “Gold,” and “Platinum” levels.

Due to their very purpose, football stadiums—high school, college, and professional—have particularly unique obstacles when it comes to meeting the requirements for LEED certification. For example, they are large, open spaces by design, which leaves little control over the temperature for both the teams on the field and the fans in the stands, especially if it is an

outdoor stadium. For those schools fortunate enough to have their games aired on television, the technicalities of broadcasting require very bright lighting that consumes a large amount of energy and can potentially cause light pollution nearby.

Even without obtaining a LEED certification, many universities and their stadiums are doing what they can to help the environment and increase their sustainability. Recycling stations and compostable and biodegradable packaging are becoming the norm on many game days in the stadiums. Even tailgating has gone green. Dozens of schools participate in the Environmental Protection Agency’s Game Day Challenge, which promotes waste reduction and recycling at college football games. In 2012, 5.4 million college football fans participated in the Game Day Challenge, and through recycling and composting, kept 1.09 million pounds of waste out of U.S. landfills.

This activity begins with the scorecards for the first four college football stadiums to obtain LEED certifications: [University of Minnesota](http://www.umn.edu), [University of North Texas](http://www.utdallas.edu), [University of Richmond](http://www.richmond.edu), and [Texas Christian University](http://www.tcu.edu). Your students will compare and contrast the credits earned by these four LEED projects to look for the trends, challenges, and innovations involved in creating a sustainable stadium. The scorecards are located at the end of the Student Activity pages. You may want to print copies of these scorecards for each student or show them on a screen in front of the class.

In Part 2, your students will analyze an interview with the Sustainability Coordinator for the Georgia World Congress Center Authority, site of

the College Football Hall of Fame. He answers questions about the challenges involved in making college football stadiums sustainable. Part 1 and Part 2 can easily be separated into lessons for two separate days, depending on your schedule.

Green is now the universal color of college football – no matter which team is your favorite!

## ANSWER KEY

### Part 1

School	University of Minnesota	University of North Texas	University of Richmond	Texas Christian University
<b>Sustainable Sites</b>	8/14	11/14	8/14	9/14
<b>Water Efficiency</b>	3/5	3/5	4/5	2/5
<b>Energy and Atmosphere</b>	4/17	15/17	3/17	4/17
<b>Materials and Resources</b>	6/13	7/13	6/13	6/13
<b>Indoor Environ. Quality</b>	7/15	12/15	11/15	10/15
<b>Innovation</b>	5/5	5/5	4/5	4/5
<b>Total Points</b>	33/69	53/69	36/39	35/69
<b>Certification Level</b>	Silver	Platinum	Silver	Silver
<b>Date Certified</b>	Sept 2009	Oct 2011	Oct 2011	Mar 2013

- University of Minnesota
- University of North Texas
- (a) University of North Texas, 78.6%, (b) University of Richmond, 80%, (c) University of North Texas, 88.2%, (d) University of North Texas, 53.9%, (e) University of North Texas, 80%, (f) University of Minnesota & University of North Texas, 100%
- (a) Energy & Atmosphere, 23.5%, (b) Materials & Resources, 53.9%, (c) Energy & Atmosphere, 17.7%, (d) Energy & Atmosphere, 23.5%
- SSc6.1 Storm water design—quantity control and SSc8 Light pollution reduction
- WEc2 Innovative wastewater techniques
- EAc5 Measurement and verification
- MRc1.1 Building reuse—maintain 75% of existing walls, floors and roof; MRc1.2 Building reuse—maintain 95% of existing walls, floors and roof; MRc1.3 Building reuse—maintain 50% of interior non-structural elements; MRc3.1 Materials reuse—5%; MRc3.2 Materials reuse—10%; MRc4.2 Recycled content—20% (post consumer + ½ pre-consumer); MR c6 Rapidly renewable materials
- EQc2 Increased ventilation; EQc5 Indoor chemical and pollutant source control; EQc6.2 Controllability of systems—thermal comfort
- For Energy and Atmosphere, UNT was the only one to earn the green power credit (EAc6) and they earned 9 out of 10 points for “optimize energy performance” (EAc1)

11. Answers will vary. May include Materials and Resources, because that had the most credits missed universally, or Energy and Atmosphere, because three of the four scored very low in that area

## Part 2

1. Tailgating is a favorite pastime of many football fans and traditionally that has taken place in the paved parking lots surrounding a football stadium.
2. Technologies and strategies are being used to avoid the need for traditional cement pavement
3. Earlier models of these fixtures were untested and many facility operators did not want to test their uncertainty.
4. Impact the environments of nocturnal creatures, disrupt nighttime visibility, and decrease night sky access.
5. (a) minimizing any unnecessary site lighting, providing shielding to lighting and by utilizing the best angles for the light fixture positioning
6. (a) better landscaping techniques, use of least toxic chemicals, use in targeted locations and only for targeted species, or use of locally adapted plants that need no fertilizer
7. (a) recycling bins available for fans and athletes to use
8. better signage or an educational course for the students identifying what is recyclable and how the process works
9. energy reducing projects with a quick payback
10. (a) Lighting. Switch to more efficient bulbs like light-emitting diodes (LEDs), compact fluorescent lights (CFLs) or lower-wattage alternatives to the existing fixtures.

# Sustainable Stadiums

## *Student Activity*

The building that houses the College Football Hall of Fame was specifically constructed with the environment in mind. It was built to conserve energy and minimize water use. These efforts were recognized by the U.S. Green Building Council, or USGBC, which awarded the Hall a LEED certification upon its completion.

The USGBC uses rating systems for the design, construction, and operation of buildings in order to award LEED certifications, Leadership in Energy and Environmental Design. Certifications are given to different kinds of buildings that have been constructed in an environmentally responsible way. For example, there is a category of requirements just for school buildings, one for private homes, and yet another for healthcare facilities. Your students can see a list of all the projects at [www.usgbc.org/leed/rating-systems](http://www.usgbc.org/leed/rating-systems). Buildings are awarded points based on how they meet specific requirements in areas such as Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, and Indoor Environmental Quality. The number of points, or credits, a project earns determines its level of LEED certification, starting with “Basic” certification and then moving up to “Silver,” “Gold,” and “Platinum” levels.

Due to their very purpose, football stadiums—high school, college, and professional—have particularly unique obstacles when it comes to meeting the requirements for LEED certification. For example, they are large, open spaces by design, which leaves little control over the temperature for both the teams on the field and the fans in the stands, especially if it is an outdoor stadium. For those schools fortunate enough to have their games aired on television, the technicalities of broadcasting require very bright lighting that consumes a large amount of

energy and can potentially cause light pollution nearby.

Even without obtaining a LEED certification, many universities and their stadiums are doing what they can to help the environment and increase their sustainability. Recycling stations and compostable and biodegradable packaging are becoming the norm on many game days in the stadiums. Even tailgating has gone green. Dozens of schools participate in the Environmental Protection Agency’s Game Day Challenge, which promotes waste reduction and recycling at college football games. In 2012, 5.4 million college football fans participated in the Game Day Challenge, and through recycling and composting, kept 1.09 million pounds of waste out of U.S. landfills.

This activity begins with the scorecards for the first four college football stadiums to obtain LEED certifications: University of Minnesota, University of North Texas, University of Richmond, and Texas Christian University (TCU). You will compare and contrast the credits earned by these four LEED projects to look for the trends, challenges, and innovations involved in creating a sustainable stadium. In Part 2, you will analyze an interview with the Sustainability Coordinator for the Georgia World Congress Center Authority, site of the College Football Hall of Game. He answers questions about the specific challenges involved with making college football stadiums sustainable.

Green is now the universal color of college football, no matter which team is your favorite!



Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

**Words to Know:** *certified, irrigation, landscaping, nocturnal, sustainable, turbine*

**Part 1**

Complete the chart below with data collected from the four LEED scorecards provided. The first row has been filled in for you. Then use this data to answer the questions that follow.

School	University of Minnesota	University of North Texas	University of Richmond	Texas Christian University
<b>Sustainable Sites</b>	<i>8/14</i>	<i>11/14</i>	<i>8/14</i>	<i>9/14</i>
<b>Water Efficiency</b>				
<b>Energy and Atmosphere</b>				
<b>Materials and Resources</b>				
<b>Indoor Environ. Quality</b>				
<b>Innovation</b>				
<b>Total Points</b>				
<b>Certification Level</b>				
<b>Date Certified</b>				

1. Which school's football stadium was the first to be LEED certified?

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2. Which school's football stadium was the first to be certified with a "Platinum" rating?

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Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

3. Which schools' football stadiums had the highest score in each of these categories below, and what percentage of the total possible points did they earn in each category?

a) Sustainable Sites \_\_\_\_\_

b) Water Efficiency \_\_\_\_\_

c) Energy and Atmosphere \_\_\_\_\_

d) Materials and Resources \_\_\_\_\_

e) Indoor Environmental Quality \_\_\_\_\_

f) Innovation \_\_\_\_\_

4. In which category did each of the school's football stadiums score the lowest, and what percentage of the total possible points did they earn in that category?

a) University of Minnesota \_\_\_\_\_

b) University of North Texas \_\_\_\_\_

c) University of Richmond \_\_\_\_\_

d) Texas Christian University \_\_\_\_\_

5. Which credit or credits for “Sustainable Sites” did all four universities fail to get?

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6. Which credit or credits for “Water Efficiency” did all four universities fail to get?

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Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

7. Which credit or credits for "Energy and Atmosphere" did all four universities fail to get?

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8. Which credit or credits for "Materials and Resources" did all four universities fail to get?

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9. Which credit or credits for "Indoor Environmental Quality" did all four universities fail to get?

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10. Of the four schools on this list, the University of North Texas was the only one to install their own source of renewable green energy right on their campus: three, power-generating, wind turbines. How is this effort reflected on their scorecard?

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11. Based on your comparison on this chart, which of the certification categories do you feel is most in need of future innovations, research, and development? Why?

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Name	Class	Date
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**Part 2**

In 2010, Tim Trefzer became the Sustainability Coordinator for the Georgia World Congress Center Authority, or GWCCA, a state-owned 200-acre campus in downtown Atlanta. This property includes the College Football Hall of Fame, the Georgia World Congress Center, the Georgia Dome and Centennial Olympic Park. Trefzer is responsible for improving the efficiency of internal operations as well as working with clients to elevate the sustainability of special events held at the GWCCA. Trefzer is a LEED Accredited Professional and a member of the USGBC–Georgia Chapter and the Green Meetings Industry Council. Prior to joining the GWCCA team, Trefzer was LEED project manager for Sustainable Options, an Atlanta-based green building consulting firm. He is a graduate of Florida State University, where his studies included real estate, property management, property development, construction, and green building, along with business administration.

The primary source that follows comes from an interview with Tim Trefzer about sustainable college football stadiums. Read the excerpt below and answer the questions that follow.

Question 1: A comparison of some of the first college football stadiums to achieve LEED certification shows that they were unable to get points for “Stormwater design—quantity control” and “Innovative wastewater techniques.” Why are these two credits particularly challenging?

*Answer: Tailgating is a favorite pastime of many football fans and traditionally that has taken place in the paved parking lots surrounding a football stadium. While newer technologies and strategies are being used to avoid the need for traditional cement*

*pavement, it still tends to be the most common reason that stormwater runoff remains an issue. While treating wastewater can be expensive if done on-site, low and no-flow water fixtures have more recently become a normalcy in buildings. Earlier models of these fixtures were untested and many facility operators did not want to test their uncertainty. Quickly, however, they have become reliable and are commonly found in stadia.*

Question 2: How can a football stadium address the issues of light pollution when they have to be lit brightly at night, especially for a television broadcast?

*Answer: Open stadia often deal with the unique and challenging issue of light pollution. Light pollution can impact the environments of nocturnal creatures, disrupt nighttime visibility, and decrease night sky access. By minimizing any unnecessary site lighting, providing shielding to lighting and by utilizing the best angles for the light fixture positioning, light pollution can be safely addressed without compromising safety.*

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

**Question 3:** What recommendations do you have for high school students who want to make their own school’s existing stadium more sustainable?

*Answer: Try to identify what is most important to your school, community, or region. Has drought been a common issue? Ask the grounds manager if he or she is monitoring the irrigation for leaks and if it is only being used when necessary. The usage of chemical fertilizers can also be minimized through better landscaping techniques and healthier alternatives. A few examples of healthier alternatives could be use of least toxic chemicals, use in targeted locations and only for targeted species, or use of locally adapted plants that need no fertilizer.*

*Are recycling bins available for fans and athletes to use? This is often the most visible way to show that your school is being proactive toward the environment. If there are already containers, are they effective? Perhaps better signage or an educational course for the students identifying what is recyclable and how the process works is in order.*

*Energy projects are often the most financially feasible, but not necessarily the most noticeable. Proposing energy reducing projects with a quick payback may be an opportunity to use the savings to fund other sustainability-related projects. Lighting usually has the best payback and is likely the largest electricity consumer in outdoor high school stadiums. Switch to more efficient bulbs like light-emitting diodes (LEDs), compact fluorescent lights (CFLs) or lower-wattage alternatives to the existing fixtures.*

**Answer the questions below with text from the interview with Tim Trefzer.**

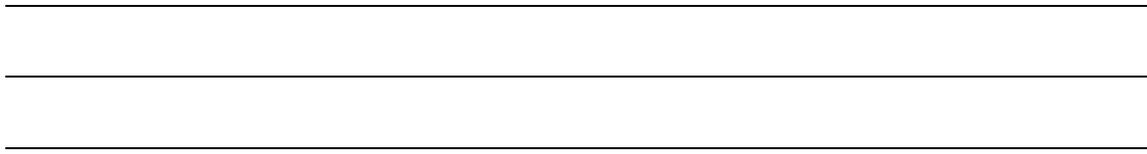
1. Why has controlling stormwater runoff (“Stormwater control—quantity”) been a challenge for football stadiums?

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2. What measures are being taken to reduce storm water runoff?



Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

3. Although they are much more common now, why were many stadium operators hesitant to try earlier models of low and no-flow water fixtures as innovative wastewater techniques?

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4. List three effects of light pollution from night time games at football stadiums.

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5. (a) List three steps that can be taken to reduce light pollution from college football stadiums without compromising safety at night. (b) Does your school use any of these methods? If so, which ones?

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6. (a) If your school's football field has natural grass for its turf, how can your school reduce the use of chemical fertilizers? (b) Does your school use any of these methods? If so, which ones?



Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

7. (a) What is the most visible way your school can show it is being proactive in protecting the environment? (b) Does your school have recycling bins at the athletic facilities and in the classrooms?

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8. What are two steps your school could take to increase recycling by fans and athletes at football games?

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9. What measures may provide your school with an opportunity to use financial savings to fund other sustainability-related projects?

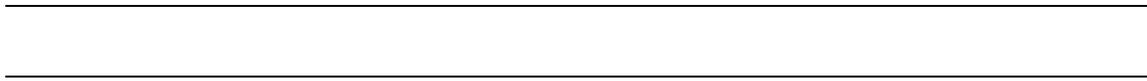
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10. (a) What is likely the largest electricity consumer in outdoor high school stadiums? What can be done to save both energy and money in this area? (b) Does your school use any of these methods? If so, which ones?

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Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

**The Extra Point**

The green building industry is a growing one! Not only are many schools filling their campuses with environmentally-friendly structures, they also offer classes and programs in sustainable construction and green architecture. Advances in technology make sustainability much more attainable.

Right here in Atlanta—the home of the College Football Hall of Fame—the Georgia Institute of Technology has made it a priority to have every student take at least one course in sustainability, regardless of his or her specific field of study. Research a college or university near where you live to see what kind of sustainability course work they offer. Can you earn a “green”-related degree at that school? If so, make a list of the classes required to obtain that degree.

**IT’S A FOOTBALL FACT!**

Although college football stadiums did not start using solar panels as a source of renewable energy as early as some professional football stadiums did, at the time the College Football Hall of Fame was constructed, 23 collegiate sports departments (eight athletics departments and 15 student recreation programs) already had installed onsite solar energy production systems.

UNIVERSITY OF MINNESOTA TCF BANK STADIUM <i>LEED for New Construction and Major Renovations (v2.2)</i>			University of Minnesota, Minneapolis MN <i>SILVER, Awarded September 2009</i>		
<b>SUSTAINABLE SITES</b>			<b>MATERIALS AND RESOURCES</b>		
<b>Awarded: 8/14</b>			<b>CONTINUED</b>		
SSc1	Site Selection	1/1	MRC2.2	Construction waste mgmt—divert 75% from disposal	1/1
SSc2	Development density and community connectivity	1/1	MRC3.1	Materials Reuse—5%	0/1
SSc3	Brownfield redevelopment	1/1	MRC3.2	Materials Reuse—10%	0/1
SSc4.1	Alternative transportation—public transportation access	1/1	MRC4.1	Recycled content—10% (post consumer + ½ pre-consumer)	2/1
SSc4.2	Alternative transportation—bicycle storage and changing rooms	1/1	MRC4.2	Recycled content—20% (post consumer + ½ pre-consumer)	0/1
SSc4.3	Alternative transportation—low-emitting and fuel efficient vehicles	0/1	MRC5.1	Regional materials—10% extracted, processed, and manufactured regionally	1/1
SSc4.4	Alternative transportation—parking capacity	1/1	MRC5.2	Regional materials—20% extracted, processed, and manufactured regionally	1/1
SSc5.1	Site development—protect or restore natural habitat	0/1	MRC6	Rapidly renewable materials	0/1
SSc5.2	Site development—maximize open space	0/1	MRC7	Certified wood	0/1
SSc6.1	Stormwater design—quantity control	0/1			
SSc6.2	Stormwater design—quality control	1/1			
SSc7.1	Heat island effect—non-roof	0/1			
SSc7.2	Heat island effect—roof	1/1			
			<b>INDOOR ENVIRONMENTAL QUALITY</b>		
			<b>Awarded: 7/15</b>		

SSc8	Light pollution reduction	0/1
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**WATER EFFICIENCY**

**Awarded: 3/5**

WEc1.1	Water efficient landscaping—reduce by 50%	1/1
WEc1.2	Water efficient landscaping—no potable water use or no irrigation	0/1
WEc2	Innovative wastewater technologies	0/1
WEc3.1	Water use reduction—20% reduction	1/1
WEc3.2	Water use reduction—30% reduction	1/1

**ENERGY AND ATMOSPHERE**

**Awarded: 4/17**

EAc1	Optimize energy performance	2/10
EAc2	On-site renewable energy	0/3
EAc3	Enhanced commissioning	1/1
EAc4	Enhanced refrigerant mgmt	1/1
EAc5	Measurement and verification	0/1
EAc6	Green power	0/1

**MATERIALS AND RESOURCES**

**Awarded: 6/13**

MRC1.1	Building reuse—maintain 75% of existing walls, floors and roof	0/1
MRC1.2	Building reuse—maintain 95% of existing walls, floors and roof	0/1
MRC1.3	Building reuse—maintain 50% of interior non-structural elements	0/1
MRC2.1	Construction waste mgmt-divert 50% from disposal	1/1

EQc1	Outdoor air delivery monitoring	0/1
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EQc2	Increased ventilation	0/1
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EQc3.1	Construction IAQ mgmt plan—during construction	1/1
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EQc3.2	Construction IAQ mgmt plan—before occupancy	1/1
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EQc4.1	Low-emitting materials—adhesives and sealants	1/1
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EQc4.2	Low-emitting materials—paints and coatings	1/1
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EQc4.3	Low-emitting materials—carpet systems	1/1
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EQc4.4	Low-emitting materials—composite wood and agrifiber products	0/1
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EQc5	Indoor chemical and pollutant source control	0/1
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EQc6.1	Controllability of systems—lighting	0/1
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EQc6.2	Controllability of systems—thermal comfort	0/1
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EQc7.1	Thermal comfort—design	1/1
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EQc7.2	Thermal comfort—verification	1/1
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EQc8.1	Daylight and views—daylight 75% of spaces	0/1
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EQc8.2	Daylight and views—views for 90% of spaces	0/1
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**INNOVATION**

**Awarded: 5/5**

IDc1	Innovation in design	4/4
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IDc2	LEED Accredited Professional	1/1
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**TOTAL**

**33/69**



**FIRST MARKET STADIUM (now ROBINS FOOTBALL STADIUM)**

LEED for New Construction and Major Renovations (v2.2)

University of Richmond, Richmond VA

SILVER, Awarded October 2011

<b>SUSTAINABLE SITES</b>		<b>Awarded: 8/14</b>
SSc1	Site Selection	1/1
SSc2	Development density and community connectivity	1/1
SSc3	Brownfield redevelopment	0/1
SSc4.1	Alternative transportation—public transportation access	1/1
SSc4.2	Alternative transportation—bicycle storage and changing rooms	0/1
SSc4.3	Alternative transportation—low-emitting and fuel efficient vehicles	1/1
SSc4.4	Alternative transportation—parking capacity	1/1
SSc5.1	Site development—protect or restore natural habitat	0/1
SSc5.2	Site development—maximize open space	1/1
SSc6.1	Stormwater design—quantity control	0/1
SSc6.2	Stormwater design—quality control	1/1
SSc7.1	Heat island effect—non-roof	0/1
SSc7.2	Heat island effect—roof	1/1
SSc8	Light pollution reduction	0/1

<b>WATER EFFICIENCY</b>		<b>Awarded: 4/5</b>
WEc1.1	Water efficient landscaping—reduce by 50%	1/1
WEc1.2	Water efficient landscaping—no potable water use or no irrigation	1/1
WEc2	Innovative wastewater technologies	0/1
WEc3.1	Water use reduction—20% reduction	1/1
WEc3.2	Water use reduction—30% reduction	1/1

<b>ENERGY AND ATMOSPHERE</b>		<b>Awarded: 3/17</b>
EAc1	Optimize energy performance	2/10
EAc2	On-site renewable energy	0/3
EAc3	Enhanced commissioning	1/1
EAc4	Enhanced refrigerant mgmt	0/1
EAc5	Measurement and verification	0/1
EAc6	Green power	0/1

<b>MATERIALS AND RESOURCES</b>		<b>Awarded: 6/13</b>
MRC1.1	Building reuse—maintain 75% of existing walls, floors and roof	0/1
MRC1.2	Building reuse—maintain 95% of existing walls, floors and roof	0/1
MRC1.3	Building reuse—maintain 50% of interior non-structural elements	0/1
MRC2.1	Construction waste mgmt-divert 50% from disposal	1/1

<b>MATERIALS AND RESOURCES</b>		<b>CONTINUED</b>
MRC2.2	Construction waste mgmt—divert 75% from disposal	1/1
MRC3.1	Materials Reuse—5%	0/1
MRC3.2	Materials Reuse—10%	0/1
MRC4.1	Recycled content—10% (post consumer + ½ pre-consumer)	2/1
MRC4.2	Recycled content—20% (post consumer + ½ pre-consumer)	0/1
MRC5.1	Regional materials—10% extracted, processed, and manufactured regionally	1/1
MRC5.2	Regional materials—20% extracted, processed, and manufactured regionally	1/1
MRC6	Rapidly renewable materials	0/1
MRC7	Certified wood	0/1

<b>INDOOR ENVIRONMENTAL QUALITY</b>		<b>Awarded: 11/15</b>
EQc1	Outdoor air delivery monitoring	0/1
EQc2	Increased ventilation	0/1
EQc3.1	Construction IAQ mgmt plan—during construction	1/1
EQc3.2	Construction IAQ mgmt plan—before occupancy	1/1
EQc4.1	Low-emitting materials—adhesives and sealants	1/1
EQc4.2	Low-emitting materials—paints and coatings	1/1
EQc4.3	Low-emitting materials—carpet systems	1/1
EQc4.4	Low-emitting materials—composite wood and agrifiber products	1/1
EQc5	Indoor chemical and pollutant source control	0/1
EQc6.1	Controllability of systems—lighting	1/1
EQc6.2	Controllability of systems—thermal comfort	0/1
EQc7.1	Thermal comfort—design	1/1
EQc7.2	Thermal comfort—verification	1/1
EQc8.1	Daylight and views—daylight 75% of spaces	1/1
EQc8.2	Daylight and views—views for 90% of spaces	1/1

<b>INNOVATION</b>		<b>Awarded: 4/5</b>
IDc1	Innovation in design	3/4
IDc2	LEED Accredited Professional	1/1

<b>TOTAL</b>	<b>36/69</b>
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**AMON G. CARTER STADIUM REDEVELOPMENT**

LEED for New Construction and Major Renovations (v2.2)

Texas Christian University, Fort Worth TX

SILVER, Awarded March 2013

<b>SUSTAINABLE SITES</b>			<b>Awarded: 9/14</b>			<b>MATERIALS AND RESOURCES</b>			<b>CONTINUED</b>		
SSc1	Site Selection	1/1	MRc2.2	Construction waste mgmt—divert 75% from disposal	1/1	MRc3.1	Materials Reuse—5%	0/1	MRc3.2	Materials Reuse—10%	0/1
SSc2	Development density and community connectivity	1/1	MRc4.1	Recycled content—10% (post consumer + ½ pre-consumer)	2/1	MRc4.2	Recycled content—20% (post consumer + ½ pre-consumer)	0/1	MRc5.1	Regional materials—10% extracted, processed, and manufactured regionally	1/1
SSc3	Brownfield redevelopment	1/1	MRc5.2	Regional materials—20% extracted, processed, and manufactured regionally	1/1	MRc6	Rapidly renewable materials	0/1	MRc7	Certified wood	0/1
SSc4.1	Alternative transportation—public transportation access	1/1	<b>INDOOR ENVIRONMENTAL QUALITY</b>			<b>Awarded: 10/15</b>					
SSc4.2	Alternative transportation—bicycle storage and changing rooms	1/1	EQc1	Outdoor air delivery monitoring	0/1	EQc2	Increased ventilation	0/1	EQc3.1	Construction IAQ mgmt plan—during construction	1/1
SSc4.3	Alternative transportation—low-emitting and fuel efficient vehicles	1/1	EQc3.2	Construction IAQ mgmt plan—before occupancy	0/1	EQc4.1	Low-emitting materials—adhesives and sealants	1/1	EQc4.2	Low-emitting materials—paints and coatings	1/1
SSc4.4	Alternative transportation—parking capacity	1/1	EQc4.4	Low-emitting materials—composite wood and agrifiber products	1/1	EQc5	Indoor chemical and pollutant source control	0/1	EQc6.1	Controllability of systems—lighting	1/1
SSc5.1	Site development—protect or restore natural habitat	0/1	EQc6.2	Controllability of systems—thermal comfort	0/1	EQc7.1	Thermal comfort—design	1/1	EQc7.2	Thermal comfort—verification	1/1
SSc5.2	Site development—maximize open space	0/1	EQc8.1	Daylight and views—daylight 75% of spaces	1/1	EQc8.2	Daylight and views—views for 90% of spaces	1/1			
SSc6.1	Stormwater design—quantity control	0/1	<b>INNOVATION</b>			<b>Awarded: 4/5</b>					
SSc6.2	Stormwater design—quality control	0/1	IDc1	Innovation in design	3/4	IDc2	LEED Accredited Professional	1/1			
SSc7.1	Heat island effect—non-roof	1/1	<b>TOTAL</b>			<b>35/69</b>					
SSc7.2	Heat island effect—roof	1/1									
SSc8	Light pollution reduction	0/1									
<b>WATER EFFICIENCY</b>			<b>Awarded: 2/5</b>								
WEc1.1	Water efficient landscaping—reduce by 50%	0/1									
WEc1.2	Water efficient landscaping—no potable water use or no irrigation	0/1									
WEc2	Innovative wastewater technologies	0/1									
WEc3.1	Water use reduction—20% reduction	1/1									
WEc3.2	Water use reduction—30% reduction	1/1									
<b>ENERGY AND ATMOSPHERE</b>			<b>Awarded: 4/17</b>								
EAc1	Optimize energy performance	2/10									
EAc2	On-site renewable energy	0/3									
EAc3	Enhanced commissioning	1/1									
EAc4	Enhanced refrigerant mgmt	1/1									
EAc5	Measurement and verification	0/1									
EAc6	Green power	0/1									
<b>MATERIALS AND RESOURCES</b>			<b>Awarded: 6/13</b>								
MRc1.1	Building reuse—maintain 75% of existing walls, floors and roof	0/1									
MRc1.2	Building reuse—maintain 95% of existing walls, floors and roof	0/1									
MRc1.3	Building reuse—maintain 50% of interior non-structural elements	0/1									
MRc2.1	Construction waste mgmt-divert 50% from disposal	1/1									

## Lesson 4: Technology Takes the Field

### *Teacher Instructions*

Amos Alonzo Stagg is a legend in college football for many reasons. In *Building Leaders* at the College Football Hall of Fame, you and your students will see the Gold Medal awarded to him by The National Football Foundation in 1960 for his significant contributions to the sport. He is also a charter member of the College Football Hall of Fame, elected both as a player and a coach in 1951. Stagg played at Yale and his career as a head coach spanned 57 years at Springfield College, University of Chicago, and College (now University) of the Pacific. Hall of Fame coach Knute Rockne recognized Stagg's great contribution to football by saying, "Everything in football comes from Stagg."

By the 1920s the game's popularity had exploded, and with it came budgets for equipment, training, and practice. Traditional methods on the practice field—like throwing footballs through tires and grueling "two-a-day" schedules persisted for decades before advances in technology offered new ways to improve player safety, enhance communication on the sidelines, and develop innovative training techniques. Were Stagg alive today, he'd likely be stunned to see the drone cameras that schools, including Southern California, Tennessee and UCLA, are experimenting with to enhance the critical process of filming practice. He'd also be shocked to see college coaches hold transmitters up to players' bodies to test their internal temperature.

In *Building a Champion* at the College Football Hall of Fame, you will see how at Stanford, players wear mouthpieces with tiny sensors that measure the number and force of head impacts during games and practice. Shirts are being designed that can actually lower a player's body

temperature by 10 degrees. From Virginia Tech to Arizona State, researchers are working on safer, stronger helmets.

When specialized mass produced football equipment became available at the turn of the 20<sup>th</sup> century, its only role was safety. Football equipment in the 21<sup>st</sup> century is not just meant to protect, but now is being used to enhance athletic performance. Game day itself has been influenced by cutting edge technology. In the first part of this activity, your students will analyze how contributions from NASA, the US military and even Hollywood have changed both the way the game is played and the way it is delivered to your television.

Not too long ago, some of these feats of technology and engineering may have seemed more like science fiction than football fact. Budgets play a large role in determining which teams are using the latest equipment. Some schools, such as Alabama and Oregon, have been able to invest early in new technology, like cryogenic tubs and anti-gravity treadmills to reduce healing time for their players, while others may have to be more selective in their investments. On the other hand, replacing each player's large, cumbersome playbook with mobile tablets is becoming commonplace.

In Part 2 of this activity, your students will investigate the feasibility of eight inventions and innovations that may be part of college football sooner rather than later. Divide your class into eight groups and either assign or allow them to select one of the topics provided. This section involves student-directed research and requires computers with internet capabilities. At the culmination of their research the groups will

present the results of their investigation and the class will vote on which one they think has the

most potential to become a standard part of college football.

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### **ANSWER KEY**

**Part 1:** 1d, 2b, 3g, 4f, 5h, 6c, 7a, 8e

# Technology Takes the Field

## *Student Activity*

Hall of Famer Amos Alonzo Stagg is a legend in college football for many reasons. In *Building Leaders* at the College Football Hall, you will see the Gold Medal awarded to him by The National Football Foundation in 1960 for his significant contributions to the sport. He is also a charter member of the College Football Hall of Fame, elected both as a player and a coach in 1951. Stagg played at Yale and his career as a head coach spanned 57 years at Springfield College, University of Chicago, and College (now University) of the Pacific. Hall of Fame coach Knute Rockne recognized Stagg's great contribution to football by saying, "Everything in football comes from Stagg."

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**Words to Know:** *cryogenic, drone, flak, g-force, perspective, reconnaissance, thermoplastic, viscoelastic*

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

**Part 1**

Score points with technology! Using context clues, match the descriptions of these eight innovations and inventions in college football with their origins in the box that follows the list. Then brainstorm at least two other current or potential applications for that technology, besides football. One example of another use is provided for you to get you started.

1.     *d*     Players swallow pills that can measure their body temperature to prevent overheating during games and practices in hot weather.

*Firefighters inside a burning building can have their internal temperatures monitored, so they* \_\_\_\_\_

*know when the heat is too dangerous to be inside.* \_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_ The “first down line” is the yellow line that appears on television during a game to show the line past which the players need to move the ball in order to keep progressing down the field.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

3. \_\_\_\_\_ Coaches use wireless headsets to communicate with other team members from the sidelines. They are also used by the referees to announce official calls.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

4. \_\_\_\_\_ Unmanned aerial vehicles fly over the football field to film practices for review and to broadcast games from new camera perspectives.

\_\_\_\_\_

\_\_\_\_\_

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

5. \_\_\_\_\_ Video stabilization software improves the quality of game broadcasts from overhead cameras that ride on wires above the field. It can also clarify replays called by the officials.

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6. \_\_\_\_\_ Protective padding made from viscoelastic “memory foam” absorbs and distributes energy during tackles and other contact.

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7. \_\_\_\_\_ Pads made from strong, light-weight Kevlar® provide extra protection from injury for vulnerable areas on the body, such as the exposed ribs of a quarterback trying to throw a long pass.

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8. \_\_\_\_\_ Replay technology using multiple cameras can “pause” a play during a television broadcast, rotate around a player, and resume the play from another angle for a complete view of the action on the field from multiple perspectives.

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Name

Class

Date

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### Origins

- a. Military: body armor vests, flak jackets
- b. Hollywood: computer generated imagery (CGI) that can be inserted into live action scenes, used in films like *Jurassic Park*
- c. NASA: seats in spacecrafts developed in the 1960s to protect astronauts from the g-forces experienced during liftoff
- d. NASA: monitoring and tracking astronauts' core body temperature from Earth, developed by Johns Hopkins University and the Goddard Space Flight Center
- e. Hollywood: visual effects in movies like *The Matrix* with robotic cameras on platforms to make objects and people appear to be filmed from 360° degrees by one camera
- f. Military: reconnaissance drones used to gather information in dangerous war zones
- g. Military, NASA: used by the US Army in World War I to communicate with fighter pilots and later improved with two-way communication capabilities for space missions in the 1960s
- h. NASA: software developed to be able to better analyze films of space shuttle launches

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## Part 2

Your favorite college football team has just received a major donation from a grateful alumna. Your group has been tasked with finding the best way to put that money to use. Select one of the topics from the Football Inventions and Innovations list, below, for your group. Prepare a presentation to explain why the college should take on the research and development of this latest technology and make it standard equipment for their team. At the conclusion of all the presentations, your class will vote on which one they think has the most potential to become a feasible part of college football.

### Innovations and Inventions in College Football:

1. Microchip technology inside a football indicates its exact location after every play.
2. A laser system on the field makes the first-down line visible to everyone in the stadium, similar to the yellow line seen on television broadcasts.

Name \_\_\_\_\_

Class \_\_\_\_\_

Date \_\_\_\_\_

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3. Referees and coaches carry mobile viewing devices with instant replay capabilities to review certain plays and calls immediately.
4. The Army is currently working on a new kind of a thermoplastic, a substance that is soft when heated and solid when cooled, which is very lightweight but stronger than steel and could be used in pads and helmets.
5. Gloves and shoes with sensors inside provide data on how receivers and kickers are making contact with the ball in order to determine how they might improve their techniques.
6. Computer modeling software analyzes real college football game statistics to determine which play has a greater chance of succeeding in any given situation and thus should be called next.
7. Virtual reality practices, similar to a video game, allow players to review and practice plays without the threat of getting injured on the field.
8. A wearable computer with video capabilities, like Google Glass, outfitted in a player's helmet, which allows people watching the game on TV to see how the game looks from the players' viewpoint and provides vital feedback to the coaches on both sides of the ball.

Your research and presentation must include answers to the following questions:

- Does the technology currently exist to make the item? Is the technology needed to make the item already being used in a field other than football? If so, how?
- Are any schools or other sports currently exploring that technology? If so, which ones? Are there any corporations or companies currently exploring that technology? If so, which ones?
- How would the technology improve college football, either how it is played or how it is viewed?

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### **The Extra Point**

Review the list of eight cutting-edge innovations and inventions from Part 2, above. What might be some unforeseen side effects of the new technology? For example, the use of camera drones might become an issue with cheating if teams accuse each other of trying to film their practices. For each of the other new technologies, try to predict complications that may arise as well as possible solutions to counteract them.

<b>IT'S A FOOTBALL FACT!</b>
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As a star athlete in several sports, Alonzo Amos Stagg's contributions to technology in sports were not limited to football. He also invented the batting cage for baseball and an overflow trough for swimming pools.

## Lesson 5: Football Family—A Logic Puzzle

### Teacher Instructions

In this lesson, your students will read a short story and solve a logic puzzle that involves a debate amongst the four members of a family of dedicated college football fans. Logic puzzles are a fun way to practice mathematical skills without using any numbers! You will be making deductions and establishing equalities similar to those used in algebra. If  $A = B$  and  $B = C$ , then  $A = C$ . Therefore if  $C \neq D$ , then  $A \neq D$  and  $B \neq D$ .

Each unique fan has one unique favorite tailgate food, perhaps even made with a “Vendor Food Fling” recipe from the *Fans’ Game Day Interactive Table* at the College Football Hall of Fame! Each one also has a unique favorite player position and one unique graduation date, so you will use the process of elimination to solve the puzzle. To solve the puzzle, read each clue carefully. Use the answer grid to help you keep track of what you do and do not know. If a clue tells you that two attributes (fan, position, graduation, or tailgate food) do NOT go together, place an X in the box formed at the intersection of the two attributes on the answer grid. If a clue tells you that two attributes DO go together, place a check mark in their intersecting box.

For example, Clue #6 tells us that the fan who believes that quarterback is the most important position on the team is Latrice. Therefore, none of the other three fans can have quarterback as their most important player position. When you are able to match two attributes, you can place a checkmark in the box where their column and row intersect and use X’s to show that no other fan goes with the quarterback. This clue has been marked for you in the answer grid.

Keep reading the clues and marking an X on the grid for what you know is not true and a checkmark for what you know is true. For a puzzle of this size, it may be helpful to write the clue # that gave you a particular piece of information, along with the X or check mark on the grid, in case you need to retrace your steps at any point.

When you finish all the clues and still have not completed the logic puzzle, read through the clues one at a time again. Once you make some basic deductions, you will discover new relationships and come closer to solving the puzzle. Be diligent! If you get stuck, check your grid to see if any connections have revealed themselves. Watch out for any trick plays!

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### ANSWER KEY

Graduation = Fan’s name = Position = Tailgate food  
1954 Big Ten = Christie = Wide Receiver = Burger  
1974 Ivy League = Brad = Middle Linebacker = Hotdog  
1994 MAC = John = Safety = Chili  
2014 SEC = Latrice = Quarterback = Wings

## Football Family—A Logic Puzzle

### *Student Activity*

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**Words to Know:** *attribute, deduction, elimination, grid, logic, tailgate*

Name \_\_\_\_\_

Class \_\_\_\_\_

Date \_\_\_\_\_

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## The Story

A family of football fans sits down for dinner after a visit to the College Football Hall of Fame, just as college football season is about to kick-off. Their experience spurs a discussion that quickly turns into a heated debate over two important issues: which player position on a college football team is the most important for and which is the best food to bring to a tailgate. Using the clues given below, figure out whose opinion is whose, and match them to the year the fans graduated from college.

### Football fan's name

- John
- Brad
- Latrice
- Christie

### Most important position

- Quarterback (Offense)
- Wide Receiver (Offense)
- Middle Linebacker (Defense)
- Safety (Defense)

### College conference and graduation year

- 1954 from a Big Ten school
- 1974 from an Ivy League school
- 1994 from a MAC school
- 2014 from an SEC school

### Favorite tailgate food

- Chili
- Wings
- Hotdog
- Burger

## The Clues

1. The fan who loves wings graduated more recently than John.
2. Either the fan who went to an Ivy League school or the fan who graduated in 1994 thinks that the middle linebacker is the most important position in the game.
3. The fan who graduated in 1994 thinks the middle linebacker is not as important to the defense as some other positions.
4. The fan who always brings wings to a tailgate party graduated more recently than the graduate from a school in the Middle Atlantic Conference (MAC) who thinks that the safety is the most important position on the team.
5. The 1954 graduate loves hamburgers and veggie burgers.
6. The fan who believes that quarterback is the most important position on the team is Latrice.
7. The four fans are: (1) the fan who brings burgers, (2) the 1994 graduate, (3) the fan who thinks quarterback is the most important position, and (4) Brad.

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

8. The fan who pays the most attention to what the wide receivers are doing each game does not like chili or hotdogs.
9. Neither John nor the fan who thinks the quarterback is the most important will eat hotdogs or burgers.
10. John played safety on the defensive team himself when he was in college.

Use this chart to keep track of the solutions as you solve the puzzle.

<b>Graduation</b>	<b>Fan's Name</b>	<b>Position</b>	<b>Tailgate Food</b>

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

		Fan				Position				Food			
		John	Brad	Latrice	Christie	Quarterback	Wide Receiver	Middle Linebacker	Safety	Chili	Wings	Hotdog	Burger
Graduation	1954 Big Ten												
	1974 Ivy												
	1994 MAC												
	2014 SEC												
Food	Chili												
	Wings												
	Hotdog												
	Burger												
Position	Quarterback	x	x	√	x								
	Wide Receiver			X									
	Middle Linebacker			X									
	Safety			X									

**IT'S A FOOTBALL FACT!**  
 About 41% of tailgaters spend more than \$500 per season on tailgate supplies and 80% of the U.S. population tailgates or picnics at least once a year at a game.

# Interdisciplinary Project Ideas

Make your field trip to the College Football Hall of Fame a school-wide event! Use these inquiry-based interdisciplinary activities and project ideas to incorporate the College Football Hall of Fame into additional classes and content areas. Let's get everyone in the game!

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1. For a long time, the only sports in which women could realistically participate professionally were tennis and golf. At the collegiate level, there were not many more choices. The "Title IX" Act, written in 1972 and revised in 1979, was designed to create greater gender equality in education but also applies to equality in sports and athletics programs at schools and universities. Read the full text of the original law here [www.dol.gov/oasam/regs/statutes/titleix.htm](http://www.dol.gov/oasam/regs/statutes/titleix.htm) and then research recent articles and editorials to report on the positive effects of Title IX that are being seen more than 40 years after it was first written.

## **IT'S A FOOTBALL FACT!**

Place kicker Liz Heaston became the first woman to play and score points in college football when the Willamette University Bearcats shut out the Linfield College Wildcats, 27-0, at a home game in Salem, OR, during the 1997 season.

2. As you see in *Why We Love College Football* in the College a Football Hall of Fame, conferences were organized geographically in the early days of college football. In 1921, 14 schools from Alabama, South Carolina, Georgia, Kentucky, Maryland, Mississippi, North Carolina, Tennessee, and Virginia met in Atlanta to form the Southern Intercollegiate Conference. In 1933, 13 members of the Southern Conference withdrew to form the SEC. The Southern Conference continues on today. Schools in the oldest major conference formed in 1895, the Big Ten, traditionally came from Midwestern states like Iowa, Ohio, and Michigan. The Mountain West was created in 1998 by schools in Wyoming, Nevada, and Colorado, decided that the 16-member WAC was too large.

More recently, the twenty-first century has seen a few conferences grow larger, others shrink, and geographical boundaries broken as schools from one part of the country join conferences in another. Research and create a list of the schools that have changed conferences, or announced plans to do so, in the past two years. Find the reasons why a school would make such a move. Why would a conference want more members? Are there benefits to having fewer "super-conferences" with more members? What academic and economic implications are there for conference membership, outside of football season? Present your opinions on this trend in a persuasive essay with an equal balance of facts and opinions.

## **IT'S A FOOTBALL FACT!**

The premier college football conference for Historically Black Colleges and Universities (HBCU) is the Southwestern Athletic Conference (SWAC), founded in 1920. It includes schools in Alabama, Arkansas, Mississippi, Texas, and Louisiana. However, the oldest HBCU conference is the Central Intercollegiate Athletic Association (CIAA), which began in 1912. Its colleges and universities are in Maryland, Pennsylvania, North Carolina, and Virginia.

3. History vs. Hollywood: Below is a list of movies relevant to the history of college football, based on actual events and real people including College Hall of Fame members Knute Rockne, Ernie Davis, and

Paul Bryant. Select one of the movies, watch it, and then research the story behind the story. What facts were changed in the movie? Why were they changed? Were any characters created for the sake of the movie? How much artistic license did the director take with the topic? Write a review that discusses both the movie’s quality as a film and its historical accuracy.

Film	Subject	Rating	Year Made
<i>Knute Rockne, All American</i>	Knute Rockne	N/A	1940
<i>The Junction Boys</i>	Bear Bryant	TV-14	2002
<i>We Are Marshall</i>	Marshall University	PG	2006
<i>The Express</i>	Ernie Davis	PG	2008
<i>Blindside</i>	Michael Oher	PG-13	2009

**IT’S A FOOTBALL FACT!**

Irvine “Cotton” Warburton, who played at Southern California from 1932 to 1934, is the only member of the College Football Hall of Fame to receive an Academy Award. He won an Oscar for his film editing work on *Mary Poppins* in 1964.

4. Although the world spent the 1930s in the grip of the Great Depression, that same decade began the golden age of radio as the main form of communication and entertainment. Advances in technology made regular college football game day broadcasts feasible and people could stay home on Saturdays to listen to games on the radio for free. In fact, the growing number of empty seats in their football stadiums caused some colleges to try banning or restricting broadcasts of their football games!

Investigate the effects of the Great Depression on other local popular sports. For example, baseball game attendance plummeted when people could no longer afford to buy tickets to see games. What teams or leagues in your area disappeared in the 1930s because of financial trouble? The 1930s were the glory days for famous race horses like Seabiscuit and War Admiral. Why did the number of states with legal horse racing increase from 6 to 21 at this time? The Civilian Conservation Corps constructed ski runs and jumps and sites for other winter sports made popular by the 1932 Olympics in Lake Placid, NY. What recreational or athletic projects did the Civilian Conservation Corps construct where you live?

5. Currently, the National Football League (NFL) does not have an age qualification, but it does require that a player be three seasons removed from high school in order to play professionally. Conduct a debate with your classmates on whether there should be age requirements for becoming a professional athlete. While forming your stance on this issue, consider the following questions. Do all sports have the same age qualifications? Why might a basketball or baseball player go straight to the professional level from high school, while football players go to college first?

## Puzzle Tiles: Glenn “Pop” Warner

Hall of Fame member Glenn “Pop” Warner is identified as one of the “Coaches Who Changed the Game” in *Building a Champion* at the College Football Hall of Fame. In his long career, he served as a coach at Georgia (1895-1896), Cornell (1897-1898, 1904-1906), Carlisle, (1899-1903, 1907-1914), Pittsburgh (1915-1923), Stanford (1924-1932), and Temple (1933-1938). In a career that spanned over 40 years, he invented or began practices and plays that are still used in college football today. His legacy also lives on in the Pop Warner youth football, cheer, and dance leagues found in many communities.

His contributions are found both on and off the football field. He even made forays into the

burgeoning field of sports psychology. In the 1920s, while at Stanford, he teamed with psychologist Walter Miles to test the reaction time of linemen to varying snap count cadences.

This puzzle contains a quote from Warner that represents his coaching philosophy. To solve this puzzle, rearrange the tiles below until the groupings of letters, spaces, and punctuations form one complete sentence—the quote from Glenn “Pop” Warner. Some of the tiles have already been filled in—the rest are up to you. Begin by looking for the tile that has a capital letter (that will be the first tile) and the one with punctuation (that will be the last).

a c h	t h	c a	m a k	A g	c o
n w	l l	t h a	w i	a t h	e h
w h a	a r e.	e r	h e y	e e	e r
s s	t t	p l a			

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

Write your answer here:

	o	o	d							i	s
--	---	---	---	--	--	--	--	--	--	---	---

	y	e	r					
--	---	---	---	--	--	--	--	--

	n	b							h	a	t
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	e	y	
--	---	---	--

**IT'S A FOOTBALL FACT!**

Becoming a legendary football coach was not Glenn "Pop" Warner's first career choice. When he graduated from Cornell in 1894, he became a lawyer in western New York.

## Word Search: The First Hall of Fame Coaches

To be officially accepted into the College Football Hall of Fame, a coach must have won a minimum of 60% of all his games as a coach. This word search contains the 21 members of the first Hall of Fame coach class, inducted in 1951. Not familiar with some of these renowned names in the game of college football? Take a quick look at their history to learn why they are enshrined in the Hall of Fame.

- |           |          |        |            |          |
|-----------|----------|--------|------------|----------|
| ALEXANDER | HAUGHTON | ONEILL | SMITH      | WARNER   |
| BIBLE     | JONES    | OWEN   | STAGG      | WILLIAMS |
| CAMP      | KERR     | ROCKNE | SUTHERLAND | YOST     |
| DOBIE     | MCGUGIN  | ROPER  | THOMAS     | ZUPPKE   |
| DONAHUE   |          |        |            |          |

T	J	W	M	V	Z	N	D	A	S	M	A	I	L	L	I	W	E	O
V	Y	P	D	U	I	P	J	I	T	Y	C	P	G	D	A	Y	R	O
N	U	M	P	G	N	A	M	E	A	C	M	I	O	Y	N	E	N	N
V	P	P	U	N	I	U	W	N	G	D	S	O	R	O	C	K	N	E
C	K	G	S	M	N	O	T	H	G	U	A	H	U	N	R	Y	A	I
E	C	G	P	M	L	E	R	A	L	E	F	O	K	W	D	S	L	L
M	K	E	A	C	I	S	H	D	J	L	I	Z	X	R	W	Y	F	L
N	A	Y	K	U	D	T	H	O	M	A	S	D	I	R	A	A	L	P
L	S	E	D	A	E	R	H	Z	A	F	U	Q	M	Z	R	J	E	P
H	L	C	O	G	R	M	F	E	L	B	I	S	B	M	N	S	V	A
J	X	B	B	O	N	O	R	A	L	U	M	U	K	G	E	E	D	S
E	L	B	I	B	W	S	P	I	R	N	Z	T	Q	A	R	N	C	U
Y	G	U	E	D	E	Y	X	E	O	Y	J	H	L	G	H	O	H	S
N	L	P	A	T	U	L	O	I	R	Z	Z	E	N	U	C	J	S	I
H	E	L	V	S	H	A	G	T	N	R	X	R	B	H	K	M	E	Q
M	Y	W	T	O	A	R	M	K	O	A	N	L	X	I	E	C	N	U
U	W	Q	O	Y	N	P	G	G	N	B	K	A	S	F	A	E	B	H
A	T	J	W	E	O	M	N	D	Z	L	R	N	I	M	K	C	Y	V
U	M	N	R	J	D	O	E	P	E	R	A	D	P	T	H	S	M	E
R	R	E	K	M	C	R	C	R	U	K	K	D	G	Q	F	Q	R	C

**IT'S A FOOTBALL FACT!**  
 The first African-American head football coach at an NCAA Division 1-A school was Willie Jeffries, at Wichita State University in 1979. He was inducted into the College Football Hall of Fame in 2010.

Name \_\_\_\_\_

Class \_\_\_\_\_

Date \_\_\_\_\_

# Cryptogram: Career Fair

Can you imagine having a Hall of Famer as your teacher? Almost five million scholar-athletes have played college football since the first game on November 6, 1869. However, only a small percentage (0.0002%) of those players has been inducted into the College Football Hall of Fame.

Most went on to follow their passions down different paths, while making good use of the

lessons they learned as football players. This puzzle is a cryptogram, a code in which letters have been replaced by numbers. You will decipher a list of ten careers, not related to sports, pursued by members of the College Football Hall of Fame. Hints are provided and those letters have been filled in to get you started.

<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>	<b>F</b>	<b>G</b>	<b>H</b>	<b>I</b>	<b>J</b>	<b>K</b>	<b>L</b>	<b>M</b>
10		15							1			

<b>N</b>	<b>O</b>	<b>P</b>	<b>Q</b>	<b>R</b>	<b>S</b>	<b>T</b>	<b>U</b>	<b>V</b>	<b>W</b>	<b>X</b>	<b>Y</b>	<b>Z</b>
						18	16					

A	T	T
10	18	18

,

			T			T
9	7	6	18	4	12	18

		C	T
9	3	15	18

,

		T								U
7	6	18	26	7	11	26	7	6	7	16

,

J	U
1	16

,


				C
11	3	21	4	15

,

				C
3	24	24	4	15

,


				T		C		A
11	3	21	4	18	4	15	4	10

,

				A		C
26	10	6	15	25	7	26

T		A	C
---	--	---	---

,

T			A		A
---	--	--	---	--	---

18 | 7 | 10 | 15 | 25 | 7 | 26

13 | 7 | 18 | 7 | 26 | 4 | 6 | 10 | 26 | 4 | 10 | 6

**IT'S A FOOTBALL FACT!**

Some College Football Hall of Fame members such as Jim Brown (Syracuse), Alex Karras (Iowa), and Merlin Olsen (Utah State) became noted actors after they finished their football careers.

**ANSWER KEY**

**Puzzle Tiles:** A good coach will make his players see what they can be rather than what they are.

**Word Search:**

T	J	W	M	V	Z	N	D	A	S	M	A	I	L	L	I	W	E	O
V	Y	P	D	U	I	P	J	I	T	Y	C	P	G	D	A	Y	R	O
N	U	M	P	G	N	A	M	E	A	C	M	I	O	Y	N	E	N	N
V	P	P	U	N	I	U	W	N	G	D	S	O	R	O	C	K	N	E
C	K	G	S	M	N	O	T	H	G	U	A	H	U	N	R	Y	A	I
E	C	G	P	M	L	E	R	A	L	E	F	O	K	W	D	S	L	L
M	K	E	A	C	I	S	H	D	J	L	I	Z	X	R	W	Y	F	L
N	A	Y	K	U	D	T	H	O	M	A	S	D	I	R	A	A	L	P
L	S	E	D	A	E	R	H	Z	A	F	U	Q	M	Z	R	J	E	P
H	L	C	O	G	R	M	F	E	L	B	I	S	B	M	N	S	V	A
J	X	B	B	O	N	O	R	A	L	U	M	U	K	G	E	E	D	S
E	L	B	I	B	W	S	P	I	R	N	Z	T	Q	A	R	N	C	U
Y	G	U	E	D	E	Y	X	E	O	Y	J	H	L	G	H	O	H	S
N	L	P	A	T	U	L	O	I	R	Z	Z	E	N	U	C	J	S	I
H	E	L	V	S	H	A	G	T	N	R	X	R	B	H	K	M	E	Q
M	Y	W	T	O	A	R	M	K	O	A	N	L	X	I	E	C	N	U
U	W	Q	O	Y	N	P	G	G	N	B	K	A	S	F	A	E	B	H
A	T	J	W	E	O	M	N	D	Z	L	R	N	I	M	K	C	Y	V
U	M	N	R	J	D	O	E	P	E	R	A	D	P	T	H	S	M	E
R	R	E	K	M	C	R	C	R	U	K	K	D	G	Q	F	Q	R	C

**OVER, DOWN, DIRECTION**

- |                      |                  |                      |
|----------------------|------------------|----------------------|
| ALEXANDER 15, 12, SW | KERR 4, 20, W    | SUTHERLAND 13, 10, S |
| BIBLE 5, 12, W       | MCGUGIN 1, 7, NE | THOMAS 7, 8, E       |
| CAMP 17, 16, SW      | ONEILL 19, 2, S  | WARNER 16, 7, S      |
| DOBIE 4, 9, S        | OWEN 4, 17, NW   | ROCKNE 14, 4, E      |
| DONAHUE 6, 19, N     | ROPER 6, 10, SE  | WILLIAMS 17, 1, W    |
| HAUGHTON 13, 5, W    | SMITH 4, 5, SE   | YOST 5, 17, N        |
| JONES 17, 14, N      | STAGG 10, 1, S   | ZUPPKE 6, 1, S       |

**Cryptogram:** Attorney, dentist, doctor, entrepreneur, judge, police officer, politician, rancher, teacher, veterinarian

A	B	C	D	E	F	G	H	I	J	K	L	M
10	19	15	9	7	24	5	25	4	1	14	21	22

N	O	P	Q	R	S	T	U	V	W	X	Y	Z
6	3	11	20	26	12	18	16	13	2	17	23	8

# COLLEGE FOOTBALL 101

Keep this reference guide handy as you introduce your class to the basics of college football. Be prepared to tackle their questions about the field, the player positions, the point system, and the College Football Hall of Fame itself. Get ready to play!

## THE PLAYING FIELD

Field	Rectangle, 120 yards long by 53 1/3 yards wide
Sidelines	Borderlines on each side of the field, 6-feet wide
End zone	Part of the field inside the end line where touchdowns are scored, 10-yards wide
Goal line	Line that runs across the front of the end zone, 8-inches wide
Yard lines	A solid white line that runs across the 100 yards of playing area on the field every 5 yards, and includes a number every 10 yards
Hash marks	Short white lines on the field 53 feet and 4 inches in from the sidelines, spaced exactly 1 yard apart down the length of the 100 yard playing area 53 ft 4 in
Goal posts	Poles that designate the area for a field goal to score at the back of either end zone with a 10-foot vertical pole connected to a cross bar, 18 feet and 6 inches long, with upright poles on either end of the cross bar that are at least 22 feet tall
Coaches box	Area on the sidelines where the coaches and team members not playing must remain, between the 25-yard marks

## THE POSITION NAMES

### *Offense*

Role	Position	
Offensive linemen	C	Center
	G or OG	Offensive guards
	T or OT	Offensive tackles
Backs & receivers	QB	Quarterback
	RB	Running backs (TB/tailback, HB/halfback, FB/fullback, WB/wingback, SB/slotback)
	WR	Wide receivers (split end, flanker, slot receiver)
	TE	Tight ends (H-back)

### *Defense*

Role	Position	
Defensive linemen	DT	Defensive tackles (defensive guard, nose tackle/guard)
	DE	Defensive ends
Linebackers	MLB	Middle linebacker (inside linebacker)
	OLB	Outside linebacker (right outside, left outside)
Defensive backs	CB	Cornerback
	S	Safety (strong safety, free safety)

### *Special Teams*

Role	Position	
Kickers	K	Placekicker
	H	Holder
	LS	Long snapper
	P	Punter
	PR	Punt returner
	KR	Kick returner

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## THE POINTS

Value	Play	Description
6	Touchdown	A player carries or catches the ball in the end zone
3	Field goal	A player kicks the ball through the goal posts, in place of a touchdown
2	Safety	A player is tackled in his own team's end zone
2	2-pt conversion	A player carries or catches the ball in the end zone after a touchdown
1	Extra point	A player kicks the ball through the end zone after a touchdown

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## THE HALL OF FAME

The National Football Foundation's College Football Hall of Fame represents the highest level of achievement for players and coaches and serves as a shrine for all of amateur football. Almost 5 million scholar-athletes have played college football since the first game on November 6, 1869, but less than a thousand have been inducted into the Hall of Fame. The criteria for eligibility are as follows (from [www.cfbhall.com](http://www.cfbhall.com)).

1. First and foremost, a player must have received first team All-America recognition by a selector recognized by the NCAA and utilized to comprise their consensus All-America teams.
2. A player becomes eligible for consideration by the NFF's Honors Court ten years after his last year of intercollegiate football played.
3. While each nominee's football achievements in college are of prime consideration, his post-football record as a citizen is also weighed. He must have proven himself worthy as a citizen, carrying the ideals of football forward into his relations with his community. Consideration may also be given for academic honors and whether or not the candidate earned a college degree.
4. In accordance to the 50-year rule\*, players must have played their last year of intercollegiate football within the last 50 years. For example, to be eligible for the 2013 ballot, the player must have played his last year in 1961 or thereafter. In addition, current professional players and / or coaches are not eligible until retirement.
5. A coach becomes eligible three years after retirement or immediately following retirement provided he is at least 70 years old. Active coaches become eligible at 75 years of age. He must

have been a head coach for a minimum of 10 years and coached at least 100 games with a .600 winning percentage\*.

*\* Those players that do not comply with the 50-year rule may still be eligible for consideration by the FBS and Divisional Veterans Committees, which examine unique cases.*

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## **THE AWARDS**

### Annual Player Awards

- Heisman Memorial Award – Outstanding Player
- William V. Campbell Trophy – Top Scholar Athlete
- Maxwell – Outstanding Player
- Walter Camp Award – Player of the Year
- Doak Walker Award – National Running Back Award
- Johnny Unitas Golden Arm Award—Outstanding Senior Quarterback
- Davey O’Brien Award – National Quarterback Award
- Fred Biletnikoff Award – Outstanding Wide Receiver
- John Mackey Award – Outstanding Tight End
- Outland Trophy – Outstanding Interior Lineman
- Vince Lombardi/Rotary Award – Outstanding Lineman
- Rimington Trophy – Outstanding Center
- Chuck Bednarik Award – Defensive Player of the Year
- Bronko Nagurski Award – Defensive Player of the Year
- Dick Butkus Award – Outstanding Linebacker
- Jim Thorpe Award – Outstanding Defensive Back
- Lou Groza Award – Place-kicker Award
- Ray Guy – Outstanding Punter
- Ted Hendricks – Defensive End of the Year
- Walter Payton Award – FCS Offensive Player of the Year
- Buck Buchanan Award – FCS Defensive Player of the Year
- Harlon Hill – NCAA Div II Outstanding Player
- Gagliardi Trophy – NCAA Div III Outstanding Player
- Danny Wuerffel Trophy – Top Citizen

### Annual Coach Awards

- FWAA/Eddie Robinson Coach of the Year
- Liberty Mutual Coach of the Year
- Home Depot Coach of the Year

# Recommended Reading

Check this out – of your school library! Before or after a class trip to the College Football Hall of Fame, you will want to use these lists as a starting point to create your own “Literary Hall of Fame” exploring the science, math, history and fun of college football. These books are divided by reading level into YOUTH: Elementary School, JUNIOR VARSITY: Middle School and VARSITY: High School, which is also appropriate for adults. Huddle up and start reading!

## YOUTH

### Elementary School: Grades 3 - 5

- Gibbons, Gail. *My Football Book*. HarperCollins, 2000.
- Gigliotti, Jim. *Kick-off: How Football Began*. Beach Ball Books, 2011.
- Golanty, Eric. *Ahead of Their Time*. Eric Golanty & Associates, 2010.
- Gordon, Samantha & Ari Breuning. *Sweet Feet: Samantha Gordon's Winning Season*. Walker Childrens, 2013.
- Herzog, Brad. *T is for Touchdown: A Football Alphabet*. Sleeping Bear Press, 2004.
- Jacobs, Greg. *The Everything Kids' Football Book: The all-time greats, legendary teams, today's superstars--and tips on playing like a pro*. Adams Media, 2010.
- Malott, Zachary. *I'm With the Team: My Summer with the Harvard Football Team*. CreateSpace Independent Publishing, 2009.
- Sports Illustrated. *Sports Illustrated Kids 1st and 10: Top 10 Lists of Everything in Football*. Sports Illustrated, 2011.
- Sports Illustrated. *Sports Illustrated Kids' Football Playbook: Games, Activities, Puzzles, and Fun!* Sports Illustrated, 2011.
- Stewart, Mark. *Touchdown: The Power and Precision of Football's Perfect Play*. Millbrook Press, 2009.
- Thomas, Keltie. *How Football Works (How Sports Work)*. OwlKids Books, 2010.
- Wiese, Jim. *Sports Science: 40 Goal-Scoring, High-Flying, Medal-Winning Experiments for Kids*. Wiley, 2002.

## JUNIOR VARSITY

### Middle School: Grades 6 – 8

- Barr, George. *Sports Science for Young People (Dover Children's Science Books)*. Dover Publications, 2011.
- Biskup, Agnieszka. *Football: How It Works (The Science of Sports)*. Capstone Press, 2010.
- Coffland, Jack. *Football Math: Touchdown Activities and Projects for Grades 4–8*. Good Year Books, 2005.
- DeCock, Luke. *Great Teams in College Football History*. Heinemann-Raintree, 2005.
- Frederick, Shane. *The Best of Everything Football Book (All-Time Best of Sports)*. Capstone Press, 2010.
- Frederick, Shane. *Football: The Math of the Game*. Capstone Press, 2011.
- Gardner, Robert. *Science Projects about the Physics of Sports*. Enslow Publishers, 2000.
- Goodstein, Madeline. *Sports Science Projects: The Physics of Balls in Motion*. Enslow Publishers, 1999.
- Hantula, Richard. *Science at Work in Football*. Marshall Cavendish Children's Books, 2011.
- Hauser, Dan, Ed Turner, & Dan Gennantonio. *Antique Sports Uniforms & Equipment: Baseball - Football - Basketball 1840-1940*. Schiffer Publishing, 2008.
- Sports Illustrated. *Sports Illustrated: The College Football Book*. Sports Illustrated, 2008

## **VARSIITY**

**High School: Grades 9 – 12, Adult**

- Beck, Stan. *College Sports Traditions: Picking Up Butch, Silent Night, and Hundreds of Others*. Scarecrow Press, 2013.
- Dosh, Kristi. *Saturday Millionaires: How Winning Football Builds Winning Colleges*. Wiley, 2013.
- Freedman, Samuel G. *Breaking the Line: The Season in Black College Football That Transformed the Sport and Changed the Course of Civil Rights*. Simon & Schuster, 2013.
- Gallian, Joseph A., ed. *Mathematics and Sports*. Mathematical Association of America, 2010.
- Gay, Thomas. *The Physics of Football: Discover the Science of Bone-Crunching Hits, Soaring Field Goals, and Awe-Inspiring Passes*. It Books, 2005.
- Goff, John Eric. *Gold Medal Physics: The Science of Sports*. The Johns Hopkins University Press, 2009.
- Koreivo, Stephen J. *Tales From The Tailgate: From the Fan who's Seen Them All*. AuthorHouse, 2011.
- Layden, Tim. *Blood, Sweat & Chalk: The Ultimate Football Playbook: How the Great Coaches Built Today's Game*. Sports Illustrated, 2010.
- Mac Cambridge, Michael, ed. *ESPN College Football Encyclopedia: The Complete History of the Game, unabridged*. ESPN, 2005.
- Miller, John J. *The Big Scrum: How Teddy Roosevelt Saved Football*. Harper, 2011.
- Oriard, Michael. *Bowled Over: Big-Time College Football from the Sixties to the BCS Era*. The University of North Carolina Press, 2009.
- Sporting News. *Every Saturday in Autumn: The Sporting News Presents College Football's Greatest Traditions*. McGraw-Hill/Contemporary, 2001.
- Sporting News. *Saturday Shrines: Best of College Football's Most Hallowed Grounds*. Sporting News, 2005.
- St. John, Allen & Ainissa G. Ramirez. *Newton's Football: The Science Behind America's Game*. Ballentine Books, 2013.
- Vizard, Frank. *Why a Curveball Curves: The Incredible Science of Sports (Popular Mechanics)*. Hearst, 2009.
- Watterson, John Sayle. *College Football: History, Spectacle, Controversy*. The Johns Hopkins University Press, 2002.
- Whittingham, Richard. *Rites of Autumn: The Story of College Football*. Free Press, 2001.

# Touchdown Timeline

America was still recovering from the Civil War when Rutgers beat Princeton 6-4 on November 6, 1869, in New Brunswick, NJ, in what is considered to be the first college football game. Today, little if anything looks as it did then in either the nation or the game. Through world wars, social, political and economic progress and upheaval, college football grew steadily in appeal, and now counts its fan base at nearly 100 million people. Forecasting the nation's future is tougher than picking bowl game winners, but one thing is certain: Americans will always love college football!

## AMERICAN HISTORY AND COLLEGE FOOTBALL

- 1865**      **The Civil War ends and President Lincoln is assassinated.**
- 1869**      The first college football game is played between Rutgers and Princeton in New Brunswick, NJ. This game uses a soccer-style round ball. The field is 120 yards long and 75 yards wide with 25 players on each side. The first team to score six goals wins.
- 1874**      Harvard travels to Montreal to play McGill University in a game more akin to rugby than soccer where players were able to carry the ball. From this game, American football moves from a kicking game to one that features running and tackling.
- 1876**      A cross bar is added to the goal posts at a height of 10 feet. It is still in use today. The number of players on each team is reduced to 15.
- 1883**      **The Brooklyn Bridge opens.**
- 1880**      The number of players is reduced to 11 on each side by Walter Camp, who also developed the line of scrimmage.
- 1888**      Rules are changed to allow tackling below the waist.
- 1892**      The Flying Wedge play or "V trick" is introduced by Harvard. The dangerous tactic remains legal for only one more season.
- 1908**      **Henry Ford introduces the Model T.**
- 1902**      On January 1, the first Rose Bowl game is played at Pasadena's Tournament Park.
- 1905**      The field is now marked with transverse lines every five yards running parallel to the sidelines. This checkerboard appearance gives the field a nickname that sticks: The Gridiron.
- 1905**      President Theodore Roosevelt convenes a summit to address the concerns of some schools over violence and injuries resulting from "mass momentum" plays. Two rules committees merged to form what would become the NCAA, and made radical changes to increase player safety.
- 1906**      The Intercollegiate Athletic Association (today's NCAA) is created.
- 1909**      The first homecoming game takes place at Baylor University in Waco, Texas.
- 1917**      **The U.S. enters World War I.**
- 1911**      Rules are changed to make it illegal to hide the ball under clothing.
- 1912**      The value of a touchdown is raised from five to six points and end zones are added.

- 1922** Rules are changed to bar players who are removed from the game in the first half from playing until the second half.
- 1929** **The stock market crashes.**
- 1932** In order to protect players, the ball is ruled dead when any part of the ball carrier (other than hands or feet) touch the ground. Flying blocks and flying tackles are declared illegal.
- 1937** Numbers are required on both the front and back of the jerseys.
- 1939** All players must wear helmets.
- 1941** **The United States enters World War II.**
- 1941** The first penalty flag is introduced.
- 1943-45** Many schools temporarily discontinue football because so many players have gone off to fight the war. College teams regularly schedule games against service teams from military training bases.
- 1947** The National Football Foundation is created to promote amateur football and encourage leadership and academic excellence among American youth.
- 1951** The National Football Foundation establishes the College Football Hall of Fame and inducts its first class.
- 1969** **Neil Armstrong walks on the moon.**
- 1957** A penalty for grabbing an opponent's facemask is created. Two-point conversions are added the following year.
- 1965** In December, Nat Northington signs with Kentucky, becoming the first African-American football player to sign with an SEC school. Other schools in the South are still reluctant to sign African-American players.
- 1966** The first artificial surface, AstroTurf, is created and installed at the AstroDome in Houston, Texas. Players complain of serious rug burns.
- 1976** **The United States celebrates its Bicentennial.**
- 1972** NCAA declares college freshmen eligible to play football.
- 1982** "Tearaway" jerseys are banned from the game.
- 1984** The Supreme Court rules that individual schools, not the NCAA, own the television rights to their college football games. This allows schools to sell their own television rights, which eventually leads to an explosion of college football on TV.
- 1989** **The Berlin Wall falls.**
- 1989** The NCAA bans the use of kicking tees for field goal attempts. Kickers are now required to kick the ball straight off the ground.
- 1990** Air Force running back, Chris Howard, is awarded the first NFF Campbell Trophy as college football's top scholar-athlete.
- 1995** The NCAA further strengthens academic requirements with the passage of Proposition 16, which established minimum GPA and SAT scores. Prop. 16 increases minimum class requirements and creates a sliding scale that balances GPA with standardized test scores.

- 1996** Tie games are eliminated, and overtime rules are put in place starting with the 1995 bowl season. The first ever overtime game was the 1995 Las Vegas Bowl when Toledo beat Nevada, 40-37.
- 1999** Tennessee beats Florida State at the Tostitos Fiesta Bowl to win the first BCS National Championship.
- 2001** **September 11<sup>th</sup> terrorist attacks**
- 2002** Riddell develops a helmet designed to reduce concussions called the Revolution, similar to the Schutt DNA Pro Adult Helmet. A University of Pittsburgh Medical Center study says these types of helmets reduce concussions by 31%.
- 2006** The Bowl Championship Series (BCS) National Championship Game becomes a separate bowl game to determine the National Champion of the NCAA Division I Football Bowl Subdivision. Originally, the game rotated between the Rose, Fiesta, Orange and Sugar Bowls.
- 2010** Specific rules are put in place that do not allow a player with a possible concussion to return to the game until he has been cleared by medical personnel. The player must miss at least one play, even if he has been cleared by team doctors.
- 2012** Conference commissioners announce the formation of a four-team playoff, the first of its kind at the FBS level. The new entity is called the College Football Playoff and replaces the BCS.
- 2014** The 100<sup>th</sup> Rose Bowl Game is played in Pasadena, California.

# Curriculum Correlations

We know how important it is for you to be able to justify field trips and document how instructional time is spent outside of your classroom. With that in mind, both the activities in this Teacher’s Guide and the experiences your class will have at the College Football Hall of Fame have been directly correlated to the Common Core State Standards for Mathematics and English Language Arts along with the Next Generation Science Standards and the C3 Framework for Social Studies State Standards.

In addition you will find specific state requirements for: Alabama (Science, Career/Technical Education, Social Studies), Florida (Science, Social Studies), Georgia (Science, STEM Career Clusters, Social Studies), North Carolina (Science, Information & Technology, Social Studies), South Carolina (Science, Social Studies), and Tennessee (Science, Computer Technology, Social Studies).

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## COMMON CORE STATE STANDARDS

### Mathematics Practice

CCSS.Math.Practice.MP1, CCSS.Math.Practice.MP2, CCSS.Math.Practice.MP3, CCSS.Math.Practice.MP4

### Mathematics Content

Number and Quantity: CCSS.Math.Content.HSN-Q.A.1, CCSS.Math.Content.HSN-Q.A.2, CCSS.Math.Content.HSN-Q.A.3

Algebra: CCSS.Math.Content.HSA-SSE.B.3, CCSS.Math.Content.HSA-CED.A.2, CCSS.Math.Content.HSA-CED.A.4, CCSS.Math.Content.HSA-REI.B.3, CCSS.Math.Content.HSA-REI.B.4

Geometry: CCSS.Math.Content.HSG-CO.A.1, CCSS.Math.Content.HSG-GPE.A.1, CCSS.Math.Content.HSG-GMD.A.1, CCSS.Math.Content.HSG-GMD.A.3, CCSS.Math.Content.HSG-MG.A.1, CCSS.Math.Content.HSG-MG.A.3

Statistics and Probability: CCSS.Math.Content.HSS-ID.C.9, CCSS.Math.Content.HSS-IC.A.1, CCSS.Math.Content.HSS-IC.B.6, CCSS.Math.Content.HSS-CP.A.2, CCSS.Math.Content.HSS-CP.A.5

### English Language Arts: Literacy in History/Social Studies, Science, and Technical Subjects

History/Social Studies: CCSS.ELA-Literacy.RH.9-10.2, CCSS.ELA-Literacy.RH.9-10.4, CCSS.ELA-Literacy.RH.9-10.7, CCSS.ELA-Literacy.RH.11-12.2, CCSS.ELA-Literacy.RH.11-12.3, CCSS.ELA-Literacy.RH.11-12.4, CCSS.ELA-Literacy.RH.11-12.7

Science and Technical: CCSS.ELA-Literacy.RST.9-10.1, CCSS.ELA-Literacy.RST.9-10.2, CCSS.ELA-Literacy.RST.9-10.3, CCSS.ELA-Literacy.RST.9-10.4, CCSS.ELA-Literacy.RST.9-10.5, CCSS.ELA-Literacy.RST.9-10.7, CCSS.ELA-Literacy.RST.11-12.1, CCSS.ELA-Literacy.RST.11-12.2, CCSS.ELA-Literacy.RST.11-12.3, CCSS.ELA-Literacy.RST.11-12.4, CCSS.ELA-Literacy.RST.11-12.6, CCSS.ELA-Literacy.RST.11-12.7

Writing: CCSS.ELA-Literacy.WHST.9-10.1b, CCSS.ELA-Literacy.WHST.9-10.1e, CCSS.ELA-Literacy.WHST.9-10.2b, CCSS.ELA-Literacy.WHST.9-10.2d, CCSS.ELA-Literacy.WHST.9-10.2f, CCSS.ELA-Literacy.WHST.9-10.7, CCSS.ELA-Literacy.WHST.11-12.1b, CCSS.ELA-Literacy.WHST.11-12.1e, CCSS.ELA-Literacy.WHST.11-12.2b, CCSS.ELA-Literacy.WHST.11-12.2e, CCSS.ELA-Literacy.WHST.11-12.7

## **NEXT GENERATION SCIENCE STANDARDS**

Waves and their Applications in Technologies for Information Transfer: HS-PS4-2.

Ecosystems: Interactions, Energy, and Dynamics: HS-LS2-7.

Biological Evolution: Unity and Diversity: HS-LS4-6.

Earth and Human Activity: HS-ESS3-2., HS-ESS3-4.

Engineering Design: HS-ETS1-2., HS-ETS1-3.

## **C3 FRAMEWORK FOR SOCIAL STUDIES STATE STANDARDS**

Civics: D2.Civ.5.9-12., D2.Civ.10.9-12., D2.Civ.12.9-12., D2.Civ.13.9-12., D2.Civ.14.9-12.

Geography: D2.Geo.3.9-12.

History: D2.His.1.9-12., D2.His.3.9-12., D2.His.4.9-12., D2.His.14.9-12., D2.His.16.9-12.

Evaluating Sources & Using Evidence: D3.1.9-12., D3.4.9-12.

Communication Conclusions & Taking Informed Action: D4.2.9-12.

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## **ALABAMA**

### **Science**

Earth & Space: 12

Environmental: 3, 9

### **Career/Technical Education**

Science, Technology, Education, Mathematics

Engineering Applications: 4, 13

Foundations of Engineering: 2

### **Social Studies**

Citizenship: 11

United States History to 1877: 11

United States History From 1877 to the Present: 2, 7, 12

Contemporary Issues: 4

Sociology: 10

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## **FLORIDA**

### **Science**

Earth & Space Science: SC.912.E.5.7, SC.912.E.6.6

Life Science: SC.912.L.17.11, SC.912.L.17.12, SC.912.L.17.14, SC.912.L.17.15, SC.912.L.17.16,  
SC.912.L.17.17, SC.912.L.17.19, SC.912.L.17.20

Nature of Science: SC.912.N.1.6

### **Social Studies**

American History: SS.912.A.1.3, SS.912.A.1.4, SS.912.A.1.6, SS.912.A.1.7, SS.912.A.2.4, SS.912.A.2.5,  
SS.912.A.5.7, SS.912.A.5.10, SS.912.A.6.5, SS.912.A.7.3, SS.912.A.7.5, SS.912.A.7.7, SS.912.A.7.8

Civics & Government: SS.912.C.2.9, SS.912.C.3.10

Humanities: SS.912.H.3.1, SS.912.H.3.2

Sociology: SS.912.S.4.10, SS.912.S.4.13, SS.912.S.5.7, SS.912.S.6.4, SS.912.S.6.5, SS.912.S.6.9

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## **GEORGIA**

### **Science**

Biology: SCSH5, SCSH6, SB4d

Botany: SCSH5, SCSH6, SBO5d

Materials Chemistry: SCSH5, SCSH6, SMS1b, SMS1c, SMS3a, SMS3g

Ecology: SCSH5, SCSH6, SEC2d, SEC5a, SEC5b

Environmental Science: SCSH5, SCSH6, SEV4a, SEV4b, SEV4c, SEV4e, SEV4f, SEV5c, SEV5d, SEV5e, SEV5f

### **Science, Technology, Engineering, Mathematics Career Clusters**

Foundations of Energy & Power Technologies: ENRG-FET-3b, ENRG-FET-3c, ENRG-FET-3d, ENRG-FET-4b, ENRG-FET-5c, ENRG-FET-5e, ENGR-STEM-2a, ENGR-STEM-2c

Foundations of Engineering & Technology: STEM-FET-2.4, STEM-FET-2.5, STEM-FET-3.2, STEM-FET-3.3, STEM-FET-3.4, STEM-FET-3.5, STEM-FET-6.2, STEM-FET-8.1, STEM-FET-9.1

### **Social Studies**

American Government/Civics: SSCG6e

Sociology: SSSocSCc, SSSocIC1b

United States History: SSUSH10b, SSUSH10c, SSUSH10d, SSUSH13c, SSUSH21b, SSUSH21c, SSUSH22c, SSUSH22e

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## **NORTH CAROLINA**

### **Science**

Biology: Bio.2.2.1, Bio.2.2.2

Earth/Environmental Science: EEn.2.2.1, EEn.2.2.2, EEn.2.4.2, EEn.2.5.5, EEn.2.6.3, EEn.2.8.1, EEn.2.8.4

OCS Biology: OBio.2.2.1, OBio.2.2.2

OCS Applied Science: OA.2.1.2, OA.2.1.3, OA.6.1.1, OA.6.1.2

**Information and Technology:** HS.TT.1.1

### **Social Studies**

American History II/OCS American History II: AH2.H.1.1, AH2.H.1.3, AH2.H.1.4, AH2.H.4.1, AH2.H.4.3, AH2.H.4.4, AH2.H.5.1, AH2.H.5.2, AH2.H.7.3

Civics & Economics: CE.C&G.2.7, CE.C&G.3.1, CE.C&G.3.6, CE.C&G.3.8

Twentieth Century Civil Liberties, Civil Rights: 12.H.1.1, 12.H.1.4, 12.H.2.2, 12.H.2.4, 12.H.3.3, 12.H.3.4, 12.H.5.1, 12.H.6.4, 12.C.1.1, 12.C.1.3

Turning Points in American History: 12.H.1.2, 12.H.1.3, 12.H.1.6, 12.H.2.2, 12.H.3.5, 12.H.3.6

Sociology: 12.H.1.3, 12.C.1.3, 12.C.2.3, 12.C.4.2, 12.C.4.3

American Humanities: 12.C.5.2, 12.C.5.4, 12.C.5.5

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## **SOUTH CAROLINA**

**Science**

Biology 1: H.B.1A.1, H.B.1A.4, H.B.1A.7, H.B.1A.8, H.B.1B.1, H.B.6D.1

Earth Science: H.E.3B.4, H.E.5A.8, H.E.6A.9

**Social Studies**

United States History and the Constitution: USHC-3.3, USHC-7.6, USHC-8.1

United States Government: USG-4.5

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**TENNESSEE****Science**

Chemistry II: CLE 3224.Inq.1, CLE 3224.Inq.4, CLE 3224.T/E.1, CLE 3224.T/E.3, CLE 3224.T/E.4, CLE 3224.3

Environmental Science: CLE 3260.Inq.1, CLE 3260.Inq.4, CLE 3260.T/E.1, CLE 3260.T/E.3, CLE 3260.T/E.4, CLE 3260.4.2, CLE 3260.4.4, CLE 3260.5.1, CLE 3260.5.2, CLE 3260.5.3, CLE 3260.6.1, CLE 3260.6.3

Ecology: CLE 3255.Inq.1, CLE 3255.Inq.1, CLE 3255.T/E.1, CLE 3255.T/E.3, CLE 3255.T/E.4, CLE 3255.4.4, CLE 3255.5.5, CLE 3255.6.2, CLE 3255.6.3, CLE 3255.6.4

Scientific Research: CLE 3295.T/E.1, CLE 3295.T/E.3, CLE 3295.T/E.4, CLE 3295.1.1, CLE 3295.2.4, CLE 3295.4.1, CLE 3295.4.3

**Computer Technology**

Computer Applications: 2.1, 2.2, 2.3

**Social Studies**

African-American History: 1.3.d, 1.3.g, 4.9, 4.10, 4.11.a, 4.13.b, 4.13.c, 4.13.d, 4.13.e, 5.12, 5.13, 5.14

Contemporary Issues: 1.1, 3.1

Modern History: Era 8 5.3, 6.1; Era 9 5.3, 6.1

Sociology: 1.1, 4.1, 6.3, 6.8

United States History: Era 6 5.0; Era 7 1.0; Era 8 1.0; Era 9 1.0, 4.0, 6.0; Era 10 1.0, 4.0