Objective: Students will be able to:
- Explore the basic principles behind designing and building a ballpark.
- Describe sustainable architecture techniques.
- Work in teams to create a blueprint and scale model for their own "green" ballparks.

Time Required: 2-3 class periods

Materials Needed:
- Photos of baseball stadiums past and present (included)
- Printed copies of Nationals Park and Target Field case studies - enough for half of the class (included)
- Printed copies of the "Green Ballparks" graphic organizer for each student
- Classroom internet access (optional)
- Printed copies of the "Green Ballparks Design Brief" sheet for each student
- Model-building supplies such as balsa wood, matte board, foam core, or cardboard

Vocabulary:
- **Brownfield** - A tract of land that has been developed for industrial purposes, polluted, and then abandoned
- **Environment** - The area in which something exists or lives
- **LEED** - LEED stands for *Leadership in Energy and Environmental Design*. LEED Certification is a rating system that the U.S. Green Building Council developed in 1998. LEED helps professionals in the building industry to design and build sustainably. A building that is "LEED Certified" is awarded points based on the building's environmental impact (or lack thereof).
- **Organic** - Relating to, or derived from, living organisms
- **Sustainability** - The ability to keep in existence, to maintain
- **Sustainable Architecture** - The philosophy of designing the built environment with the principles of economic, social, and ecological sustainability
Applicable Common Core State Standards:

**CCSS.ELA-Literacy.SL.9-10.4** Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.

**CCSS.ELA-Literacy.SL.11-12.4** Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks.

**CCSS.ELA-Literacy.WHST.9-10.2, WHST.11-12.2** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

**CCSS.ELA-Literacy.WHST.9-10.4, WHST.11-12.4** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

**CCSS.ELA-Literacy.WHST.9-10.7, WHST.11-12.7** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

**CCSS.ELA-Literacy.WHST.9-10.8, WHST.11-12.8** Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

**CCSS.ELA-Literacy.WHST.9-10.9, WHST.11-12.9** Draw evidence from informational texts to support analysis, reflection, and research.
Additional Relevant National Learning Standards:
(Based on Mid-continent Research for Education and Learning)

**Engineering Education. Standard 5. [Level IV Grade 9-12].** Understands energy and power types, sources and conversions

**Engineering Education. Standard 9. [Level IV Grade 9-12].** Understands elements of planning construction projects

**Engineering Education. Standard 10. [Level IV Grade 9-12].** Uses skills and techniques related to building, maintaining, and repairing structures

**Engineering Education. Standard 11. [Level IV Grade 9-12].** Understands the interrelationship of the building trades and society

**Engineering Education. Standard 14. [Level IV Grade 9-12].** Uses the design process to solve problems

**Technology. Standard 3. [Level IV Grade 9-12].** Understands the relationships among science, technology, society, and the individual

**Technology. Standard 4. [Level IV Grade 9-12].** Understands the nature of technological design

**Technology. Standard 6. [Level IV Grade 9-12].** Understands the nature and uses of different forms of technology

**Thinking and Reasoning. Standard 1. [Level IV Grade 9-12].** Understands and applies the basic principles of presenting an argument

**Thinking and Reasoning. Standard 2. [Level IV Grade 9-12].** Understands and applies basic principles of logic and reasoning

**Thinking and Reasoning. Standard 4. [Level IV Grade 9-12].** Understands and applies basic principles of hypothesis testing and scientific inquiry

**Thinking and Reasoning. Standard 5. [Level IV Grade 9-12].** Applies basic troubleshooting and problem-solving techniques

**Thinking and Reasoning. Standard 6. [Level IV Grade 9-12].** Applies decision-making techniques
1. Begin the lesson by passing around photos of Major League Baseball stadiums from the past and present (included).

2. As a class, brainstorm factors that must be considered when designing and building a baseball stadium. Record student answers on the board or on a sheet of chart paper. Possible answers include:
   - Seating capacity
   - The shape of the building
   - The layout of the viewing area
   - Easy-to-access entrance and exit points
   - Building materials
   - Utilities such as electricity and water
   - Ventilation
   - Environmental factors - will the stadium need a roof?
   - Whether or not the stadium will need to accommodate more than one sport
   - How will the stadium "fit" into the surrounding neighborhood?

3. Ask students, "What do you think the term "sustainable architecture" means? What is a "green" building?"

4. Develop a class definition of what is meant by a "green" building. Guide students to understand that sustainable architecture is a broad term that refers to the creation or restructuring of buildings so they have a minimal impact on the environment.

5. Discuss that construction is a major contributor to environmental pollution. A huge amount of energy is required to build and run residential, institutional and commercial buildings. For example, baseball stadiums require a lot of electricity to power the lights, the scoreboard, air conditioning, etc. Architects and consumers need to be aware of the environmental impact of buildings.

6. Ask students, "What are some ways that architects can design buildings (i.e. stadiums) to be sustainable?"
7. Discuss that there are a number of different approaches to sustainable architecture, including:
   - Using building materials that are composed of organic compounds such as wood, bricks, or other elements that are harvested from older buildings scheduled for demolition.
   - Responsible recycling of existing resources.
   - Efficient use of environmentally friendly systems to provide water and electricity.

8. Explain to students that they will be examining case studies for two Major League ballparks that feature sustainable architecture.

9. Provide all students with a "Green Ballparks" graphic organizer.

10. Provide half of the students with Nationals Park Case Study sheet, and the other half with the Target Field Case Study sheet. Allow students several minutes to read through the information, and fill out their graphic organizers.

11. *Optional* If you have internet access in your classroom, have students continue their research online at the websites recommended on the case studies.

12. Once students have finished working, have students share the information they learned from their respective ballpark case studies. How are the two ballparks similar and different in their sustainable design?

13. Lead a class discussion based on the following questions:
   - What specific issues did the designers of this stadium address when intending for the building to become an integral part of the community?
   - What type of design decisions were made to conserve energy and use elements of the natural environment?
   - In what ways do these stadiums serve as models for sustainable design?
   - In what ways can the local or national government encourage new construction using sustainable design?

1. Explain that students will work in teams to create a brand new design for a baseball stadium using sustainable design strategies.

2. Divide students into groups of 2-3. Assign or allow each team to choose a city in which to build their new stadium.

3. Provide each student with the "Green Ballparks Design Brief" and review the project.

Conclusion:

To conclude this lesson, have each design team do a class presentation featuring their blueprint and model. Review each project. Determine if the design team met all the parameters laid out in the Design Brief. Were teams able to stay within budget for building materials? How did the cost of materials affect the teams' design decisions?

Revisit some of the discussion topics from Day 1.
- What specific issues did the designers of these stadiums address when intending for the building to become an integral part of the community?
- What type of design decisions were made to conserve energy and use elements of the natural environment?
- In what ways do these stadiums serve as models for sustainable design?
- In what ways can the local or national government encourage new construction using sustainable design?

To check for understanding, have students turn in a cost/benefit analysis of their stadium. The analysis should address the following questions:

1. What impact will this stadium have on the local community?
2. What effects will this stadium have on the city environment?
3. What will be the economic effects of this stadium?
4. Are the benefits worth the cost of building?
Ballparks Past and Present

- **Atlanta Fulton County Stadium**
  - Opened: April 12, 1966
  - Closed: October 24, 1996

- **Oriole Park at Camden Yards - Baltimore**
  - Opened: April 6, 1992

- **Dodger Stadium - Los Angeles**
  - Opened: April 10, 1962

- **Ebbets Field - Brooklyn**
  - Opened: April 9, 1913
  - Closed: September 24, 1957
<table>
<thead>
<tr>
<th>Stadium</th>
<th>Location</th>
<th>Opened</th>
<th>Closed</th>
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<tbody>
<tr>
<td>PNC Park - Pittsburgh</td>
<td>Pittsburgh</td>
<td>April 9, 2001</td>
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<tr>
<td>Shibe Park - Philadelphia</td>
<td>Philadelphia</td>
<td>April 12, 1909</td>
<td>October 1, 1970</td>
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<tr>
<td>Tiger Stadium - Detroit</td>
<td>Detroit</td>
<td>April 20, 1912</td>
<td>September 27, 1999</td>
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Case Study: Nationals Park, Washington, DC

The Site:
- Nationals Park is categorized as a brownfield redevelopment site. The ballpark was designed to serve as an anchor for urban revitalization of the area, including a new mixed-use entertainment zone.

Architecture:
- The roofing materials are heat reflective. Additionally, there is a 6,300 square foot green roof area that minimizes roof heat gain.

Construction:
- Construction materials included the use of 20% recycled materials; 95% of steel used was recycled.
- Many of the building materials used on the project were from local sources to reduce the pollution that transporting materials long distances would generate.
- 5,500 tons of construction waste from the ballpark site was recycled.

Water:
- An advanced filtration system is used to separately treat rainwater, and water used to clean the ballpark before the water is released to the sanitary and storm water systems.
- Water conserving plumbing fixtures save a projected 3.6 million gallons of water per year. The fixtures also help reduce overall water consumption by 30%.
- The plants used in the landscaping around the park are drought resistant. They don't require regular watering by irrigation systems.
Lighting:
- The lights illuminating the field are energy-efficient. They use 21% less energy than standard stadium lighting.

Transportation:
- The ballpark's location is easily accessible to public transportation, including access to nearby metro stations and local bus routes. There is also bike parking outside the stadium.

Recycling:
- Storage and recycling of glass, metal, plastic, cardboard, and paper products

Interior Design:
- Low emitting materials - carpet, paint and adhesives

Additional Sources to Check Out:
- Nationals Park Information from the Official Site of the Washington Nationals: http://mlb.mlb.com/was/ballpark/information/index.jsp?content=green_ballpark

- A diagram of Nationals Park from the firm that designed it: http://washington.nationals.mlb.com/was/downloads/was_green_ballpark.pdf

Case Study: Target Field, Minneapolis, MN

The Site:
- The site for Target Field is categorized as a brownfield redevelopment site.
- The project’s location is in close proximity to shopping areas, condominiums and local businesses, providing a draw to the downtown area.

Construction:
- More than 70% of construction waste (including concrete, wood, cardboard, metals and paper) was recycled or reused.
- 30% of all building materials were made from recycled content.
- Many of the building materials used on the project were from local sources to reduce the pollution that transporting materials long distances would generate.

Water:
- A cistern system under the warning track will capture and treat rainfall runoff. That water will be filtered and reused for field irrigation and to wash down the seating area after games. It is estimated this system will save more than 1.26 million gallons of water per year.
- Water conserving plumbing fixtures help reduce overall water consumption by 30%.

Lighting:
- The lights illuminating the field are energy-efficient. They use 21% less energy than standard stadium lighting.

Transportation:
- Fans can access Target Field by walking, biking, or taking a bus, train or light rail line.
Recycling:
- Storage and recycling of glass, metal, plastic, cardboard, and paper products

Interior Design:
- Low emitting materials - carpet, paint and adhesives

Additional Sources to Check Out:
- Target Field Information from the Official Site of the Minnesota Twins:
  http://mlb.mlb.com/min/ballpark/new_faq.jsp

- Information on Target Field from the Ballparks of Baseball website:
  http://www.ballparks.com/baseball/american/minbpk.htm

- "Feats of Engineering - Target Field" from Finance & Commerce:
Step 1: Read one of the case studies on a "green" baseball stadium.

Step 2: List three of the features of the stadium that make it green. Next to each feature, list a possible health/environmental benefit.

<table>
<thead>
<tr>
<th>Feature that Makes the Stadium &quot;Green&quot;</th>
<th>Possible Health/Environmental Benefits</th>
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The Task:

1. You are to design a "green" ballpark in the city of your choice. Your budget is $200 million. You will draw a blueprint to scale, then create a 3-dimensional model based on your blueprint. Your teacher will provide you with model-building supplies.

2. Your design must meet the following parameters:
   • The seating capacity must be at least 40,000.
   • Your building materials must come from sustainable sources.
   • The utilities used in the stadium must be efficient and environmentally friendly.
   • Depending on location, your stadium should provide environmental controls such as air conditioning or a roof.
   • Your design should help the stadium "fit" into the local community.

3. Visit the following websites for ideas, inspiration and specific technology and materials used in sustainable design.
   • Building Green www.buildinggreen.com
   • U.S. Green Building Council www.usgbc.org

4. Once your blueprint and model are complete, use your original blueprint to calculate the cost of the materials necessary to realize your design. This information must be included when your final project is turned in.