VOLUME 1

STEM sports®
science • technology
engineering • math • sports

STEM.org ACCREDITED™ EDUCATIONAL EXPERIENCE

INSIDE:
Turn the page to learn more about our NEW Digital Assets!

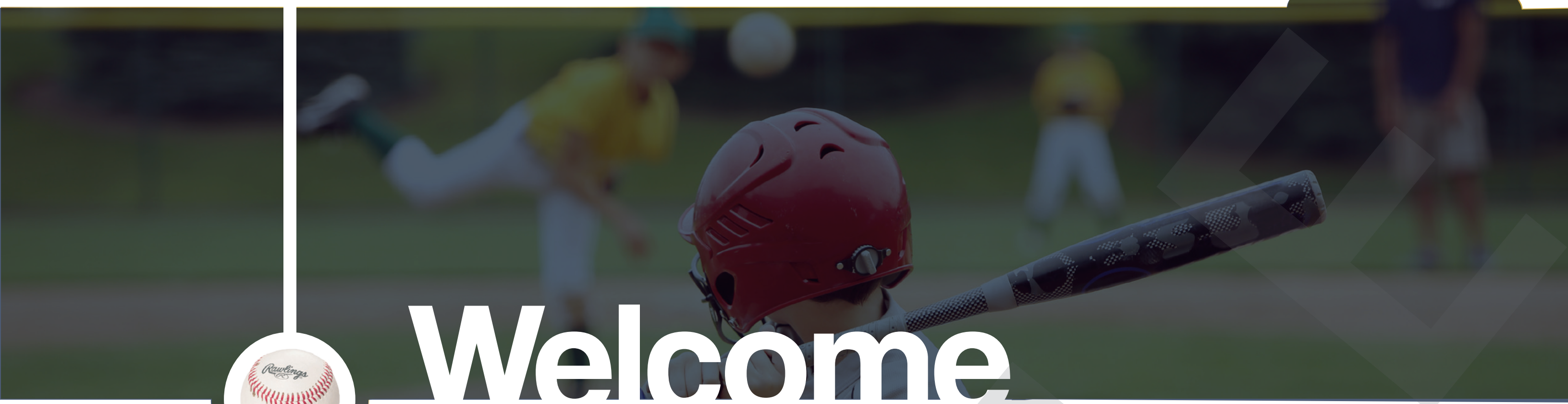
STEM BASEBALL

SUPPLEMENTAL CURRICULUM

GRADES 3 - 5 AND GRADES 6 - 8

Go Digital

In addition to the classroom, STEM Sports® K-8 Supplemental Curriculum is flexible and scalable to teach and implement at home and virtually on platforms such as Zoom, Google Classroom, Skype, and other digital learning tools. For each and every module, we provide solutions for successful remote learning with PowerPoint presentation decks and digital worksheets with keys.
To access these useful tools, visit
www.STEMSports.com/baseballdigitaltools/



Welcome

STEM Sports® provides turnkey K-8 supplemental curricula that use sports as the real-life application to drive STEM-based, hands-on learning in classrooms, after-school programs, and camps.

We are pleased to present Volume 1 of STEM Baseball, highlighted by the following:

- Content for a minimum of 16 hours of instruction that includes some healthy, physical activity.
- Turnkey kits equipped with all of the relevant sports equipment along with the necessary science supplies.
- Eight lessons aligned with Next Generation Science Standards (NGSS) and/or Common Core State Standards (CCSS) and/or National Standards for K-12 Physical Education.
- STEM.org Accredited™ Educational Experience approved
- 5E lesson plans so that students will develop 21st-century skills such as critical thinking, collaboration, creative problem-solving, and leadership.
- Differentiation: lessons for Kindergarten to 2nd graders, 3rd to 5th graders, and lessons for 6th to 8th graders.
- "Capstone" Project (Grades 6th to 8th) to commensurate student's knowledge of each curriculum.
- Assessments in each lesson to evaluate students effectively.
- Ready-to-use worksheets that align with each lesson and standards.
- A list of STEM-based, sports-related jobs pertinent to the lesson concept in each module.
- Engineering Design Process (EDP) woven into each curriculum.
- STEM Sports® glossary to support instructors and students as they come across key vocabulary in each module.
- Mindfulness Matters: important messaging to assist with the uniqueness of blending STEM with sports.
- Well designed and scalable for teachers, administrators, or volunteers.
- Professional development or training are not required.

Please visit www.STEMSports.com for additional information and to learn about all of the curricula that we offer.

We sincerely hope you and your students enjoy this STEM Sports® supplemental curriculum.

Please complete our Teacher Survey at www.stemsports.com/teacher-survey.

We appreciate your feedback.

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Mindfulness Matters

Mindfulness may not be the first thing one thinks about STEM Sports®. However, mindfulness is essential to fully understanding the design and benefits of the STEM Sports® curricula by way of the following:

- Approximately 85% of STEM jobs anticipated for the year 2030 have yet to be invented.
- Moreover, within the next 10 years or so, 80% of all jobs will be STEM related.

The STEM Sports® curricula distinctly blends STEM content areas through hands-on/active play and sports. Active play provides a mechanism to teach STEM concepts; therefore, learning is integrated, engaging and meaningful as participants are exposed to STEM applications through real world experiences.

Teachers of the curricula should be mindful of the fact STEM Sports® curricula are:

- Collaborative in nature, ensuring peer-to-peer learning opportunities
- Inquiry-based, allowing learners to discover information for themselves
- Designed for problem-solving: an essential lifelong skill
- Hands-on, engaging all types of learners
- Student-led, encouraging ownership of learning
- Active, promoting physical activity and wellbeing

Participants of the curricula should be mindful of the fact STEM Sports® curricula are:

- Introduction to STEM concepts, facilitating comfort with STEM content areas
- Blending play and sport in an environment that is engaging, fun, and applicable to life outside the classroom
- Designed for all ensuring success for all participants – students do not have to be athletic or excel at science to accomplish curricula tasks
- Applicable to the real world where learning is meaningful for all participants

In sum, stakeholders should be mindful of all the STEM Sports® curricula have to offer. The unique design of the STEM Sports® curricula is essential to maximize learning and the understanding of STEM concepts in sports and life applications.

Contents

Grades 3-5

Module 5.0
Engineering a Pitching Machine

PAGE 28

Objective
Students will brainstorm multiple ideas for a solution to the problem. Students will create a list of potential criteria and constraints. Students will explain how their idea meets criteria and constraints by presenting to their peers.

Concept
Engineering Design Process

Time
(2-4) 60-minute sessions

Module 6.0
Success at the Plate

PAGE 32

Objective
Students will predict their chances of successfully hitting a baseball by determining the larger fraction. Students will write a mathematical expression using greater than and less than symbols to determine their success at the plate.

Concept
Math: Fractions and Greater than/less than Symbols

Time
(2) 45-minute sessions

Module 7.0
Keeping Score

PAGE 35

Objective
Students will plot points on a number line less than one. Students will graph the number of runs per inning on a bar graph. Students will use a bar graph and number line to evaluate word problems about their game.

Concept
Math: Data and Graphing

Time
(2-3) 45-minute sessions

Module 8.0
Advancements in Baseball

PAGE 44

Objective
Students will evaluate instant replay technology used in baseball. Students will redesign current instant replay technology by brainstorming problems, criteria and constraints. Students will write to persuade the Commissioner's Office of Major League Baseball that instant replay needs a redesign.

Concept
Science: Observations
Use of Technology

Time
(2-3) 45-minute sessions

Contents
Grades 6-8

STEM sports science • technology engineering • math • sports

Module 5.0

Engineering a Pitching Machine

PAGE 71

Objective

Students will design a pitching machine using the Engineering Design Process. Students will support their design and its effectiveness using evidence and reasoning from a controlled experiment.

Concept

Engineering Design Process

Time

(3) 50-minute blocks

Module 6.0

Success at the Plate

PAGE 75

Objective

Students will calculate their number of hits using probability calculations. Students will graph and interpret probability data to determine their success at the plate.

Concept

Math: Probability

Time

(2) 50-minute blocks

Module 7.0

Keeping Score

PAGE 79

Objective

Students will convert data from a baseball game into ratios. Students will convert strikes to pitch ratios into unit rate. Students will use ratios and unit rates to answer real world baseball statistics questions.

Concept

Math: Ratios

Time

(2) 50-minute blocks

Module 8.0

Advancements in Baseball

PAGE 87

Objective

Students will define the criteria and constraints of an identified problem. Students will test a solution to the problem and analyze the data for improvements. Students will evaluate two solutions to a problem and use evidence to determine if they meet the criteria and constraints of the problem.

Concept

Engineering: Reviewing Design Solutions
Use of Technology

Time

(2-3) 50-minute blocks

Supplies Checklist

- ☐ **Six (6)** Baseballs
- ☐ **One (1)** Softball
- ☐ **Six (6)** 25" Tape Measures
- ☐ **One (1)** Weight Scale
- ☐ **One (1)** Cut (halved) Baseballs
- ☐ **Six (6)** Digital Stopwatches
- ☐ **One (1)** Radar Gun
- **One (1)** STEM Baseball Curriculum Manual
- ☐ **One (1)** Cut (halved) Softballs

Materials Needed

- ☐ Pencils
- ☐ Baseball Bat
- ☐ Smartphone or Tablet
- ☐ Internet Access
- ☐ Baseball Gloves
- ☐ Graph Paper
- ☐ Prototyping Materials: Cardboard, Paper Towel Rolls or PVC Piping, String, Tape
- ☐ Various Sport Balls: golf, ping pong, tennis, softball
- ☐ Outdoor Space
- ☐ Dice and Colored Pencils

Baseball STEM Sports® Glossary

Acceleration: Change in speed over time.

Angle: A figure formed by two rays that have the same endpoint

Balanced Force: Two forces acting in opposite directions on an object, equal in size.

Bunt: A ball hit lightly without swinging the bat that rolls on the infield between home plate and the pitcher's mound.

Constraints: A restriction that keeps something from being the best it can be.

Coordinate Plane System: A two-dimensional plane formed by the intersection of a vertical line called y-axis and a horizontal line called x-axis.

Criteria: A set of rules or directions that must be followed.

Energy: The motion of molecules or objects.

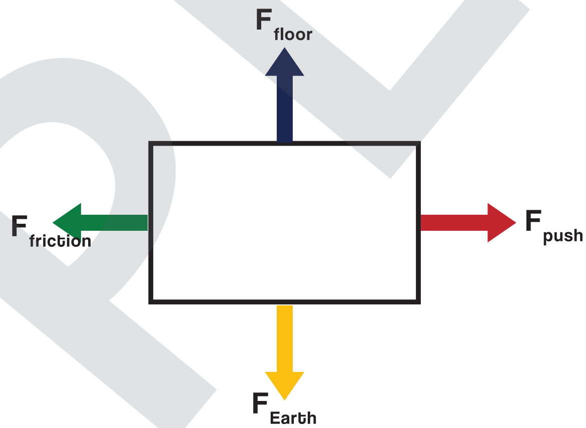
Engineering: A system of thinking that uses science and technology to solve problems.

Engineering Design Process (EDP): An organized series of steps that engineers use to develop functional products or processes.

Engineering Design Process

Force: Something that causes a change in the motion of an object.
Force = mass of object x acceleration

Force Diagram: A diagram showing all the forces acting on an object, the force's direction and its magnitude.



Function: The relationship or expression involving one or more variables.

Gravity: A force of attraction inclined to bring particles or bodies together.

Ground Ball: A ball hit that bounces or rolls along the ground.

Inertia: An inclination to do nothing or to remain unchanged.

Joule: A standard unit of energy or work in the International System of Units (SI).

Kinetic Energy: The energy an object possesses due to its motion.

Line: The part of a line with two endpoints.

Line Drive: A ball hit not far above the ground on a straight line.

Mass: A fundamental property of matter that is a numerical measure of the inertia (inactive) of an object or the amount of matter an object contains.

Newton's Third Law: The process in which an action and reaction are equal and opposite.

Parallel: Lines, planes, surfaces, or objects that are side by side, having the same distance continuously between them.

Perpendicular: A 90 degree angle to a given line, plane, or surface.

Point: An element in geometry that has position but does not extent.

Properties: Any traits that can be measured, such as mass, color, density, length, odor, and temperature.

Pythagorean Theorem: A statement about the sides of a right triangle. One of the angles of a right triangle is always equal to 90 degrees. This angle is the right angle. The theorem written as an equation is $a^2+b^2=c^2$.

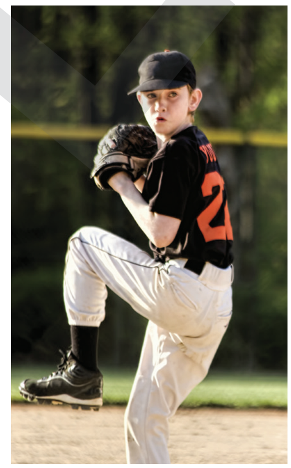
Ray: The part of a line with one endpoint that goes on forever in the opposite direction.

Scientific Method: A scientific process that involves investigation and discovery through a variety of techniques: observation, description, measurement, experimentation, formulation (or modeling), testing and adapting the hypotheses.

Speed: The distance an object travels in a given time.

$$\text{speed} = \frac{\text{d (distance)}}{\text{t (time)}}$$

Stretch position: In preparation of pitching the ball, a compact movement a pitcher uses when there are runners on first and/or second base. This motion takes less time so base runners have less time to steal.



Technology: An object, idea or method used to solve problems or invent new objects, ideas, or methods.

Unbalanced Force: A force that changes the position, speed, or direction of the object to which it is applied.

Velocity: The rate of change of position with respect to time.

$$\text{velocity} = \frac{\text{s (displacement)}}{\text{t (time)}}$$

Windup position: In preparation of pitching the ball, a series of movements a pitcher uses that includes swinging back of the arm and the raising of the forward foot. The windup position is generally used with no runners on base or the bases loaded.

Modules

Module
3.0

GRADES
3-5

The Field of Play

Concept
Math: Measurements and Real World Multiplication
Use of Technology

Objective
Students will explain how a baseball field and its materials have changed over time. Students will calculate actual measurements by multiplying whole numbers using a scale. Students will identify similarities and differences from baseball's first fields to today's fields.

Time
(1) 60-minute session

Standards

Next Generation Science Standards Connections

5-PS1-3.
Make observations and measurements to identify materials based on their properties.

Common Core State Standards Connections

CCSS.MATH.CONTENT.3.OA.A.3
Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem.

National Standards for K - 12 Physical Education Connections

Standard 4: The physically literate individual exhibits responsible personal and social behavior that respects self and others.

Supplies Provided
Worksheets

Please email Info@STEMSports.com to access Worksheet Keys.

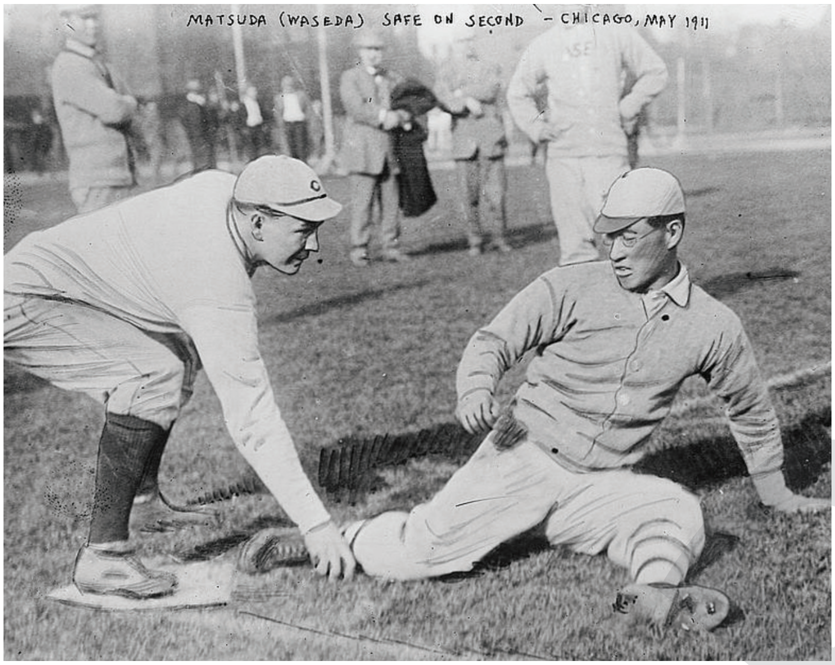
Materials Needed
Pencils

Sequence of Lesson

Have your students take this lesson's assessment prior to engaging by visiting:
www.stemsports.com/assessments
If you have limited digital capability, please email Info@STEMSports.com to access the Assessment & Key.

Engage: Tell students that the first baseball fields were basically grass fields with the pitcher's spot and bases outlined with chalk. Discuss with a partner how the game's field looks different today.

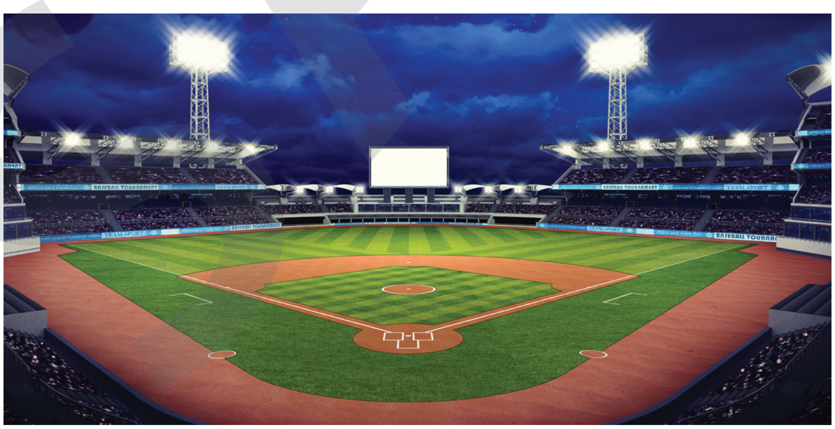
Field 1



Bain News Service, P. (1911) Matsuda Waseda University, Japan is safe; a re-enactment of a play from a baseball game with Chicago University, Marshall Field, May. , 1911. date created or published later by Bain. [Photograph] Retrieved from the Library of Congress, https://www.loc.gov/item/2014689179/.

Field 2

Field 3



Explore: Have students observe the images on this page and compare and contrast. Record both similarities and differences on the worksheet. Ask students to specifically focus on the field's surface and outline.

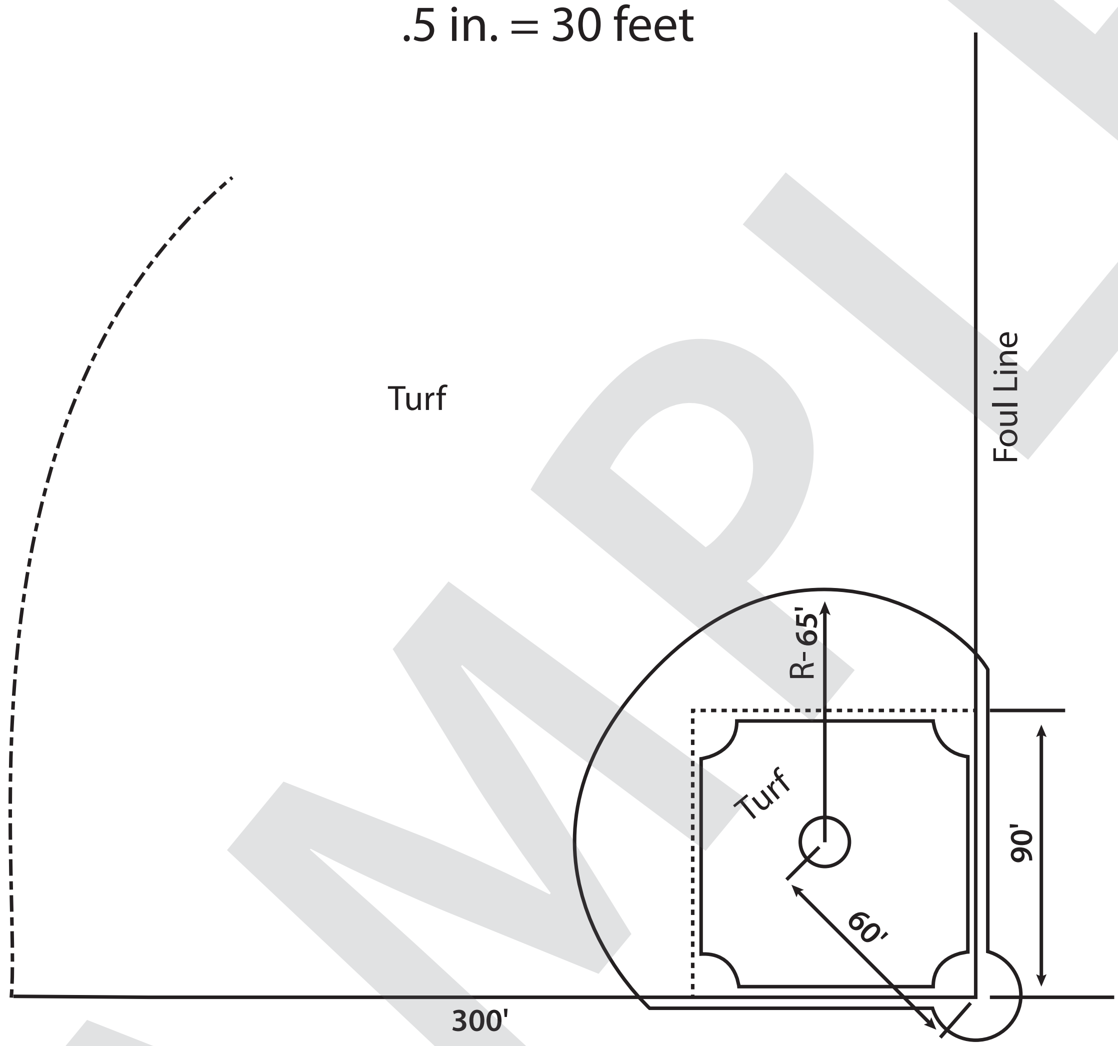
Explain: Explain to students how the materials used to create and sustain a baseball field have changed as the game has changed. For example, the first fields did not have dirt, but as the game became more and more popular and/or fields were being used more and more, the grass surface was being worn down and damaged. To help maintain fields, dirt was added to where the field has the most movement: the basepaths and pitcher's mound.

Elaborate: Have students look at Field 3 and the scaled field on the next page: the scale of the field is .5 to 30 feet. Have students measure key features of the modern field. Record observations and measurements in the data table. Based on your recorded observations in *Explore*, review how your observations differ from Fields 1 and 2.

Evaluate: Reference the worksheet and answer the following questions: What are similarities and differences between baseball fields of the past and today's baseball fields? Based on your list of similarities and differences, what field would you prefer to play on and why? How has technology changed the field of play? Has it helped or hurt the game? Explain.

Scaled Field

.5 in. = 30 feet



Have your students retake this lesson's assessment to effectively evaluate their comprehension by visiting:
www.stemsports.com/assessments
If you have limited digital capability, please email Info@STEMSports.com to access the Assessment & Key.

Extend: Students can research and select materials to create their own baseball field and compare and contrast to the modern baseball field, answering the question: "how and why may the technology change again in the future?"

STEM Jobs in Sports

- Sports Turf Technician
- Groundskeeper
- Little League: Director of Operations
- Stadium Architect
- Irrigation Specialist

Fun Facts

The first baseball stadium built in the United States was Forbes Field in Pittsburgh in 1909.

Module 3.0

Name: ____

The Field of Play

GRADES 3-5

General Similarities and Differences

Field 1	Field 2	Field 3	Scaled Field (.5 = 30 feet)
			Distance from home plate down the foul line: • Measured ____*30 = Actual ____ Distance from home plate to the pitcher's mound • Measured ____*30= Actual ____ Distance from home plate to first base • Measured ____*30= Actual ____

1. What are similarities and differences between baseball fields of the past and today's baseball field?

2. Based on your list of similarities and differences, what field would you prefer to play on and why?

3. How has technology changed the field of play? Has it helped or hurt the game? Explain.

4. How would a change in field size impact the game?

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The Field of Play

Concept
Units and Area and/or Pythagorean Theorem

Objective
Students will compare and contrast which position on the field requires the strongest arm and fastest player by using distances on a coordinate plane system. Students will calculate the unknown distance of a right triangle using the Pythagorean Theorem.

Time
(2) 50-minute blocks

Standards

Common Core State Standards Connections

CCSS.MATH.CONTENT.6.NS.C.8
Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate.

CCSS.MATH.CONTENT.8.G.B.8
Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

National Standards for K - 12 Physical Education Connections

Standard 1: The physically literate individual demonstrates competency in a variety of motor skills and movement patterns.

Standard 2: The physically literate individual applies knowledge of concepts, principles, strategies and tactics related to movement and performance.

Supplies Provided
Worksheets and Baseballs (*Extend* only)

Please email Info@STEMSports.com to access Worksheet Keys.

Materials Needed
Pencils and Space to Throw (*Extend* only)

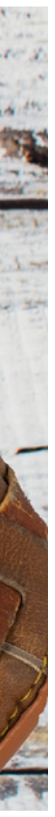
Sequence of Lesson

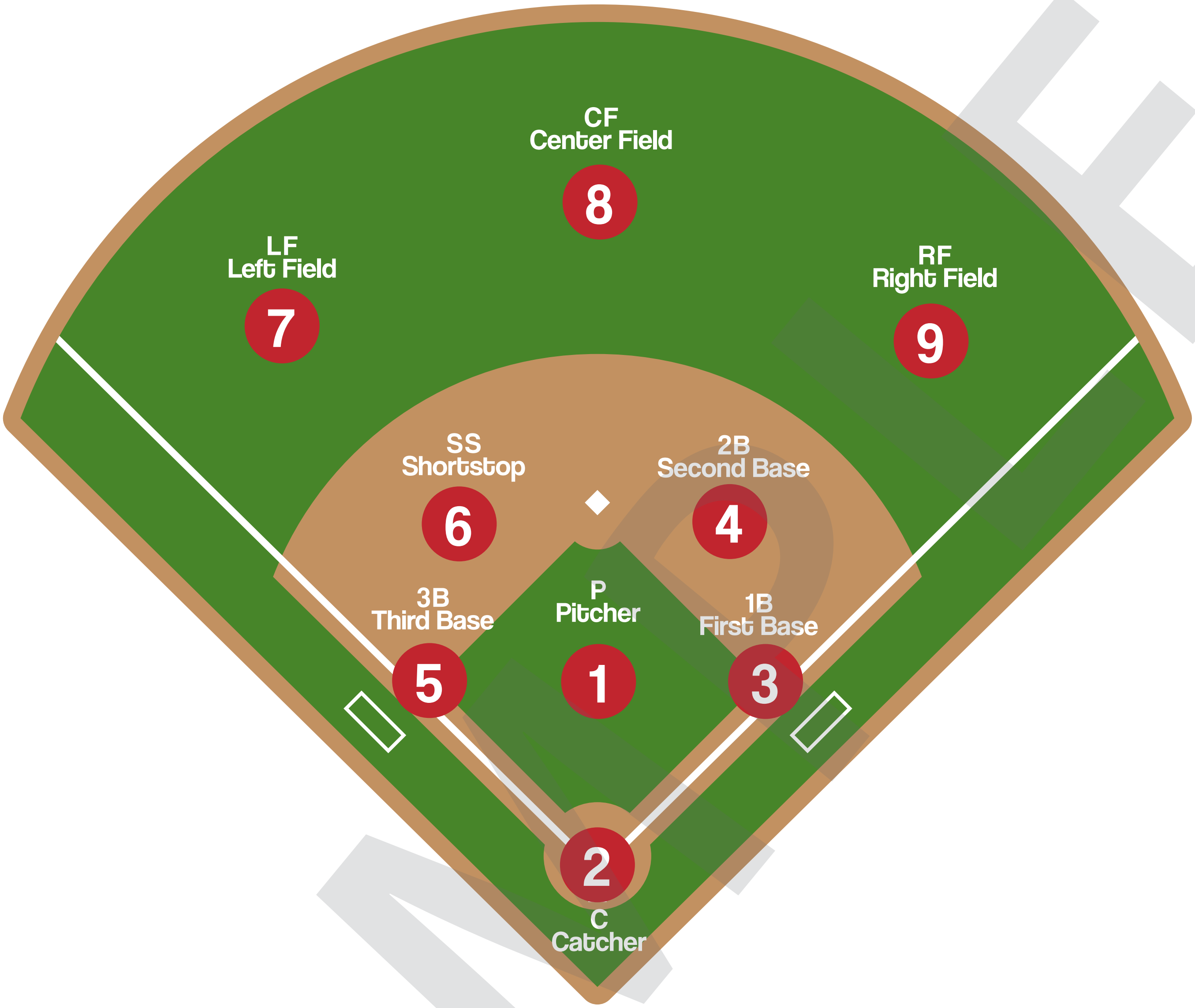
Have your students take this lesson's assessment prior to engaging by visiting:
www.stemsports.com/assessments
If you have limited digital capability, please email Info@STEMSports.com to access the Assessment & Key.

Engage: Asks students to identify their favorite position, such as Pitcher, Center Field, Shortstop or Catcher? Have them brainstorm on chart paper how and why their position is unique. What skills are required? How far do they need to throw the ball?

Explore: Review with students the field of play with the players' numbers on page 61.

Have students outline what makes a strong player at each position. Who needs to throw the farthest? Fastest? Run the furthest? Have students plot the position of the players on a coordinate plane system.





Explain: Define key terms: Coordinate Plane System and Pythagorean Theorem (if using), which can be found in STEM Sports® Glossary in the front of this manual and at STEMSports.com under Resources. Model for students on how to find the distance between each player using the coordinate plane system.

Or

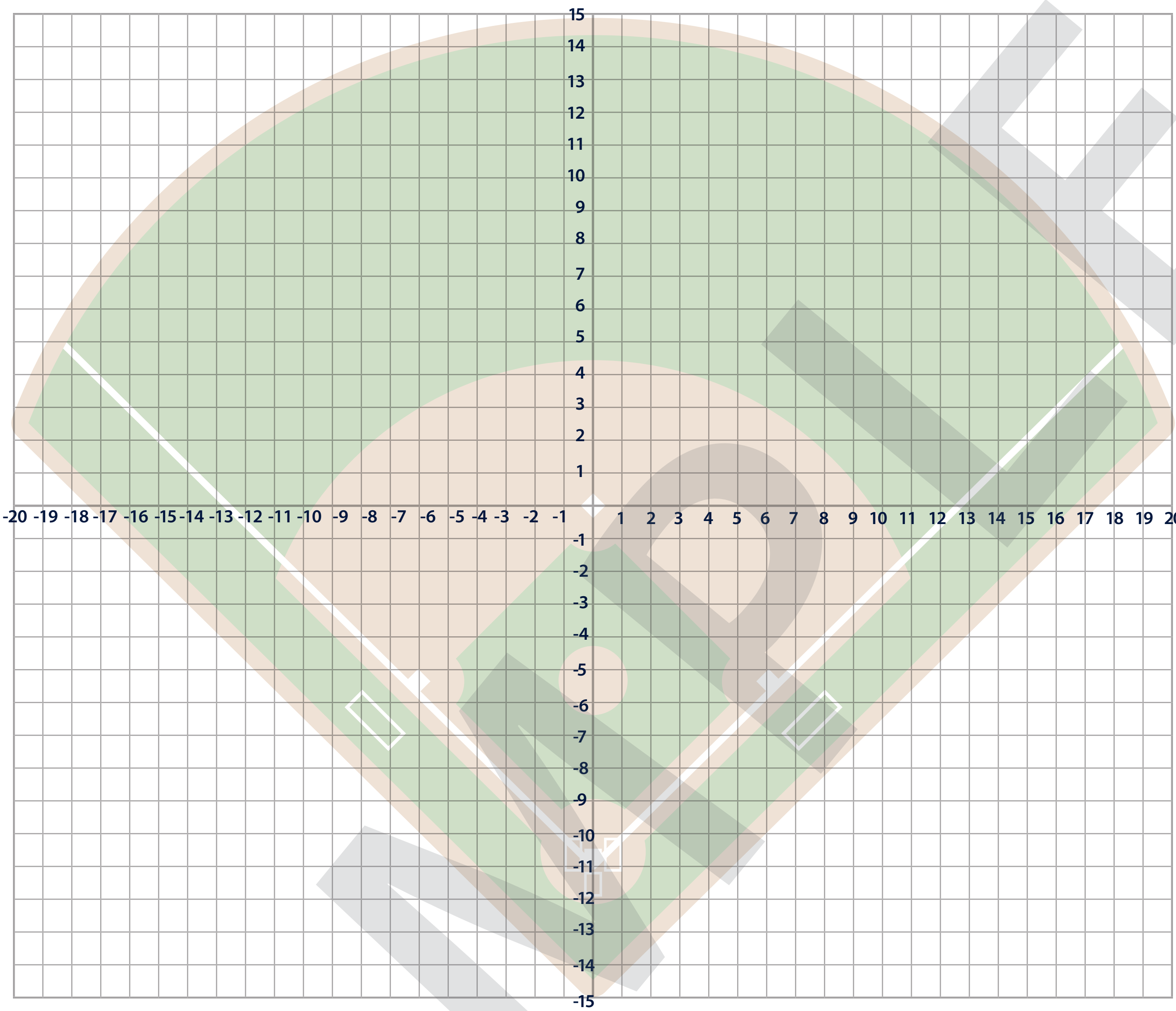
Model for students how to use the labeled distances to determine the unknown distance using the Pythagorean Theorem.

Elaborate: Have students use the coordinate plane system to fill in the distance that a player would need to throw.

**6th grade standard: Determine the distance between players by subtracting the coordinates for absolute value.*

**8th grade standard: Determine the distance between players by using the Pythagorean Theorem.*

Evaluate: Have students review the problems where the player location changed to catch the



ball. Determine how far the player would need to throw the ball to make an out. (Questions 5 and 6 on the worksheet).

Have your students retake this lesson's assessment to effectively evaluate their comprehension by visiting:
www.stemsports.com/assessments
If you have limited digital capability, please email Info@STEMSports.com to access the Assessment & Key.

Extend: If there is space available, allow students to throw the ball a distance between each player to determine what position on the field would best suit their skill set.

STEM Jobs in Sports

- Baseball Developer (IT) - Baseball Data and Development
- Softball: Assistant Coach
- Groundskeeper - Baseball & Softball Fields
- Assistant Athletic Director & JV Baseball Coach
- Parks & Recreation: Equipment Operator

Fun Facts

Baseball fans eat enough hotdogs each year to stretch from Dodger Stadium (Los Angeles) to Wrigley Field (Chicago), which is over 25.5 million hotdogs and 5.5 million sausages, a length of approximately 2,015 miles.

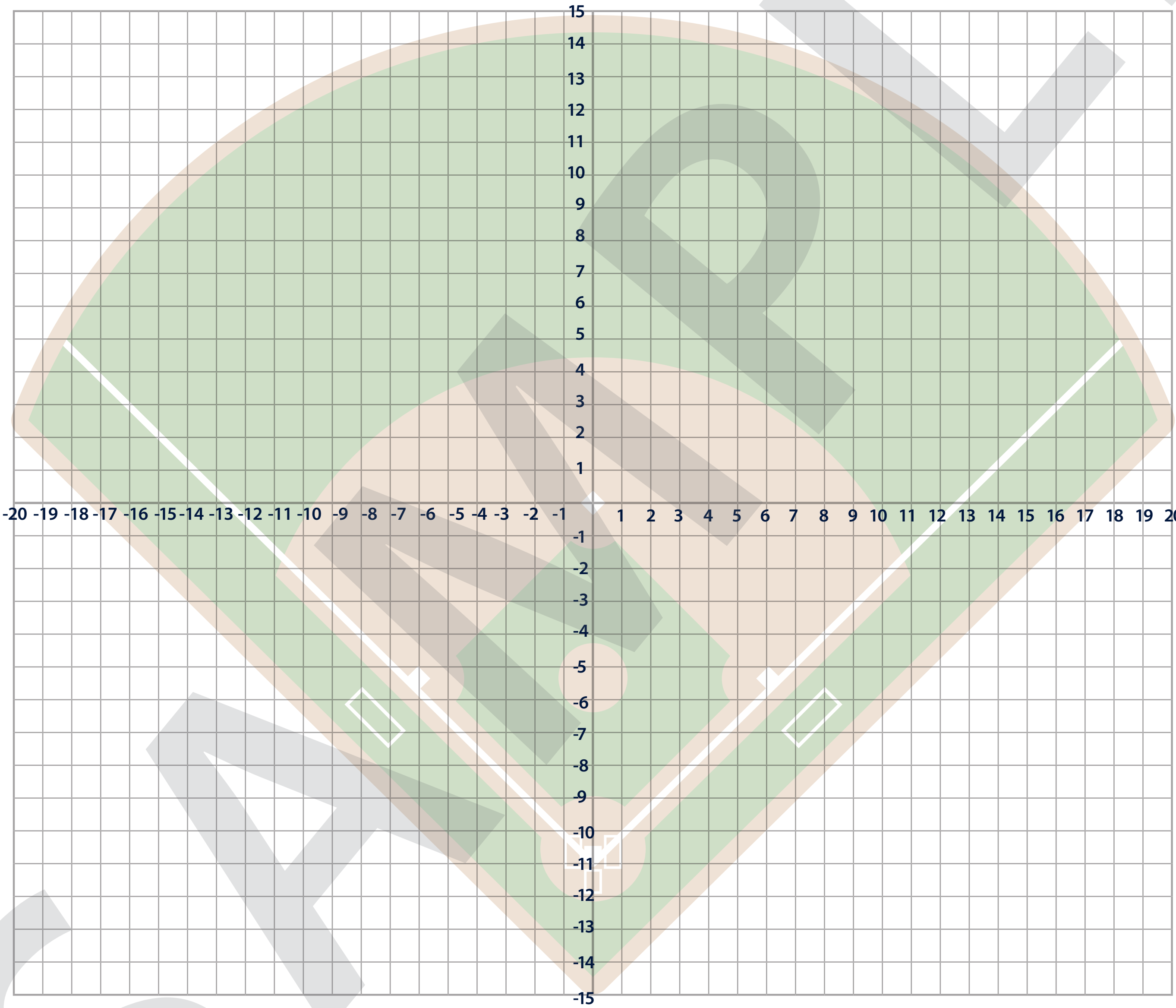
Name: ____________________ Class: __________

The Field of Play

GRADES 6-8

6th grade specific standards

Plot each player on the coordinate plane. Label their x,y coordinates.



Center field:

Pitcher:

Shortstop:

Left Field:

First Base:

Third Base:

Right Field:

Second Base:

Catcher:

Module 3.0

Name: ____________________ Class: __________

The Field of Play

GRADES 6-8

Use the coordinate plane to determine the absolute value between players.

1. How far would the Second Base player need to throw to the Shortstop?

2. How far would the Third Base player need to throw to the First Base player?

3. How far would the Pitcher need to throw to the Catcher?

4. How far does the Center Fielder need to throw to the Pitcher?

5. If the First Baseman ran to (0, 6) to catch the ball and then needed to throw to Home to make the play, how far would he/she throw?

6. If the Catcher (-11) was trying to throw out a runner stealing Third, how far would he/she throw?

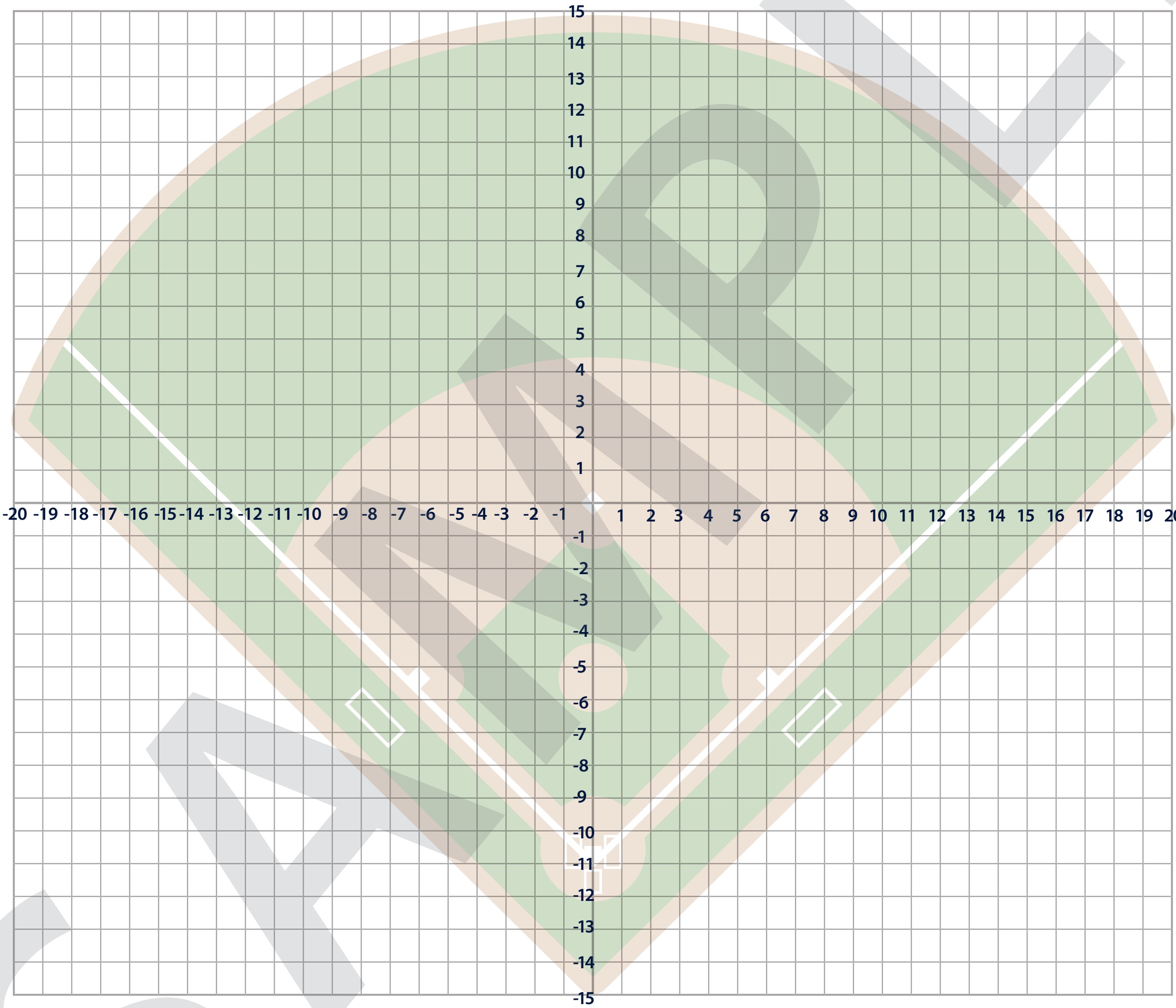
Name: ______________________________ **Class:** __________

The Field of Play

GRADES 6-8

8th grade specific standards

Plot each player on the coordinate plane. Label their x,y coordinates.



Center Field:	Pitcher:	Shortstop:
Left Field:	First Base:	Third Base:
Right Field:	Second Base:	Catcher:

Module 3.0

Name: ______________________________ Class: __________

The Field of Play

GRADES 6-8

1. Use the distance between the Pitcher and First Base (A), and the Pitcher and Catcher (B). Use the Pythagorean Theorem to calculate the distance between First Base and Catcher. $A^2 + B^2 = C^2$

2. Use the distance between the Pitcher and Third Base (A), and the Pitcher and Catcher (B). Use the Pythagorean Theorem to calculate the distance between Third Base and Catcher. $A^2 + B^2 = C^2$

3. Use the distance between the Pitcher and Center Field (A), and the Pitcher and Third Base (B). Use the Pythagorean Theorem to calculate the distance between Third Base and Center Field. $A^2 + B^2 = C^2$

4. Use the distance between the Pitcher and Center Field (A), and the Pitcher and First Base (B). Use the Pythagorean Theorem to calculate the distance between First Base and Center Field. $A^2 + B^2 = C^2$

5. The Catcher moves to (6, -11). Use the distance between First Base and Catcher (A) and First Base and Pitcher (B). Use the Pythagorean Theorem to calculate the distance between the Pitcher and Catcher. A2+ B2 =C2

6. The Right Fielder moves to (4, 7) in line with the Second Base player. Use the distance between the Second Base player and the Right Fielder (A) and the Second Base player and Shortstop (B). Use the Pythagorean Theorem to calculate the distance between Right Field and Shortstop. $A^2 + B^2 = C^2$

Notes

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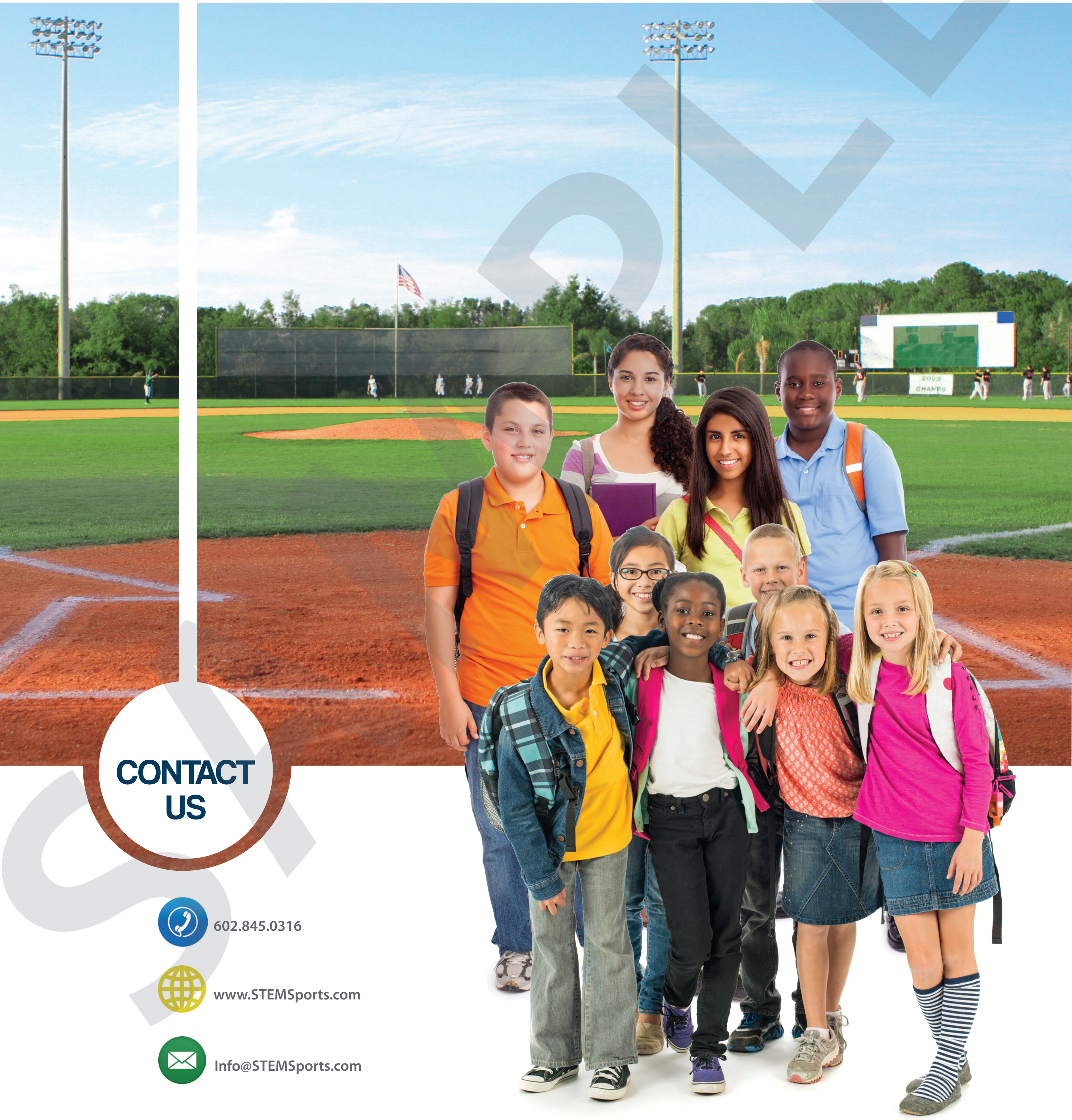

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