

#### **INSIDE:**

Turn the page to learn more about our Digital Assets!

#### Net Edition **Description Description Descrip**

## **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, Microsoft Teams, 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 STEMSports.com/digitaltools** 



# Welcome

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

We are pleased to present Volume 1 of STEM Multi-Sport: Net edition, 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<sup>™</sup> 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 grade, 3rd to 5th grade, and 6th to 8th grade.
- "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<sup>®</sup> 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 lessons for teachers, administrators, or volunteers.
- Professional development or training are not required.

Please visit **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 STEMsports.com/teacher-survey.

We appreciate your feedback.

DISCLOSURE: This curriculum, including any/all portions of this kit/equipment are intended for educational purposes only. The sports of hockey, lacrosse, and tennis involve risk of injury, loss and damage. By choosing to partake in this program, all teachers, students, and participants assume full responsibility for such risks. This curriculum makes no representation or warranty, expressed or implied, including but not limited to any warranty of merchantability or fitness for a particular purpose. There are risks associated with participantion in any athletic activity, and the student/teacher/participant is responsible for any potential risks associated with these activities. STEM Sports® shall not incur any liability for any damages, including but not limited to, direct, indirect, special or consequential damages arising out of, resulting from, or in any way connected to the use of this curriculum, whether or not based upon warranty, contract, or otherwise, whether or not injury was sustained by persons or property, and whether or not loss was sustained or rose out of, the implementation of this curriculum. The curriculum contained within this document is the property of STEM Sports®, and may not be reproduced or otherwise distributed for use without the written consent of STEM Sports®.





Mindfulness may not be the first thing one thinks about STEM Sports<sup>®</sup>. However, mindfulness is essential to fully understanding the design and benefits of the STEM Sports<sup>®</sup> 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<sup>®</sup> 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 should be mindful of the fact STEM Sports<sup>®</sup> 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** should be mindful of the fact STEM Sports<sup>®</sup> 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<sup>®</sup> curricula have to offer. The unique design of the STEM Sports<sup>®</sup> curricula is essential to maximize learning and understanding of STEM concepts in sports and life applications.

© 2019, Dr. Kimberly B Vigil, Raye Educational Services, LLC. Dr. Vigil is an education consultant and mindfulness educator. For more information on mindfulness training for your school/organization, visit **RayeEducationalServices.com** or call 602-510-0298.



## **Contents** Grades 3-5

## Module 1.0

Skating in the Zone

#### Objective

Students will determine the perimeter and area covered when stick-handling by measuring the length and width of a rectangle.

#### Concept

Math: Geometry and Area

**Time** (2) 50-minute sessions

### Module 2.0

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Playing on Ice

#### Objective

Students will learn about the physical properties of ice. Students will create a diagram that demonstrates the change from a liquid (water) to a solid (ice). Students will use this knowledge to determine the best playing surface in hockey.

#### Concept

Physical Science

Time (2) 60-minute sessions

## Module 3.0

**Energy in Lacrosse** 

#### Objective

Students will determine and explain the relationship between the speed of a lacrosse ball and energy of a lacrosse ball. Students will collect data of a controlled experiment.

#### Concept

Science: Energy

Time (2) 60-minute sessions

## Module 4.0

Wearable Technology

#### Objective

Students will observe and gather information on wearable technology. Students will determine if technology can produce equipment to track and enhance a player's movement and performance.

#### Concept

Science: Observations Technology: Information and Instrumentation

#### Time

(2) 50-minute sessions



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## Contents Grades 3-5

## Module 5.0

I'd Love to Keep Score

#### **Objective**

Students will learn how to score the game of tennis through the popular theory of its correlation to an analog clock. Students will use this information to draw fraction diagrams that represent the score in a set, game, and match. Students will use these diagrams to compare different scores throughout a tennis match.

#### Concept

Math: Comparing Values and Expressions

#### Time

(2) 60-minute sessions

## Module 7.0

Let's Serve

#### Objective

Students will learn the rules and strategies of serving in tennis. Students will use technology to find the speed of their serve. Students will analyze the speed and accuracy of their first serve to compare to their second serve.

#### Concept

Math: Decimal Notation for Fractions Use of Technology

#### Time

(2) 50-minute sessions

#### Module 6.0

May the Force Be with You!

#### Objective

Students will design an experiment that collects evidence on gravity and pushing forces on two different shooting and passing motions. Students will justify their explanation using key terms of balanced and unbalanced forces.

#### Concept

Science: Balanced and Unbalanced Forces Use of Technology

#### Time

(2) 45-minute sessions

## Module 8.0 -

Advancements in Tennis

#### Objective

Students will examine the use of instant replay in tennis. Students will evaluate instant replay technology by brainstorming and developing a list of criteria and constraints. Students will write a letter based on their findings to determine if the needs of all stakeholders are being met.

#### Concept

Engineering: Criteria and Constraints of Technology Use of Technology

#### Time

(2-3) 50-minute sessions

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## **Contents** Grades 6-8

## Module 1.0

Skating in the Zone

#### Objective

Students will determine the area of their shooting space by measuring the base and height of a triangle.

#### Concept

Math: Geometry and Area

#### Time

(2) 50-minute blocks

#### PAGE Module 2.0 Playing on Ice

#### Objective

Students will learn about the composition of ice. Students will create a diagram that identifies the physical properties of ice. Students will use this diagram to develop a model that demonstrates molecular transformation and structure to determine the best playing surface in hockey.

#### Concept

**Physical Science** 

#### Time (2-3) 50-minute blocks

## Module 3.0

Kinetic Energy in Lacrosse

#### Objective

Students will collect and graph data of a controlled experiment by using a line graph. Students will explain the relationship between velocity and kinetic energy by making a claim about the relationship using evidence and reasoning.

#### Concept

Science: Physics

#### Time

(3) 50-minute blocks

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## Module 4.0

Wearable Technology

#### Objective

Students will use points on a quadrant plane to measure the length between points for a lacrosse play. Students will demonstrate and explain how technology in lacrosse can improve play.

#### Concept

Math: Coordinate Points Use of Technology

Time (2) 50-minute blocks



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## Module 5.0

I'd Love to Keep Score

#### Objective

Students will learn how to score the game of tennis through the popular theory of its correlation to an analog clock. Students will use this information to write expressions in fraction form that represent the score in a set, game, and match.

#### Concept

Math: Multiplication and Division of Fractions

#### Time

(2) 50-minute blocks

#### Module 7.0

Let's Serve

#### Objective

Students will learn the rules and strategies of serving in tennis. Students will use technology to find the speed of their serve. Students will analyze the speed and accuracy of their first serve to compare to their second serve.

#### Concept

Math: Percentages Use of Technology

**Time** (2) 50-minute blocks

## Module 6.0

May The Force Be With You!

#### Objective

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Students will calculate the force used in two different tennis motions using Newton's Second Law. Students will explain how a change in force affects the acceleration of the ball (when mass remains constant) by using experimental data to support a claim.

#### Concept

Science: Force, Acceleration, and Mass (Newton's Second Law)

#### Time

(2) 50-minute blocks

## Module 8.0

Advancements in Tennis

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#### Objective

Students will examine the use of instant replay in tennis. Students will evaluate instant replay technology by using steps of the Engineering Design Process, such as brainstorming and developing a list of criteria and constraints. Students will write a letter based on their findings to determine if the needs of all stakeholders are being met.

#### Concept

Engineering Design Process Use of Technology

Time (2-3) 50-minute blocks

## Capstone

Choose one of three Capstone projects from either STEM Hockey, STEM Lacrosse, or STEM Tennis to continue the education for grades 6-8.



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## **Supplies Checklist**







**Area:** The amount of space a flat shape (2D) consumes.

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

**Baseline – Tennis Court:** A 36 foot line that stretches along the short sides of a tennis court's rectangular shape. It is the area that forms the back boundaries of the court.

**Center Service Line:** A line on a tennis court that divides the two service boxes on each side.



#### Claim, Evidence and Reasoning (CER):

A writing technique that supports scientific writing; a Claim answers the question or addresses the prompt; Evidence is used from student's experiments or research and explanations; Reasoning is a scientific principle, law or concept that connects the claim and evidence.

**Constraint:** 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.

**Deuce:** In the game of tennis, it is a tied score at 40-all that requires one player to get two successive points to win the game.

**Doubles Alley:** This is the area between the singles and doubles sidelines on a tennis court.

**Double Fault:** Two faults in a row result in the receiving team earning a point, including the following actions and/or scenarios:

- "Let": The ball hits the net and lands in the opposite service box; it doesn't count as anything. The server serves again.
- The ball may bounce once on your side before returning it to the other side. However, the ball does not have to bounce; it can be volleyed/hit before it bounces.



- Your racket or body may not touch the net.
- A ball hitting the net and going over during play is live and playable. When playing doubles, partners do not have to alternate shots.

**Doubles Sideline**: This is the outermost line that runs the length of the entire tennis court.

**Energy:** The motion of molecules or objects.

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



**Equal to:** A relationship between two quantities, or two mathematical expressions, stating that the amounts have the same value, or that the expressions represent the same mathematical object.

**Fault:** If the serve does not land in the correct service box, the serving player will get two chances to serve correctly into the service "opposite" box.

**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.



**Greater than Symbol:** A symbol placed between two numbers where the first number is more than the second number.

**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.



**Less than Symbol:** A symbol placed between two numbers where the first number is less than the second number.

**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.

**Molecular Motion:** An unsystematic movement of molecules inside a substance without any outside influence.



**Molecular Structure:** The manner of electrons and nuclei interacting to form a molecule.

**Molecules:** A group of two or more atoms connected by electrons in a chemical bond.

**Momentum:** The product of mass and velocity; a measure that describes an object's ability to continue in motion.

**Observation:** The process of carefully watching or examining a person or object.

**Perimeter:** A continuous line forming the boundary of a closed geometric figure.

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

**Right Triangle:** A triangle with a 90° angle.

**Slap Shot:** The hardest shot in hockey that requires full and one fluid body motion to execute. Slap shot typically requires a player to raise the stick's blade above their shoulders or higher, whereas a "One-timer" is often lower or at shoulder height due to timing by way of receiving a teammate's pass.

#### **States of Matter:**



- A **Solid** is a set of atoms or molecules held together (within a constant state) so they maintain a distinct shape and size.
- A Liquid is a state of matter defined by its condensed make-up and ability to flow.
- **Gas** is a state of matter defined by its movable or non-condensed state and/or ability to flow.

**Stick-Handling:** A player's ability to effectively control the puck with their stick.

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



**Tennis Racket:** Sports equipment consisting of a handle and oval frame with tight interlaced strings used to hit the ball.

**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.

**Wrister:** A wrist shot in which a player uses their arms (less body) to generate force on the shot.





## **Playing on Ice**

#### Concept

**Physical Science** 

#### Objective

Students will learn about the physical properties of ice. Students will create a diagram that demonstrates the change from a liquid (water) to a solid (ice). Students will use this knowledge to determine the best playing surface in hockey.

#### Time

(2) 60-minute sessions

## Standards

#### Next Generation Science Standards Connections

**5-PS1-1:** Develop a model to describe that matter is made of particles too small to be seen.

**5-PS1-2:** Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.

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

#### National Standards for K-12 Physical Education Connections

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

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

#### Supplies Provided Worksheets

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Visit <u>STEMSports.com/digitaltools</u> to access presentation decks, worksheets, and answer keys.

#### **Materials Needed**

Pencils Optional yet recommended: Ice Rink/Platform

## **Sequence of Lesson**



Have your students take this lesson's assessment prior to engaging by visiting: STEMSports.com/assessments

If you have limited digital capability, please email Info@STEMSports.com to access the Assessment & Key.

**Engage:** Ask students the following: What do you think of when you see ice? Have you ever walked or skated on ice? If so, what makes it unique from walking on a basketball court or soccer field?

**Explore:** Have students reference the images of the hockey player and the physical results to the ice after skating/playing hockey. With a partner, ask students to brainstorm and share why they think this is a reaction with the ice and share out with the class.

Teacher note: We strongly recommend the use of an ice rink/platform for students to skate on, and if possible, play a game of hockey to witness the physical results on the ice.





**Explain:** Define the terms Molecule and Molecular Structure for students, which can be found in the STEM Sports<sup>®</sup> Glossary in the front of this manual and at **STEMSports.com** under Resources. Tell students that all things, including ice/water, are made up of small particles we can not see called "molecules". Explain that while we can see the physical properties of water, we are unable to witness the change from a liquid (water) to a solid (ice) in real time. Using the molecular images as a guide, explain to students that when water reaches its freezing point of 0° Celsius or 32° Fahrenheit, molecules form a definitive structure known as a "molecular structure".

#### Elaborate: Use the

diagram on page 21 and define the following key terms: **Critical Point and** Triple Point, which can be found in the STEM Sports® Glossary in the front of this manual and at STEMSports.com under Resources. Tell students the Toluene diagram depicts the states of matter – by phase – when transforming from a gas (vapor), liquid (water), and solid (ice).

Have students create a diagram that demonstrates the change from a liquid Solid (Ice)



Liquid (Water)



to a solid. Encourage students to use lines, arrows, boxes, and circles to clearly outline and describe this change. Use the worksheet as a guide.

**Evaluate:** Using the worksheet as a guide, have students fill in the blanks to determine the best playing surface for hockey.



Have your students retake this lesson's assessment to effectively evaluate their comprehension by visiting: STEMSports.com/assessments

If you have limited digital capability, please email Info@STEMSports.com to access the Assessment & Key.

**Extend:** Students could draw a scale model of a hockey rink and depict how the playing surface/ ice transforms through heat/energy before, during, and after a hockey game by inserting the third state of matter: gas (vapor).

## STEM Jobs in Sports

- Ice Technician
- Zamboni Mechanic & Operator
- Ice Crew
- Hockey Skating Coach
- Operations Coordinator, Women's Ice Hockey

For a growing list of occupations throughout the sports industry, click on the resource tab at <u>STEMSports.com</u>.

## **Fun Facts**

The ice in a hockey rink is less than an inch thick.







#### Elaborate

Create a diagram that demonstrates the change from a liquid to a solid. Use lines, arrows, boxes, and circles to clearly describe this change.







## Playing on Ice GRADES 3-5







# Playing on Ice

#### Evaluate

Fill in the blanks to determine the best playing surface for ice hockey.

2. The temperature to play ice hockey must be at least: \_\_\_\_\_°C / \_\_\_\_\_°F

3. Before changing to ice, it is this state of matter \_\_\_\_\_\_. (Solid or Liquid)

- 4. To play on the ice, it must be in this state of matter \_\_\_\_\_\_. (Liquid or Solid)
- 5. Based on the images from the *Explore* section, as well as your diagram that demonstrates the change from a liquid to a solid, why do you think this reaction occurs on ice? Please explain your answer.







## Playing on Ice

#### Concept

**Physical Science** 

#### **Objective**

Students will learn about the composition of ice. Students will create a diagram that identifies the physical properties of ice. Students will use this diagram to develop a model that demonstrates molecular transformation and structure to determine the best playing surface in hockey.

#### Time

(2-3) 50-minute blocks

## **Standards**

#### **Next Generation Science** Standards Connections

**MS-PS1-1:** Develop models to describe the atomic composition of simple molecules and extended structures.

MS-PS1-4: Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

#### National Standards for K-12 Physical Education Connections

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

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

#### **Supplies Provided** Worksheets

Visit STEMSports.com/digitaltools to access presentation decks, worksheets, and answer keys.

#### **Materials Needed** Pencils

Optional yet recommended: Ice Rink/Platform

## **Sequence of Lesson**



Have your students take this lesson's assessment prior to engaging by visiting: STEMSports.com/assessments

If you have limited digital capability, please email Info@STEMSports.com to access the Assessment & Key.







**Engage:** Ask students the following: What do you think of when you see ice? Have you ever walked or skated on ice? If so, what makes it unique from walking on a volleyball court or football field?

**Explore:** Have students reference the images of the hockey player and the physical results to the ice after skating/playing hockey to the right. With a partner, ask students to brainstorm and share why they think this is a reaction with the ice and share out with the class.

Teacher note: We strongly recommend the use of an ice rink/platform for students to skate on, and if possible, play a game of hockey to witness the physical results on the ice.

**Explain:** Define the terms Molecule and Molecular Structure for students, which can be found in the STEM Sports<sup>®</sup> Glossary in the front of this manual and at **STEMSports.com** under Resources. Tell students that all things, including ice/water, are made up of small particles we can not see called "molecules". Explain that while we can see the physical properties of water, we are unable to witness the change from a vapor (gas) to a liquid (water) to a solid (ice) in real time. Using the image as a guide, identify the three states of matter and following temperatures of each state:







- Gas Water Vapor: Above 100°C / 212°F
- Liquid Water: 0° 100°C / 32° 212°F
- Solid Ice: O°C / 32°F or below

Explain to students that molecules form a definitive structure during the solid state known as "molecular structure" as energy/temperature decreases.

**Elaborate:** Define the following key terms: Critical Point and Triple Point, which can be found in the STEM Sports<sup>®</sup> Glossary in the front of this manual and at <u>STEMSports.com</u> under Resources. Tell students the Toluene diagram depicts the states of matter - by phase - when transforming from a gas (vapor), liquid (water), and solid (ice).

Have students create and label an outline that demonstrates the transformation from a gas to a liquid to a solid. Students should use lines, arrows, boxes and/or circles to concisely describe each composition's transformation from a few molecules to a defined structure.

**Evaluate:** Have students draw a scale model of a hockey rink and depict how the playing surface/ice is created and sustainable using information and data throughout the lesson, including molecular transformation by way of heat/energy before, during, and after a hockey game.

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

**Extend:** Students could research the properties and function of a Zamboni to understand its effectiveness to sustain and ensure the best playing surface.

## STEM Jobs in Sports

- Ice Technician
- Zamboni Mechanic & Operator
- Ice Crew
- Hockey Skating Coach
- Operations Coordinator, Women's Ice Hockey

For a growing list of occupations throughout the sports industry, click on the resource tab at <u>STEMSports.com</u>.

## **Fun Facts**

The layer of ice in an NHL rink is approximately three-quarters of an inch thick and is kept at a temperature of -9° Celsius or 16° Fahrenheit.



Class: \_\_\_\_

## Playing on Ice GRADES 6-8

#### Elaborate

Create and label an outline that demonstrates the transformation from a gas to a liquid to a solid. Use lines, arrows, boxes and/or circles to concisely describe each composition's transformation from a few molecules to a defined structure.









## Playing on Ice GRADES 6-8

#### Evaluate

Draw a scale model of a hockey rink. Depict how the playing surface/ice is created and sustainable using information and data throughout the lesson, including molecular composition and transformation by way of heat/energy before, during, and after a hockey game.











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