VOLUME
2

STEM sports®

science • technology
engineering • math • sports

STEM BASKETBALL

SUPPLEMENTAL CURRICULUM

GRADES 3 - 5 AND GRADES 6 - 8

Welcome

STEM Sports® provides turnkey K-8 supplemental curriculum that uses 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 2 of STEM Basketball, highlighted by the following:

- Content for a minimum of 16 hours of instruction that includes some healthy, physical activity.
- Turnkey kits come equipped with all of the relevant sports equipment along with the necessary science supplies.
- Each curriculum has eight lessons aligned with the Next Generation Science Standards (NGSS) and/or Common Core State Standards (CCSS) and/or National Standards for K-12 Physical Education.
- Through our 5E lesson plans, students will develop 21st-century skills such as critical thinking, collaboration, creative problem-solving, and leadership.
- Differentiation: lessons for 3rd to 5th graders and lessons for 6th to 8th grade students.
    - "Capstone" Project (6th to 8th) to commensurate student's knowledge of each curriculum.
- Assessments in each lesson to effectively evaluate students.
- Ready-to-use worksheets that align with each lesson and standards.
- Each module has a list of STEM-based, sports-related jobs pertinent to the lesson concept.
- Engineering Design Process (EDP) woven into each curriculum.
- Mindfulness Matters: important messaging to assist with the uniqueness of blending STEM with sports.
- Well designed and scalable for teachers, administrators, or volunteers.

Please visit www.STEMSports.com for additional information and to learn about the other STEM Sports® curriculum that we offer.

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

Please complete our Teacher's Survey at www.stemsports.com/teacher-survey.
We appreciate your feedback.

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Mindfulness Matters

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Mindfulness may not be the first thing one thinks about regarding 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

Contents

Grades 6-8

Module 5.1
Engineering Design Process

PAGE 58

Objective
Students will design and build a mechanical shooting device (aka catapult) by using the Engineering Design Process. Students will test and redesign their prototype by using Newton's Second Law to determine the change in force.

Concept
Engineering and Science: Physics

Time
(3) 50-minute blocks

Module 6.1
Calculating Calories

PAGE 62

Objective
Students will explain how food is converted to energy (kcal) through cellular respiration. Students will develop an equation for calories burned during activity by using letters to represent variable for the equation.

Concept
Science and Math: Biology and Equations

Time
(1) 50-minute block

Module 7.2
Shot Tracking with Technology

PAGE 66

Objective
Students will use data collected to make a claim using evidence from technology by interpreting graphs.

Concept
Science and Math: Process of Science, Statistics

Time
(2) 50-minute blocks

Module 8.1
Advancements in Shoe Technology

PAGE 70

Objective
Students will use qualitative data to evaluate and improve shoe technology by using the Engineering Design Process.

Concept
Engineering

Time
(2) 50-minute blocks

Supplies Checklist

- [ ] **Five (5)** indoor basketballs
- [ ] **Five (5)** outdoor basketballs
- [ ] **Five (5)** 25' tape measures
- [ ] **Five (5)** hair dryers
- [ ] **Five (5)** calipers
- [ ] **Twelve (12)** protective eyewear
- [ ] **Five (5)** cut ball swatches - indoor
- [ ] **Five (5)** cut ball swatches - outdoor
- [ ] **Five (5)** masking tape rolls
- [ ] **One Hundred (100)** plastic spoons
- [ ] **Five (5)** digital timers
- [ ] **One Thousand (1,000)** craft sticks
- [ ] **Four-Hundred Seventy-Five (475)** rubber bands
- [ ] **Two (2)** ball bags
- [ ] **One (1)** ball pump
- [ ] **One (1)** set of inflation needles
- [ ] **One (1)** STEM Basketball Curriculum Manual

Materials Needed

- [ ] 18x18 Pieces of Paper
- [ ] Marshmallows
- [ ] Notecards
- [ ] Large Bucket
- [ ] Projector
- [ ] Tennis Balls
- [ ] Cotton Balls
- [ ] Music Player
- [ ] Ice
- [ ] Internet Access
- [ ] Golf Balls
- [ ] Labels of Multiple Foods
- [ ] Student Shoes or Sample Shoes
- [ ] Poster Paper
- [ ] iPhone 6s or later
- [ ] Baseballs
- [ ] Calculators
- [ ] Plain Paper
- [ ] Markers
- [ ] iPad 6th Generation or later

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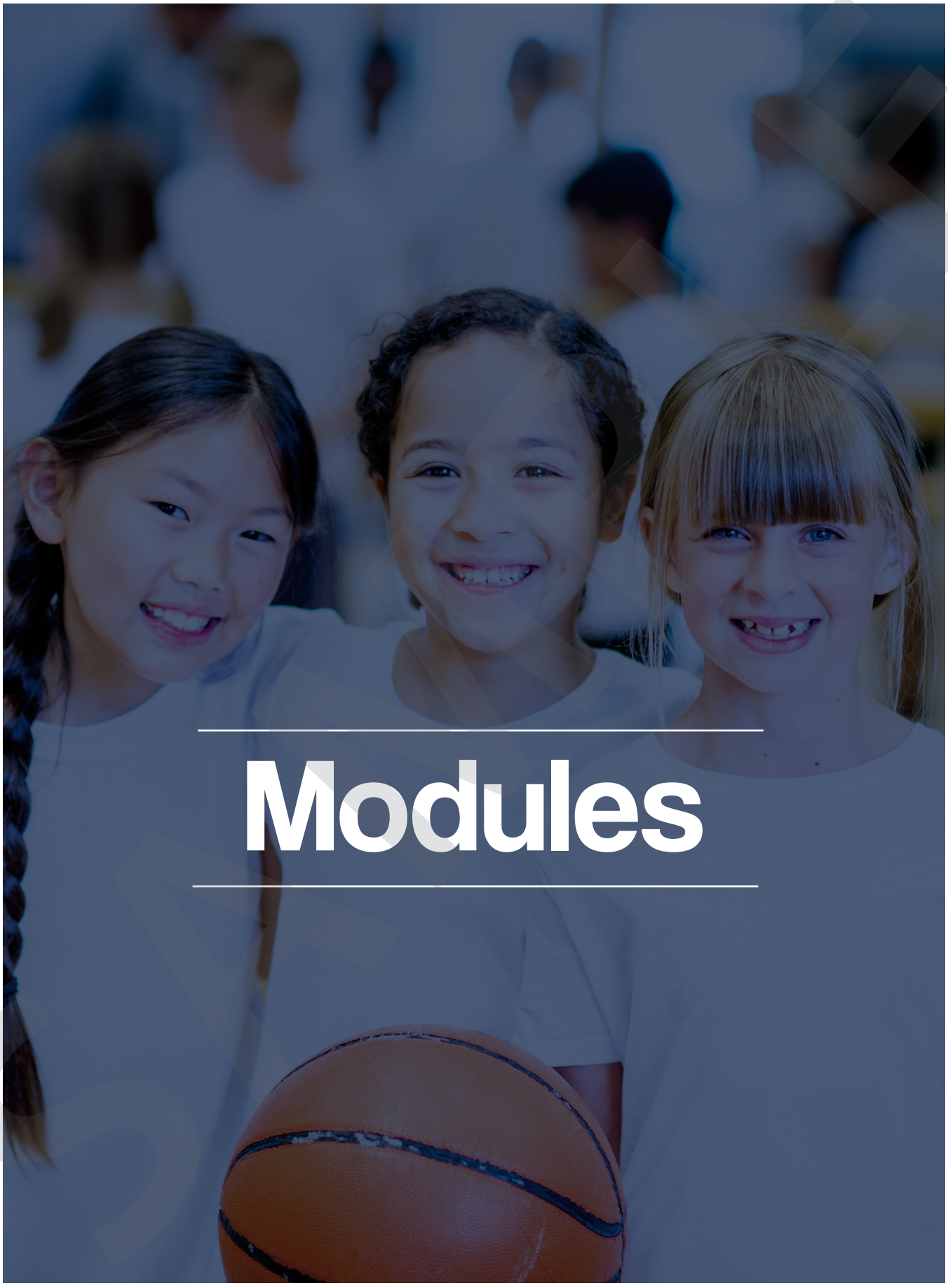

Modules

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Module 2.1

GRADES 3-5

Forces in Basketball

Concept
Science: Motion and Gravity

Objective
Students will conduct a controlled experiment to determine the change in motion by measuring the number of bounces and the height of the first bounce. Students will predict how gravity/motion will affect/change the ball if it is dropped at a higher or lower height.

Time
(2) 45-minute sessions

Standards

Next Generation Science Standards Connections

3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

4-PS3-1. Use evidence to construct an explanation relating the speed of an object to the energy of that object.

4-PS3-3. Ask questions and predict outcomes about the changes in energy that occur when objects collide.

5-PS2-1. Support an argument that the gravitational force exerted by Earth on objects is directed down.

National Standards for K - 12 Physical Education

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

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

Supplies Provided
Worksheets, Tape Measures, Masking Tape and Basketballs

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: Allow students to dribble the ball. Ask them the following: How does dribbling work? Why does the ball bounce back up? How can you change the motion of the ball?

Explore: Students conduct experiments measuring the total height, number of bounces when a basketball is dropped from a variety of heights, and attempt to identify patterns in the behavior of the ball.

1. With a small group or a partner, find a hard surface next to a wall (Control Variable).
2. From the floor, measure 48 inches up the wall and mark the spot with masking tape (Independent Variable).
3. Holding the ball against the wall, lineup the bottom of the ball with the top of the tape.
4. From the measured height, drop the ball.
5. Measure the height the ball returns to after the first bounce. One partner should be counting the number of times the ball bounces until it stops bouncing and comes to a rest. Record data (Dependent Variable).
6. Using the same ball and surface, repeat steps 4 - 6, but this time from a height of 24 inches (Independent Variable).
7. Repeat each trial 3 - 5 times.

Explain: Explain that gravity occurs when the ball bounces and that dribbling occurs with a combination of gravity and force is placed on the ball. In turn, ask students to come up with other examples for gravity making things fall or bounce.

Elaborate: Ask students to think back to the experiment and how they can change the motion of the ball (or increase the energy of the bounce). The worksheet will guide them to the areas of the experiment they should change and keep the same.

Evaluate: Students should answer the following questions: Why does the motion of the ball change when you push on it vs. drop it? How does gravity change the motion of a basketball if it is further away from the ground?
Predict what would happen if you dropped the basketball from 12 inches and 50 inches.

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: Complete the experiment with another variable. Hard and soft surfaces as the independent variable; air pressure changes as the independent variable

STEM Jobs in Sports
- Statistician
- Head Coach
- Director of Basketball Operations
- Equipment Manufacturer
- Engineer

Fun Facts
The Guinness World Record for longest dribbling was done over 3 days from December 10, 2007 until December 12, 2007 by Pawan Kumar Srivastava for 55 hours and 26 minutes.

Name: _____

Gravity and Push Force

GRADES 3-5

Part 1

# of bounces	Trial 1	Trial 2	Trial 3
48 inches			
24 inches			

Part 2

# of bounces	Trial 1	Trial 2	Trial 3
48 inches Dropped			
48 inches Dribbled/Pushed			
24 inches Dropped			
24 inches Dribbled/Pushed			

Name: _____

Gravity and Push Force

GRADES 3-5

QUESTIONS:

1. Why does the motion of the ball change when you push on it vs. drop it?

_____

_____

_____

_____

2. How does gravity change the motion of a basketball if it is further away from the ground?

_____

_____

_____

_____

3. Predict what would happen if you dropped the basketball from 12 inches and 50 inches.

_____

_____

_____

_____

_____

Module 2.1

GRADES 6-8

Science of Basketball

Concept
Science: Physics

Objective
Students will compare the forces acting and reacting to a basketball by using data from a controlled experiment. Students will explain how Newton's Third Law is demonstrated in dribbling a basketball.

Time
(3) 50-minute blocks

Standards

Next Generation Science Standards Connections

MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.

MS-PS2-4. Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.

Common Core State Standards Connections

CCSS.MATH.CONTENT.6.SP.B.5
Summarize numerical data sets in relation to their context, such as by:

- **CCSS.MATH.CONTENT.6.SP.B.5.A**
  Reporting the number of observations.
- **CCSS.MATH.CONTENT.6.SP.B.5.**
  Describing the nature of the attribute under investigation, including how it was measured and its units of measurement.
- **CCSS.MATH.CONTENT.6.SP.B.5.C**
  Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.
- **CCSS.MATH.CONTENT.6.SP.B.5.D**
  Relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data were gathered.

National Standards for K - 12 Physical Education

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

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

Supplies Provided

Worksheets, Tape Measures, Masking Tape and Basketballs

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: Allow students to dribble the ball. Ask them the following: How does dribbling work? Why does the ball bounce back up? What variables would affect the ball's ability to bounce?

Explore: Using the student's engaged responses, or the following questions: How do different surfaces affect the ball bouncing? How does the amount of air in the ball affect the ball bounce? Allow students to design an experiment to test their questions. In lieu of students designing an experiment, you can use the following:

- Students conduct experiments measuring the total height, number, and duration of a bouncing basketball dropped from a variety of heights, and attempt to identify patterns in the behavior of the ball.
  1. With a small group or a partner, find a hard surface next to a wall (Control Variable).
  2. From the floor, measure 48 inches up the wall and mark the spot with masking tape (Independent Variable).
  3. Holding the ball against the wall, lineup the bottom of the ball with the top of the tape.
  4. From the measured height, drop the ball.
  5. Measure the height the ball returns to after the first bounce. One partner should be counting the number of times the ball bounces until it stops bouncing and comes to a rest. Record data (Dependent Variable).
  6. Using the same ball and surface, repeat steps 4 - 6, but this time from a height of 24 inches (Independent Variable).
  7. Repeat each trial 3 - 5 times.

Explain: Explain to the students the force acting on the ball is gravity and is the normal force. Draw a force diagram for both dribbling and dropping the ball. Explain the reason why the ball bounces back up is because of Newton's Third Law -- for every action there is an equal and opposite reaction.

Elaborate: Ask students to think back to the experiment and collect data on the difference between bouncing and dribbling the ball.

Evaluate: Students should answer the following question: How does dropping the ball and dribbling the ball change how Newton's Third Law is demonstrated? (By dribbling the ball, the player adds a force with each bounce, plus gravity is acting on the ball. By dropping the ball, only gravity is acting on the ball -- less force on the dropped ball equals less reaction). Make a hypothesis on how bouncing the ball on a harder surface would change the forces acting on the ball.

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: Complete the experiment with another variable. Hard and soft surfaces as the independent variable; air pressure changes as the independent variable.

STEM Jobs in Sports

- Athletic Material Scientist
- Equipment Manufacturer
- Sports Physiologist
- Athletic Quality Control Coordinator
- Facility Safety Engineer

Fun Facts

The Guinness World Record for longest dribbling was done over 3 days from December 10, 2007 until December 12, 2007 by Pawan Kumar Srivastava for 55 hours and 26 minutes.

Name: _____ Class: _____

Science of Basketball

GRADES 6-8

Part 1

# of bounces	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Average
48 inches						
24 inches						

Part 2

# of bounces	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Average
48 inches Dropped						
48 inches Dribbled						
24 inches Dropped						
24 inches Dribbled						

Name: _____ Class: _____

Science of Basketball

GRADES 6-8

QUESTIONS:

1. How does dropping the ball and dribbling the ball change how Newton's Third Law is demonstrated?

_____

_____

_____

_____

_____

2. Make a hypothesis on how bouncing the ball on a harder surface would change the forces acting on the ball. _____

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Notes

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CONTACT US

602.845.0316

www.STEMSports.com

Info@STEMSports.com