



# STEM VOLLEYBALL

C U R R I C U L U M



# VOLLEYBALL CURRICULUM

We greatly appreciate your purchase of our STEM Volleyball kit. In your kit, you will find all the items you need to transform your students into critical thinkers.

Another advantage of having any STEM Sports® program is that it is designed to have a long shelf-life and is flexible to be applied in classrooms, during after-school programs, and even in camp settings.

STEM Volleyball is not the only program we have available. Check out [www.STEMSports.com](http://www.STEMSports.com) for additional sports such as basketball, BMX, football, multi-sport, and soccer. Each and every curricula are aligned with **Next Generation Science Standards (NGSS)** and **Common Core State Standards (CCSS)** and are designed by the most knowledgeable people in education and sport.

**We sincerely hope you and your students enjoy this STEM Sports® curriculum!**



# VOLLEYBALL CURRICULUM

## INTRODUCTION

USA Volleyball is the National Governing Body (NGB) for the sport of volleyball in the United States and is recognized as such by the Federation International de Volleyball and the United States Olympic Committee (USOC). The vision of USA Volleyball is to be a world-class leading organization in all aspects of volleyball and to engage and inspire our nation through a cultivated passion for the game and continued success at winning Olympic and Paralympic medals.

The mission of USA Volleyball is to lead, serve and grow all areas of the sport of volleyball - including beach, indoor and sitting - achieving excellence while providing a lifetime of opportunities for all to participate in a safe and positive environment. In order to accomplish this mission, USA Volleyball has established four strategic priorities:

- **Sustained competitive International, Olympic and Paralympic Success:** As the USOC-recognized NGB, provide the opportunities and support necessary for our athletes at all levels of international competition, in beach, indoor and sitting, to reach the podium.
- **Participation, Program and Membership Growth:** Provide the opportunities and resources through available programs which develop and retain a steadily growing participation base and a membership that is increasingly diversified.
- **Resource Optimization:** Have a strategic and fiscally prudent financial plan that includes both resource cultivation and judicious allocation in support of our overall goals.
- **Marketing and Brand Affinity:** Increase brand awareness while expanding affinity for USA Volleyball.

USA Volleyball is committed to and works toward opportunity for all to participate. It is an advocate for all Americans endeavoring to assure universal access to opportunities at all levels of the game. Thus, USA Volleyball will diligently:

- Work toward provision of ample opportunity, quality opportunity and equality of access for every resident of this diverse nation.
- Act to expand opportunity for under-represented groups and aggressively recruit participation from those groups.
- Make its daily decisions concerning resources, players, coaches, officials, administrators, and employees on the basis of individual merit and excellence of performance regardless of age, class, ancestry, color, national origin, race, religious creed, disability or handicap, gender, or sexual orientation.
- Exercise its corporate will to encourage constituent organizations to act in accordance with the foregoing principles.



# VOLLEYBALL CURRICULUM

USA Volleyball believes that volleyball has so many positive things to offer those who participate. First, and most importantly, whether one is a gifted athlete or a recreational player, volleyball is fun. It is a lifetime sport enjoyed by players from 8 to 80. Participation in volleyball is not only good exercise but also involves team cooperation and spirit. We are committed to introducing our sport to all of America. Exercise its corporate will to encourage constituent organizations to act in accordance with the foregoing principles

## STRUCTURE

This STEM Volleyball manual is designed to deliver content for a minimum of 16 hours of instruction. Each kit can reach hundreds of students as a project-based, student-centered, and student-led program. Each of the eight modules is designed for groups of 12 students (6 pairs) at a time. If a classroom has 24 students, they would break up into two groups and the same lesson could be administered to all 24 students, simultaneously. The enclosed curriculum is your guide as a teacher/administrator/volunteer to implement the program. How you format that instruction is up to you. In the back of this book are the worksheets for each lesson. The worksheets are to be copied for each student to use and keep as they work their way through each exercise.

 **See Appendix to reference Next Generation Science Standards and Common Core State Standards connections.**

## DISCLAIMER

This curriculum, including any/all portions of this kit/equipment are intended for educational purposes only. Sports 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 participation 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 from, 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®.



# VOLLEYBALL CURRICULUM

## MODULES

- MODULE 1.0 - COURT AND MATHEMATICS
- MODULE 2.0 - USING TECHNOLOGY
- MODULE 3.0 - SERVING AND SCIENCE
- MODULE 4.0 - SCIENTIFIC METHOD
- MODULE 5.0 - VOLLEYBALL PROPERTIES
- MODULE 6.0 - CALCULATING TOTAL CONTACT TIME
- MODULE 7.0 - OPTIMAL SERVE SPEED
- MODULE 8.0 - ENGINEERING DESIGN PROCESS

## WORKSHEETS

- MODULE 3.0 - SERVING AND SCIENCE
- MODULE 4.0 - SCIENTIFIC METHOD
- MODULE 5.0 - VOLLEYBALL PROPERTIES
- MODULE 6.0 - CALCULATING TOTAL CONTACT TIME
- MODULE 7.0 - OPTIMAL SERVE SPEED

## ADDITIONAL INFO

- SUPPLIES CHECKLIST
- APPENDIX
- NOTES SHEETS
- CONTACT US





# MODULES

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# MODULE 3.0

## SERVING AND SCIENCE

**CONCEPT:** The Magnus Effect and Bernoulli's Principle

**OBJECTIVE:** The students will discuss how these two laws apply to the game of volleyball.

Many times, these two laws are seen as similar, yet they are different. Magnus Effect, or Magnus Force is named after Gustav Magnus. He explained how projectiles can curve when moving through a fluid (like air). When a ball is spinning, the Magnus Force will push it in a direction perpendicular to the direction of movement. Bernoulli's Principle, or Bernoulli's Equation, named after Daniel Bernoulli, says a slow-moving fluid exerts more pressure than a fast-moving fluid. In the case of volleyball, the fluid is air. In simple terms, the Magnus Effect gives the ball the spin and Bernoulli's Principle gives the lift or drop.

### ACTIVITY

One of the key skills in volleyball is serving. The key to a good serve is having an idea and a routine. What are you going to do and how are you going to do it? In other words, where are you serving the ball and what type of serve are you going to use?

Most beginners worry about getting the ball over the net and lose focus on the other details. For this exercise we remove the distraction of the net. Do not use a net for this exercise.

The three types of serves are torque serve, overhead, and underhand. For this exercise we are going to use the torque serve. For a video demonstration, follow the instructions on the following page.

Pair off in groups of two with a balloon and two volleyballs. Stand 30 feet (9 meters) from a wall, using the wall as a backdrop. One partner will record data while the other is serving. The partner that is recording data is also looking for movement in the ball. What is the balloon/ball doing?

Starting with the balloon, using a torque serve, strike it towards the wall. Repeat this five times then switch places with your partner. Now switch to the recreational volleyball, still using a torque serve, and strike the ball towards the wall. Repeat five times then switch places with your partner. After each of you has done this five times, switch to the light touch volleyball and repeat the process five times each.



# SERVING AND SCIENCE

## MODULE 3.0

**CONCEPT:** The Magnus Effect and Bernoulli's Principle

**OBJECTIVE:** The students will discuss how these two laws apply to the game of volleyball.

### QUESTIONS

1. Did you notice movement in each? If so, please describe it.
2. How can you tell if the sphere was moving?
3. When the sphere moved,
4. Did you notice any change in the movement between three spheres? If so, why?
- what did you do differently to cause the change in direction?

Now, go back and repeat the activity again with the balloon, Light Touch Volleyball, and Recreation Volleyball, but try to make contact on the top part of the sphere rather than making direct contact with the center of the sphere.

5. Any change in movement from before?
6. Did it create more movement or less movement? Why do you think that?

### OUTCOME:

Students should be able to describe and discuss the forces at play and how those forces affect the balls and balloon and ultimately, how those actions could affect match play.

### RELATED SKILL SET:

Torque serve

### STANDARDS:

See appendix on page 27 to reference the NGSS and CCSS connections.

### RELATED VIDEO:

<https://www.teamusa.org/usa-volleyball/video/2013/12/13/usav-skill-video-torque-serve>

### STEM JOBS IN SPORTS

- Physics Teacher or Professor
- Aeronautical Engineer
- Coach
- Biomechanics Coach
- Information Technology (IT)

### FUN FACTS

The ideal speed for a floater serve is calculated at 38-42 MPH.

### MATERIALS

Recreational volleyball

Balloons

Light Touch volleyball

Worksheet





# WORKSHEETS

# SERVING AND SCIENCE

# MODULE 3.0 WORKSHEET

Record your findings (what the ball is doing) below:

**Striking**  
Center of Sphere (Ball)

**Striking**  
Top of Sphere

### Balloon

<b>Partner 1</b>		
<b>Partner 2</b>		

### Recreational Ball

<b>Partner 1</b>		
<b>Partner 2</b>		

### Light Touch Ball

<b>Partner 1</b>		
<b>Partner 2</b>		



# ADDITIONAL INFO

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# SUPPLIES CHECKLIST

## PROVIDED (QUANTITIES):

<input type="checkbox"/>	Six (6) Molten First Touch volleyballs
<input type="checkbox"/>	Six (6) Molten Light Touch volleyballs
<input type="checkbox"/>	Six (6) Molten Recreational volleyballs
<input type="checkbox"/>	One (1) P&G inflatable GoPlay! Volleyball
<input type="checkbox"/>	One (1) radar gun
<input type="checkbox"/>	Six (6) ribbon spools
<input type="checkbox"/>	Six (6) masking tape rolls
<input type="checkbox"/>	Six (6) 25' tape measures
<input type="checkbox"/>	One (1) weight scale
<input type="checkbox"/>	One (1) fishing line spool
<input type="checkbox"/>	One (1) box of 500 toothpicks
<input type="checkbox"/>	One (1) package of 100 straws
<input type="checkbox"/>	One (1) package of 100 latex balloons
<input type="checkbox"/>	Two (2) Molten ball bags
<input type="checkbox"/>	One (1) set of inflation needles
<input type="checkbox"/>	One (1) ball pump
<input type="checkbox"/>	One (1) STEM Volleyball Curriculum Manual

**MODULE 3.0: SERVING AND SCIENCE****NEXT GENERATION SCIENCE STANDARDS CONNECTIONS:**

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

**3-5.ETS1-1.** Define a simple problem reflecting a need or a want that includes specific criteria for success and constraints on materials, time, or cost.

**3-5.ETS1-2.** Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

**3-5.ETS1-3.** Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

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

**MS-PS2-2.** Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

**MS-PS2-3.** Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.

**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.

**MS-PS2-5.** Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.

**MS-PS3-1.** Construct and interpret graphical displays of data to describe relationships of the kinetic energy to the mass of an object and to the speed of an object.

**MS-PS3-2.** Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.

**MS-PS3-3.** Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.

**MS-PS3-4.** Plan an investigation to determine the relationships among the transferred, the type of matter, the mass, and the change in kinetic energy of the particles as measured by the temperature of the sample.



# STANDARDS APPENDIX

**MS-PS3-5.** Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

**MS-ESS1-1.** Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.

**MS-ESS1-2.** Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.

**MS-ESS1-3.** Analyze and interpret data to determine scale properties of objects in the solar system.

**MS-ESS1-4.** Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.

## **COMMON CORE STATE STANDARDS CONNECTIONS:**

**RST.6-8.1.** Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

**RST.6-8.3.** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

**WHST.6-8.1.** Write arguments focused on discipline-specific content.

**WHST.6-8.7.** Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

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**SL.8.5.** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.

**MP.2.** Reason abstractly and quantitatively.

**MP.4.** Model with mathematics.

**6.NS.C.5.** Understand that positive and negative numbers are used together to describe quantities having opposite directions or values; use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation.



# APPENDIX STANDARDS

**6.EE.A.2.** Write, read, and evaluate expressions in which letters stand for numbers.

**6.EE.B.6.** Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number or, depending on the purpose at hand, any number in a specific set.

**7.EE.B.3.** Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form, using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.

**7.EE.B.4.** Use variables to represent quantities in a real-world or mathematical problem and construct simple equations and inequalities to solve problems by reasoning about the quantities.

**7.EE.B.6.** Use variables to represent quantities in a real-world or mathematical problem and construct simple equations and inequalities to solve problems by reasoning about the quantities.



# NOTES

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### **Olympic & Paralympic NGB –**

USA Volleyball (USAV) is the USOC- recognized National Governing Body and believes that volleyball has so many positive things to offer those who participate. We are also the sole US representative for the 221 nation International Volleyball Federation and World ParaVolley.

### **Lifetime & Safe Sport -**

First, and most importantly, whether one is a gifted athlete or a recreational player, volleyball is FUN! It is enjoyed by players of all ages, both single gender teams and played coed, with national championships for 11 year olds & under to 80 year olds & over. Participation in the non-contact sport of volleyball is not only good and safe exercise but also involves team cooperation and spirit.

STEM is a great start to this lifetime sport, including the options to re-do all chapters for beach (on an 8x16m court, same height nets) and the third

discipline for all to play – sitting volleyball, the Paralympic sport, on a 6 x 10m court and net just a yard high.

### **Path to the Podium -**

USAV provides the opportunities and support necessary for our athletes at all levels of international competition, in beach, indoor and sitting, to reach the podium. We train officials also set the rules for the sport in the USA – for more info and tons of free resources from the rule book to videos, articles, coaching and officiating education, court creation ideas, membership in one of our 40 Regions and more, visit [www.usavolleyball.org](http://www.usavolleyball.org) or email [mvp@usav.org](mailto:mvp@usav.org)

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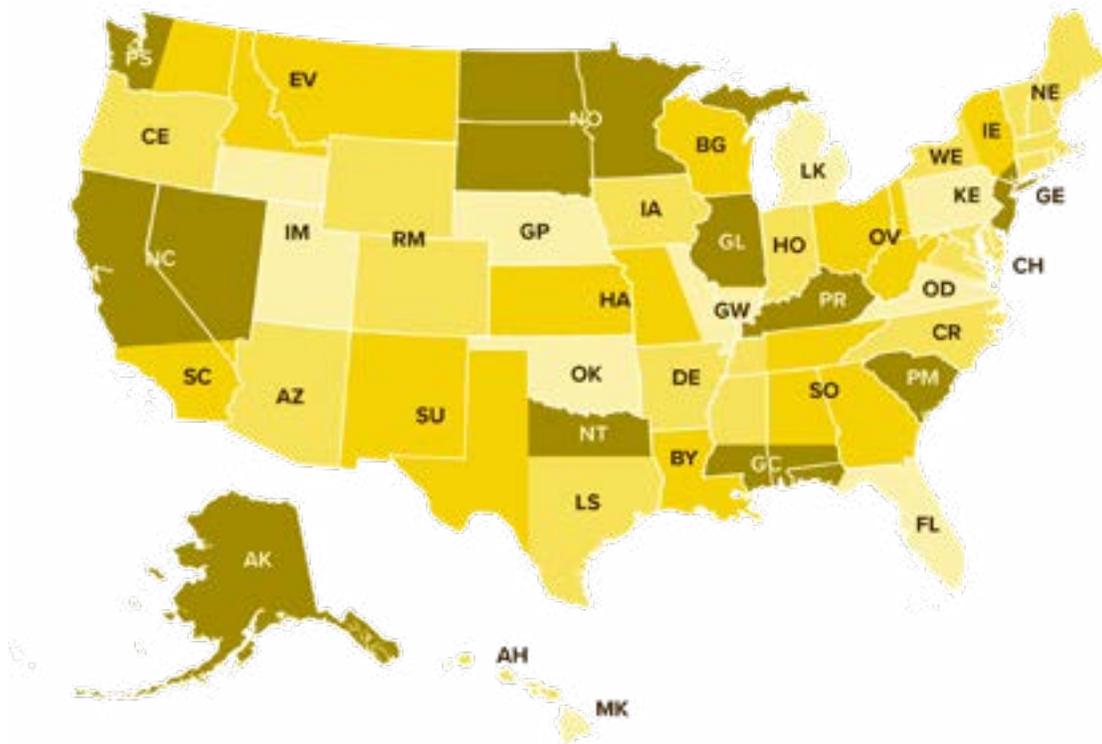


# VOLLEYBALL CURRICULUM

## FIND A PLACE TO PLAY

If you enjoyed learning and playing volleyball, keep playing!  
Find your local USA Volleyball region to find a volleyball program near you.

For more information visit:  
<https://www.teamusa.org/USA-Volleyball/Membership/Regions>

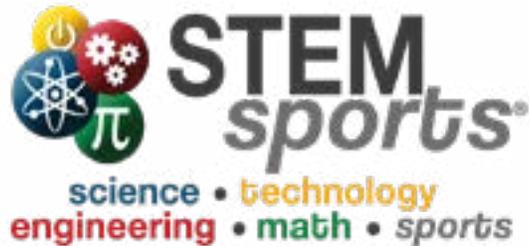


<b>AK</b> - Alaska	<b>DE</b> - Delta	<b>HA</b> - Heart of America	<b>MN</b> - Moku O Keawe	<b>PM</b> - Palmetto
<b>AH</b> - Aloha	<b>EV</b> - Evergreen	<b>HO</b> - Hoosier	<b>NE</b> - New England	<b>PR</b> - Pioneer
<b>AZ</b> - Arizona	<b>FL</b> - Florida	<b>IM</b> - Intermountain	<b>NT</b> - North Texas	<b>PS</b> - Puget Sound
<b>BG</b> - Badger	<b>GE</b> - Garden Empire	<b>IA</b> - Iowa	<b>NC</b> - Northern California	<b>RM</b> - Rocky Mountain
<b>BY</b> - Bayou	<b>GW</b> - Gateway	<b>IE</b> - Iriquois Empire	<b>NO</b> - North Country	<b>SC</b> - Southern California
<b>CR</b> - Carolina	<b>GL</b> - Great Lakes	<b>KE</b> - Keystone	<b>OV</b> - Ohio Valley	<b>SO</b> - Southern
<b>CH</b> - Chesapeake	<b>GP</b> - Great Pines	<b>LS</b> - Lakeshore	<b>OK</b> - Oklahoma	<b>SU</b> - Sun Country
<b>CE</b> - Columbia Empire	<b>GC</b> - Gulf Coast	<b>LS</b> - Lone Star	<b>OD</b> - Old Dominion	<b>WE</b> - Western Empire

The "Regional Volleyball Associations" (RVAs) of USA Volleyball are incorporated as legal entities and are each a Member Organization of USA Volleyball. The RVAs serve the grassroots function for USE Volleyball and collectively serve as a catalyst for USA Volleyball functions.



# CONTACT US



STEM Sports® creates and provides turnkey K-8 educational curriculum that combine STEM disciplines with a variety of sports. We deliver authentic engagement opportunities to students and youth by using BMX, basketball, football, soccer, and volleyball as the strategic vehicles to drive STEM-based learning in classrooms, after-school programs, and camps. As a result, students and youths develop critical thinking, collaboration, creative problem-solving, and leadership skills that can be applied throughout their education and future careers. Just as importantly, physical activity and participation are vital components of our student-led curricula. Our double-play combination of cognitive thinking and physical activity provides a comprehensive and inquiry-based educational experience, and a solution for crucial STEM literacy for students. Aligned with Next Generation Science Standards (NGSS) and Common Core State Standards (CCSS), our curricula will cultivate and promote participants' STEM engagement and retention. STEM Sports® provides all of the necessary and relevant sports equipment along with the entire list of supplies called for in the teacher/administer manual and all of the items have a long-lasting shelf life.

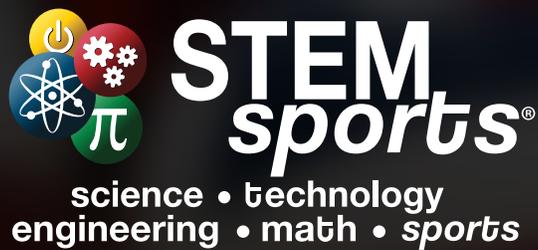
For general inquiries or questions regarding the program, please contact:

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602.845.0316

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