

DIY



BOYS & GIRLS CLUBS
OF AMERICA

STEM

#5

WEEKLY ACTIVITY GUIDES: SPORTS SCIENCE

This week, you'll take a behind-the-scenes look at sports through exercise, health and how the body works. To be either a coach or athlete, you need to know how the human body responds to motion. Make sure to warm up your muscles before starting some of these experiments!

ABOUT THE DIY STEM PROGRAM

DIY STEM is a program supported by Samsung as part of a shared commitment with Boys & Girls Clubs of America to inspire the next generation in science, technology, engineering, and math.

SAMSUNG

Participate this summer by sharing photos of your experiments on social media **#STEM**



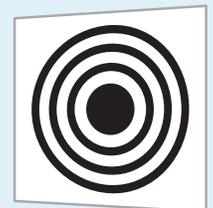
No matter your age, please enjoy conducting these experiments under the supervision of a responsible adult.

MONDAY: WEATHER

PAGE 1

MATERIALS:

- Bucket or large tub (1)
- Large bag of ice cubes (2)
- Box fan or industrial fan (1)
- Industrial strength heater or small heater (1)
- Gallon of water (2)
- NFL or NCAA footballs (2)
- Cardboard boxes or white poster boards (3)
- Black permanent markers or black markers with chisel tips (2)
- Roll of masking tape (2)
- Air pump with needle (1)
- Air pressure gauge (1)
- Measuring tape (1)
- Lab notebook for each participant (1)



LEARNING OPPORTUNITY:

Which simulated weather condition had the most significant impact on your accuracy?

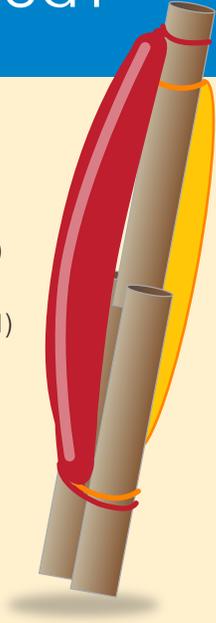
What are the scientific reasons footballs often react to extreme temperatures?

TUESDAY: KINESIOLOGY

PAGE 2

MATERIALS:

- Stereo (1)
- Smartphone or tablet (2)
- Package of long balloons (1)
- Paper towel roll (3)
- Pack of jumbo paper clips (1)
- Permanent marker (2)



LEARNING OPPORTUNITY:

How does the human body use levers in dances like the salsa?

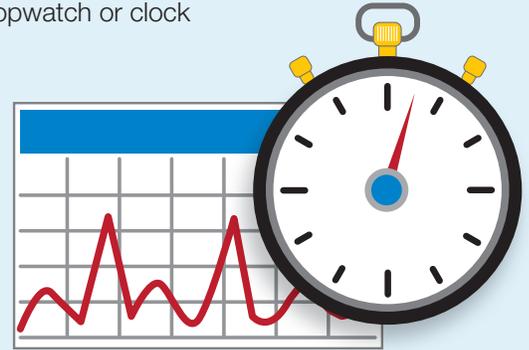
Why would dances like the salsa be an excellent activity to prepare players for football-related motions?

WEDNESDAY: HEART RATE MATH

PAGE 3

MATERIALS:

- Stopwatch or clock



LEARNING OPPORTUNITY:

What do you predict will happen to the running heart rate if you continue to run longer or faster? Will the heart rate continue to increase indefinitely?

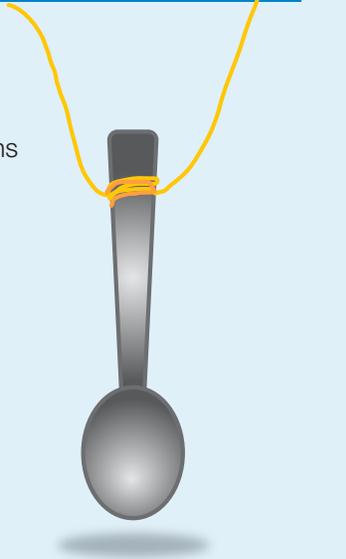
If you exercise more every day, what do you expect to happen to your Resting Heart Rate?

THURSDAY: SOUND WAVES

PAGE 4

MATERIALS:

- 12" wooden ruler
- Two different size spoons – teaspoon, tablespoon or serving spoon
- About 4 feet of string or yarn



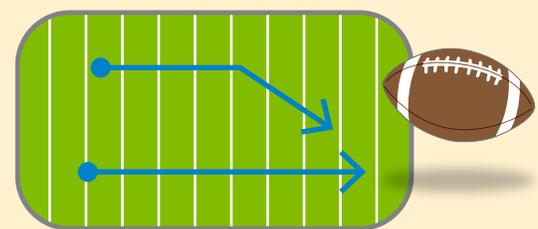
LEARNING OPPORTUNITY:

Change how high or low the spoon hangs to see what happens to the sound.

What happens if you hit the spoon harder?

FRIDAY: VELOCITY

PAGE 4



MATERIALS:

- Stopwatch (2)
- NFL or NCAA sized football (2)
- Roll of masking tape (1)
- Measuring tape (2)
- Smartphone (2)



LEARNING OPPORTUNITY:

How close was your speed to the 40-yard dash record set by Chris Johnson in 2008?

Which of the three routes that you used in this experiment is dependent the least on a player's overall speed?

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Monday: Weather

Materials:

- Bucket or large tub (1)
- Large bag of ice cubes (2)
- Box fan or industrial fan (1)
- Industrial strength heater or small heater (1)
- Gallon of water (2)
- NFL or NCAA footballs (2)
- Cardboard boxes or white poster boards (3)
- Black permanent markers or black markers with chisel tips (2)
- Roll of masking tape (2)
- Air pump with needle (1)
- Air pressure gauge (1)
- Measuring tape (1)
- Lab notebook for each participant (1)

Prep Your "football field"

1. Use the black permanent markers or black markers with chisel tips to create a large bulls-eye on the cardboard box or white poster board. Participants should make the bulls-eye large enough to see clearly from 15 yards away. If it is convenient, you can use tape to stick the poster to a wall.

2. Place your bulls-eye and measure 15 yards (or 45 feet) and mark this with a strip of masking tape. This is your line of scrimmage.

3. Before beginning the experiment, make sure the football is properly inflated with 15 pounds of air pressure. Use the air pressure gauge to help you evaluate the football's air pressure.

Perform the experiments

Experiment #1 – Normal Throwing Conditions

1. Practice throwing the football to hit the bulls-eye. It may take less experienced players a little longer to determine the appropriate arm angle and velocity needed to hit the target
2. Make sure you are holding the ball properly with your fingers on the laces and stepping into the throw to improve your accuracy.
3. How many tries did it take to hit the target?

Experiment #2 – Simulated Impact of Rain (10 minutes)

1. Fill the small tub with two gallons of water and place the football in the water until it is completely coated.
2. Dip your hands in the water prior to removing the football from the water until you have soaked both the football and your hands. Make sure to wet your hands every time you throw the football to ensure you have the proper amount of moisture on both your hands and on the ball.

3. Repeat the experiment by throwing from the simulated line of scrimmage.

4. How many tries did it take to hit the target?

Experiment #3 – Simulated Impact of Wind (10 minutes)

1. Set your fan on its maximum speed. Place the fan closely to the right or left of the bulls-eye so the wind is blowing directly across it.

2. Repeat the experiment by throwing from the simulated line of scrimmage.

3. How many tries did it take to hit the target?

Experiment #4 – Simulated Impact of Extreme Cold (10 minutes)

1. Let's simulate extreme cold during a football game by removing two pounds of air pressure from the football. Measure the change in the air pressure with the air gauge to ensure that it is accurate.

2. Place the football in the tub of ice to allow the pigskin covering to become cold.

3. You should also hold several cubes of ice in their hands for 30-45 seconds before throwing the football. This will let you experience the same numbness quarterbacks have in snowy and icy conditions.

4. Repeat the experiment by throwing from the simulated line of scrimmage.

5. How many tries did it take to hit the target?

Experiment #5 – Simulated Impact of Extreme Heat (10 minutes)

1. Now let's simulate extreme heat by adding two pounds of air pressure to the football so that it has 17 lbs. of air pressure. Measure the change in the air pressure with the air gauge to ensure that it is accurate.

2. Participants should hold the football in front of the heater for two to three minutes so they can replicate the

temperature of the football that quarterbacks experience in very hot conditions.

3. Repeat the experiment by throwing from the simulated line of scrimmage.

4. How many tries did it take to hit the target?

Tuesday: Kinesiology

Materials:

- Stereo (1)
- Smartphone or tablet (2)
- Package of long balloons (1)
- Paper towel roll (3)
- Pack of jumbo paper clips (1)
- Permanent marker (2)

Create a replica of your muscles

1. Use a permanent marker to label the three major bones in the arm (paper towel rolls), which are the humerus, radius and ulna.

2. Thread a paper clip through the radius, ulna and humerus bone so all three are held together. The bottom of the humerus bone should connect to the top of both the radius and ulna – this represents the elbow.

3. Use a rubber band to bind the other end of the radius and ulna together – this represents the wrist.

4. Blow air into a long balloon and force the air into the center of the balloon leaving the ends empty so they can be attached to the paper towel rolls.

5. Tie one of the loose ends of the balloon to the top of the humerus and the other end to the bottom of the radius and ulna – this represents the biceps.

6. Repeat the same process on the back of the cardboard rolls to create the triceps.

7. Flex and move your models to replicate how the arm moves as a lever in the human body.

Extension activities

1. Use a computer or tablet to search online for Victor Cruz's touchdown salsa. Reenact his body movements to analyze the body movements involved in the dance using your replica muscles. What muscle groups are involved in this celebration?
2. Now, identify exercises that focuses on the levers in the arms, legs and feet. It should help you stretch those muscle groups, tendons and bones so that they can prevent injury.

Wednesday: Heart Rate Math

Materials:

- Stopwatch or clock

Understand your heart rate

1. Find your pulse. To find a pulse on the side of your neck, place two fingers in the space between the windpipe and the large muscle in the neck which is below your ear. Press lightly until you feel a pulse.
2. First, we need to measure your resting heart rate while you are calmly sitting. Set a timer for 15 seconds or watch the clock. For 15 seconds, count the number of heart beats. Do a practice round first then record the result below. This is your Resting Heart Rate.

3. Next, stand up. Measure your pulse again for 15 seconds.
4. Continue filling out your heart beats for the activities below. Make sure to measure your pulse immediately after the activity for accurate results
5. A common way to record heart rate is in beats per minute. Convert your recorded number of heart beats into beats per minute (bpm). Hint: You measured beats per 15 seconds. How many seconds in a minute?
6. Let's see how much your heart rate increased. Calculate the percentage increase for each activity compared to your Resting Heart Rate. Ex: Going from 100 bpm to 120 bpm is a 20% increase. Round to nearest tenth. **see chart below*
7. Now, determine your Maximum Heart Rate (MHR). This is the highest your heart rate should reach during high intensity exercise. MHR is found by subtracting your age from 220. For example, for a 20-year-old, the MRH is $220 - 20 = 200$ beats per minute (bpm).
My Maximum Heart Rate = $220 - \underline{\hspace{2cm}}$ = $\underline{\hspace{2cm}}$ bpm
8. For moderate-intensity physical activity, a person's target heart rate should be between 50 to 70% of his or her maximum heart rate. Find your target heart rate:

Activity	Number of heart beats in 15 seconds	Beats per minute (multiply by 4)	Percentage Increase
Sitting = Resting Heart Rate			0%
Standing			
Walk in place for 30 steps			
20 Jumping Jacks			
25 Fast High Knees			

	20 Year Old	You
50% of MHR	100	
70% of MHR	100	

Thursday: Sound Waves

Materials:

- 12" wooden ruler
- Two different size metal spoons – teaspoon, tablespoon or serving spoon
- About 4 feet of string or yarn

Make sound waves

1. First, create a loop in the middle of the yarn/string and insert the handle of the spoon.
2. Pull tightly so that the spoon hangs in the center of the yarn/string and you have two long pieces of approximately equal length.
3. Take each string and wrap them around your pointer finger on each hand.
4. Push the string against each ear – not in the ear, but against the outside. Make sure the spoon is hanging below the waist once both ends of the yarn are placed near your ears.
5. Have someone gently hit the ruler against the round part of the spoon and listen!
6. Try it with different types of spoons.

Friday: Velocity

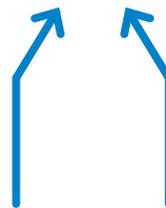
Materials:

- Stopwatch (2)
- NFL or NCAA sized football (2)
- Roll of masking tape (1)
- Measuring tape (2)
- Smartphone (2)

This activity works best in an area where you can clearly mark distances such as football fields or parking lots. You should use tape or another marker to mark 10-yard increments for a total of 50 yards. You will also use technology – a speedometer and a radar gun app – to calculate speed and distance.

1. Use the stopwatch to record how fast each member can run the 40-yard dash.
2. Now, line up beside a friend. One of you will act as a wide receiver, and the other member will act as a defensive back.
3. Record how far the wide receiver can run in five seconds on a go route, with the defensive back following the receiver straight up the field.
4. Repeat this on the slant route and the curl route. These routes will require the receiver and quarterback to have appropriate timing, and the quarterback must use the correct velocity on his throw to the receiver.

Slant Route



Go Route



Curl Route

