MIGHTY MUSCLES

If you've been to a Thunder game in person, you might have noticed that the players spend a good amount of time before the game starts warming up their muscles with different stretches. If you enjoy watching their games on TV, you probably notice that when they're taking a break from playing, they'll often put on a jacket or long pants. Why is keeping their muscles warm so important?

Pro tip: This activity can be done at home or in a classroom. It can be done by an individual student, a small student group, or a family.

HERE'S WHAT YOU'LL NEED:

- **White glue**
- **Liquid starch**
- **A container in which to mix**
- **A spoon or craft stick**
- **A notebook or some paper and a pen/pencil**

WARM-UPS

Why do you think it's so important for Thunder players to warm up before a game and stay warm even when they're not playing? Do you think that it's as important for you to warm up before any exercise or physical activity?

Write down your ideas to these questions as a way to frame your research and observations as you experiment with the upcoming activities. This is called forming a hypothesis, which is a prediction or educated guess that can be tested.

If you're a student athlete, you might have some more experience with the answers to these questions. If so, form your hypothesis about what you think could happen to muscles that have not been properly warmed up versus muscles that are warm and stretched.

Next, you're going to try some physical activities both before you do some warm ups and after to see if you can tell a difference in how you feel as well as how easy it is to do the tasks.

Before you warm up, try a couple of different movements to see how they feel. Try to touch your toes and jump straight up as high as you can, stretching your arms up above your head. How did these movements feel? Were they easy? What words would you use to describe how your muscles and joints felt? Write down your observations.

Now you're going to do some stretches and warm ups. Do whatever combination of the following warm ups you're able to and have space to do.

PRO TIP: Be sure to do at least three of these warm ups so that you can really get your blood flowing and muscles working!

- **Lunges**
- **Squats**
- **Push-ups**
- **Pull-ups**
- **Jumping jacks**
- **Slow walking knee hugs**
- **Arm circles**
- **Leg swings**

How do you feel now that you’ve spent some time warming up? Try to touch your toes again and then jump straight up with your arms overhead. How did these movements feel after you stretched and worked your muscles a bit? Write down any differences you felt in your muscles. Maybe you were able to stretch further when you reached for your toes, or maybe you were able to jump and stretch even higher. Maybe you didn’t really feel any difference, either! Whatever your personal result was is great!

GAME TIME

Did you know that there are more than 600 muscles in the human body? Muscles are made up of a type of elastic tissue that consists of thousands (or even tens of thousands!) of small muscle fibers.

Since you’ve tried some practical experiments with your own muscles, it’s time to make an analogue for muscles that will allow for further exploration. (An analogue is just a word for something that is similar to something else!) In this case, since you can’t very well pull your muscles out of your body and play around with them, you’re going to make a polymer instead! Your polymer only needs two ingredients—white glue and liquid starch.

Gather your two materials as well as a container to mix, a spoon or craft stick to stir (if you don’t want to mix with your hands) and some paper towels.

PRO TIP: Make sure you set up your polymer lab somewhere easy to clean, like a kitchen counter, desk, or other smooth surface. You definitely don’t want to mix this on the couch in your living room!

Pour 2 ounces (1/4 cup) of glue into your mixing container. Then add 1 ounce (1/8 cup or 2 tablespoons) of liquid starch to the glue. Mix it up!! Try mixing it together with your hands so that you can feel the way it changes as it bonds together. (If you’re sensory sensitive or aren’t in a place you can be messy, you can also use a craft stick or spoon to mix it.)

Once you completely combine the two ingredients, pull your piece of putty out of the container. Work with it until it loses any stickiness. As you play with it, try pulling it apart quickly. What happens?

To warm up your “muscle putty,” spend a few minutes just stretching it and working it with your hands. The heat from your hands as well as the heat from the energy produced by squishing and stretching the polymer will help it to warm up—just like your warm up exercises helped warm up your muscles! Try stretching the putty slowly and also pulling it quickly. What does each action do to it? How does it behave the more you play with it?

Now, let your elastic concoction cool down and rest in the container for about 5 minutes. After that time has passed, pull out the polymer again and immediately try to stretch it as far as you can. What happened this time? How about if you let it sit for 10 minutes, or 15, or even 20 minutes and then try to stretch it?

ANALYZE THE REPLAY

What happened?

After you’ve finished experimenting with your putty, take some time to write down your observations. Make a graph or chart to show how far you were able to stretch it when it was cold, when you played with it for a minute, and when you played with it for several minutes.

What similarities do you see between how the polymer behaved when it was warmed up versus when it was cool and how your muscles might behave cool versus warm?

As mentioned at the beginning of the Game Time segment, human muscles are made up of thousands of small muscle fibers. Each of these fibers is comprised of even smaller strands called fibrils. When you stretch your putty slowly, do you see any long bonds in your polymer that look like fibers? What happens to these if you snap your putty quickly?

What conclusions can you draw now about why Thunder players wear jackets or sweatpants when they’re sitting on the bench taking a break? What other ways can you think of that athletes can keep their muscles warm before they have to compete or play in a game? Have you ever seen swimmers slap their shoulders and legs before a race, or track athletes bounce up and down before getting in their starting positon? What benefits do you think these sorts of movements might give the athletes?

OVERTIME
Let's take it further

Grab a friend, make sure your putty is super warm and stretchy, and see how far you can stretch it between the two of you. Can you stretch it over a desk? Across a table? Do you think you could stretch from one side of the room to the other without it breaking? What could you do to it or add to it to help achieve this goal?

You've seen how the putty behaves when it's warm as opposed to when it's cool. What if you need to "put it on the bench to rest" but don't want it to get entirely cooled down? What could you design to help it stay warm and limber while it's sitting in the container so it doesn't need to be warmed up when you pick it back up?

COACH'S CORNER
Additional information and explanations for parents and educators

So why is warming up before a basketball game (or any other sort of physical activity) so important? When one's muscles are limber and warmed up, there's less threat of injury or overexertion. As the American Heart Association says, "A good warm-up before a workout dilates your blood vessels, ensuring that your muscles are well supplied with oxygen. It also raises your muscles' temperature for optimal flexibility and efficiency."

Similarly to how muscles need to be warmed up, the polymer bonds within the putty showed an example of how flexibility can come with warmth and use. When the putty is cold, students likely found that if they stretched it too quickly, it would snap or tear. The more they played with it and warmed it up, the stretchier it became. Muscles can also tear or be injured if not taken care of properly, including warming them up and cooling them down. However, when one is trying to build muscle, the muscles actually are torn in a process known as muscle hypertrophy. This occurs when the fibers of the muscles are damaged or injured, and the body repairs this by fusing the fibers together, leading to larger muscles.

OKLAHOMA ACADEMIC STANDARDS: SCIENCE

STANDARDS	3rd Grade	4th Grade	5th Grade	6th Grade
5.PS1.3 – Matter and Its Interactions	●			
5.PS1.4 – Matter and Its Interactions		●		
S3.E4 – Fitness Knowledge	●	●	●	
S3.M12 – Fitness Knowledge				●