Body Mass and Balance

Thunder players have incredible athleticism and strength, but have you ever thought about their sense of balance? Weaving and dodging the opposing players and recovering from the occasional collision requires stability in addition to quick footwork!

HERE'S WHAT YOU'LL NEED:

- **Cup**
- **Craft stick**
- **Pipe cleaner**
- **Paper clips, binder clips, or something similar**
- **Notebook and pencil**
- **One orange**
- **Scale**
- **Pitcher**

This activity can be done individually or with a partner, as well as in a classroom or at home.



Your favorite Thunder player is likely your favorite because of how hard they play—sprinting up the court, diving for loose balls and leaping into the air for a massive dunk. To handle these powerful movements, a basketball player's muscles, bones, and tendons need to be strong, flexible, and work together. Your brain plays a big role in helping those body parts work together by sending signals to the muscles that tell them what to do. For example, the idea of moving one leg forward and then the other is your brain sending signals that produce walking. When movements are random or chaotic, the brain is sending signals for movements that are less practiced, so the muscles and tendons need to be strong and flexible to hold up to this unusual stress and pressure.

Let's investigate how your brain works with your body. Standing on one leg, raise your other leg in front of you, then to the side, and then to the back. What do your arms do when you move your leg in a particular direction?

Now try the same leg movements with one arm staying at your side. How does it change your ability to stay up? Can you feel your muscles trying to help you stay balanced? If so, that is your body shifting stress around to accomplish standing upright. Your body has a center of mass (or balance point) that it gets used to and muscles are strengthened to keep you upright in those "stances". When you shift where your center is, it becomes harder to balance. That sense of balance is your body trying to maintain a controllable center of mass.

Inside of your ear is a system of fluid-filled cavities and canals that are designed to give you your "sense of balance". When your body moves, that fluid shifts and interacts with very small hair cells. This interaction sends a signal to your brain to handle movements as needed, keeping you balanced!

You can observe this effect with another short investigation. Hold a cup of water and put one finger over the top of the cup close to the water. Now close your eyes. When you tilt the cup and water sloshes around touching your finger, you can start to figure out how to adjust the cup to calm the water without even opening your eyes.

GAME TIME

The center of mass is a point where the weight of an object is evenly balanced in all directions. For simple shapes, it is usually located at the center of that object. For example, a 12-inch ruler would have a centroid (geometric center) at 6 inches. A non uniform shape could have a centroid at a unique point relative to that specific shape.

To illustrate the center of mass in an object, you will use a craft stick. Try balancing it vertically on the tip of your finger. Now try to balance it horizontally. How was this different from balancing it vertically? If you want to successfully balance the stick vertically on the tip of your finger, what might you need to change to accomplish this?

See if you can engineer a design to make the popsicle stick balance with ease, either vertically or horizontally, on the tip of your finger. Grab your pipe cleaners and binder clips, paperclips or any other supplies you gathered.

Because this is an engineering challenge, you're going to have a limited budget of materials with which to work, so begin by limiting yourself to only two binder clips or paper clips. Sketch some designs in your notebook about how you could bend the pipe cleaner and attach the weights (binder clips or paper clips) to the craft stick. Are you going to try and balance the craft stick vertically or horizontally on your finger? Keep this placement in mind as you're designing.

Now that you've come up with a design, try building it! How you attach the pipe cleaner to the craft stick will impact your design some, but your main strategy will be where you place the weights. Are you going to put them all on one side of the craft stick? What if you put them evenly on either side of the craft stick? As you're building onto the craft stick, try experimenting with the placement of the weights.

PRO TIP: All this building and balancing with only two hands can be difficult! Grab a friend and work with them to help build and balance this little design.

Were you able to make a successful design? Did you balance the stick vertically or horizontally? If you are unable to wrap the pipe cleaner and weights in a way that makes the craft stick balance, try adding one more paper clip or binder clip.

ANALYZE THE REPLAY What happened?

The craft stick is rigid, meaning it keeps its shape even when force is applied to it. However, if you hold one end of the stick with your fingers and bend the other end, the stick might eventually break. This happens because you're applying an uneven force, causing stress on one part of the stick. The stick's structure can only handle so much force (stress) before it just can't stay intact anymore.

A Thunder player's body is equipped to handle a much wider range of stress than a simple bend. A flexible body can adjust, tighten, or relax areas to help offset some stress. Eventually, even that might not be enough and an injury may occur.

A careful regimen of exercise, rest, and nutrition can help the body repair itself. Although, doing the exercises that are required when a leg or foot is injured can be challenging. Players have to make sure their body does not exert too much on non-injured areas to make up for weaknesses (injuries) elsewhere.



OVERTIME
Let's take it further.

Organizations like the Thunder have a lot of expertise in helping their players manage injury recovery. One of the most useful tools is underwater treadmills. How does being underwater help with injury recovery? Buoyancy! Buoyancy is an upward force that balances gravity's downward pull, reducing the weight felt on the body. This effect can help with balance and decrease stress on certain body parts. Injured muscles can now be stretched and exercised with less impact on joints and other body parts. This helps injured players return to the court sooner.

One way to see the effects of buoyancy is with an orange and a pitcher of water. Begin by weighing the orange and recording the result. Then ask if the orange might sink or float before testing it. Was your hypothesis correct?

Now remove the peel from the orange. Weigh the orange without its peel and record the result. Again, hypothesize if you think the peeled orange will float or sink, and then test it. What happened this time?



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

When students peel an orange, they remove not just the mass of the rind but also its structure, which plays a big role in buoyancy. The rind is thick, porous, and filled with tiny air pockets that make it less dense than water. These air pockets allow the whole orange to float. Without the rind, the orange is more dense and sinks.

Our bones and muscles are more dense than water, while fat, blood, and lungs are less dense than water. This combination makes our bodies less dense than water, allowing us to float. When different parts of our body are under water, the buoyancy effect can change, reducing the weight we feel because the water pushes up on us. This upward force from buoyancy balances the downward pull of gravity, making underwater balance feel different and shifting the way our center of mass works.

This activity can be used to support students with developing the skills and/or content associated with the areas listed below.

Subject Areas and Skills/Content	3rd Grade	4th Grade	5th Grade
Motion and Stability: Forces and Motion	●		
Motion and Stability: Types of Interactions	●		
Defining and Delimiting an Engineering Problem		●	
Developing Possible Solutions		●	
Optimizing the Design Solutions		●	
Cause and Effect	●	●	●