



AFTER SCHOOL ACTIVITY

STABILIZE YOURSELF

OBJECTIVES

Students will be able to:

- Understand the importance of balance and stability as it applies to all sports.
- Understand how center of gravity impacts balance and stability.
- Connect the role of balance and stability to industry 4.0.

Students will explore the importance of stability as it relates to sports and the future of industry 4.0. They will see how well they are able to maintain their balance through an 8-point one-legged clock tap exercise or a balance board. They will then explore the role of center of gravity on balance and stability by changing positions or adding objects that shift the center of gravity as they repeat the activity. Afterwards, students will learn how advancements in robotics have pushed industry 4.0 primarily through stabilization and how it may continue to influence industry 4.0.

MATERIALS

- 8 “cones” or objects similar to cones.
- Approximately 3" diameter x 15" length pipe-shaped object (can be PVC pipe, foam roller, log, etc.).
- A wooden board, skateboard deck or another similar object (slightly longer than shoulder width apart and ideally width allows for the whole foot to be on it).

PROCEDURE

- Explore with students who their favorite athletes are and if they can remember any particular highlight plays that their athletes were able to do. They could be professional athletes in leagues they watch or world competitions like the Olympics. Allow students to look up and share these highlights, and explain why they think it's a play worthy of being a highlight.
- Ask students what do they all have in common.
 - Example: *What do athletes like Messi, Steph Curry, Shohei Ohtani, Serena Williams, Nyjah Huston, and Simone Biles all have in common? Regardless of the sport they are playing, balance and stability are essential to their, and all other athletes', success.*
 - Are they able to identify how balance and stability occur in those highlight plays? Was it because of power? Quickness? Grace?

- Have students explain why these athletes were able to achieve what they did in the highlight.
 - Emphasize the importance of **form, mechanics, and/or technique**.
 - Ask students to identify what these concepts all share (balance and stability).
- As a primer, have students try to balance on a single leg for 10 seconds without moving—attempting on each leg. Have students identify if it is easier on one of their legs versus the other.
 - Now have them do the same challenge but close their eyes.
- Ask students if closing their eyes made it easier or more difficult.
- Ask students if they were able to balance on one leg.
- Ask students if they are stable or unstable in the one-legged position and explain why.
 - They are balanced but still unstable, because it is easy to lose their balance. Stability and balance are similar but not the same. Stability is ability to control the forces, which include unbalanced forces, to stay balanced.
- Have students watch this video on one of the world’s best balancing artists, Rocky Byun! <https://www.youtube.com/watch?v=ImnP-V0MViU>
 - Ask students what they noticed about these pieces of work? Is it always the bigger piece below? Does the artwork look stable?
- Explain to students that our research in biomechanics has recognized the importance of balance, and stability has helped in injury prevention and rehabilitation. However, what has also been better understood is that stability is often what allows for more efficient transfer of energy, not balance.
- Begin transition to the activity with students on truly testing their balance and stability. There are two ways to approach this activity.
 - **First Method: 8-Cone Clock Drill**
 - Using the 8 cones, do this training exercise and see how well you can move around the clock! https://youtu.be/rtnqo8X_bhE?t=228
 - The cones need to be placed in a circle around the student. Placement is cardinal directions of North, Northeast, East, Southeast, South, Southwest, West, Northwest. To determine how far the cones should be, have the student stand straight up and make a circle around them with one of their feet. The cones will be placed about 6"–12" further away from your standing foot reach. If the cones are very short, they can be brought in a bit closer because they will be harder to touch.

Remember Newton’s laws of motion? Stability is about countering all the forces that are being applied at once to stay balanced!

Read this Research Study

Core stability helps improve those with lower quality movement performance! However, higher performance athletes saw less improvement. While more research is needed, it seems that the higher quality your movement is, the less improvement you will see from a core stability training program. What could be one reason for that?

- **Second Method: Balance Board**
 - It's great if students have one at home, but a simple DIY method would be using the materials listed above.
 - A pipe-shaped object of any kind and a board to go on top is all that's needed. Recommended dimension are given, but will vary based on student to student. A skateboard provides a good baseline platform on dimensions for this activity.
 - The other important material consideration is that it must support the student's weight.
 - Explain to students to be careful when doing this activity, as they may lose their balance very quickly and have to come off the board right away!
 - Testing Instructions:
 - Place your pipe directly under the center of your board so that it balances similar to a seesaw (the length of the pipe goes under the width of the board).
 - Place one foot on one end of the board, and then when you are ready, place your other foot on the other side of the board shoulder-width apart (you may also use something to help keep your balance before starting to count such as a wall, handrail, or a sturdy rod that can hold your bodyweight).
 - Count how long you are able to stay on the board (make sure to let go of any assistance before you start counting).
- Ask students if they found it difficult. How were they able to find success?
- Challenge the students further in their activity. First have students watch this highwire act from Cirque du Soleil: https://www.youtube.com/watch?v=v_iOWRsw-jA
- Explain to students that they aren't going to be on highwires, but they will be experimenting with center of mass!
 - Tell students that rather than use a giant pole, they can simply use their arms! Do their test with their arms extended fully out and then again with their arms straight down by their side. Which way made it more difficult?
 - Have students also test by standing up as straight as possible, and then having them squat down a little bit. Which way of standing was more difficult?
- Once completed, bring students back together and ask if they found themselves relying on one side of their body more than the other.
 - Explain to students that the human body is great at compensating for weaknesses and imbalances, but it comes at the cost of an increased risk of injury!
 - Explain to students that the reason why technique and form are so important in sports is because of how dynamic and explosive movements are in sports. In almost any sport, even something like running, there will always be moments where only one foot will be on the ground or there will be an unbalanced ratio of weight on a particular leg. Having a strong base and foundation on that individual foot or leg is what allows the body to transfer the energy needed for success.

- Show students slow-motion video of an athlete performing an activity that showcases balance and stability. Provided example is of Shohei Ohtani who is both a high-level pitcher and batter in Major League Baseball. Emphasize how the center of mass is shifting and the transfer of energy is going from one side of the body to the other.
 - Pitching: <https://www.youtube.com/watch?v=3GTkhSDBzYo>
 - Hitting: <https://www.youtube.com/watch?v=n21sayOB9hw>
- Ask students if they can think of how stability is important in the real world.
 - Show students this video of how even very heavy objects still have this problem!
<https://www.youtube.com/watch?v=An8hW231hio>
 - Ask students what was wrong with the excavator and why was this is an issue?
- Explain to students that as industry continues to advance, there is greater recognition of how important it is to provide safer work sites out in the field, which includes not requiring a driver or pilot inside heavy equipment. By taking out the driver or pilot, heavy equipment, like extractors, are able to move into more dangerous locations. The challenge is that these giant machines are unable to correct themselves on their own like we can when we lose balance. We normally have to install stabilizers and adjust them by hand on the machine itself.
- However, explain to students that there are some pretty neat advancements in robotics tackling this very issue!
 - Have students watch the evolution of the work Boston Dynamics has done in robotics since 2012: <https://www.youtube.com/watch?v=NR32ULxjYc>
- Explain to students that the advancements in robotics being done by Boston Dynamics are helping address a huge area of need in developing safer and more efficient job sites. It can be something as simple as loading and unloading cargo to something massive like changing how cranes and excavators work entirely! Understanding how the body transfers energy for more power is just one of many important elements in engineering the sensors and systems needed for the future!