Balancing

Years 5 + 6

Scientists are endlessly exploring ideas. In the classroom we call this **tinkering**, a kind of playful experimentation. The term tinkering relates to taking apart and rebuilding, repairing, or improving something. It's also a mindset and very much an approach to pedagogy.

Learning Intentions

Students will be able to:

- Pose questions and make predictions.
- Plan and conduct experiments.
- Compare, represent, and discuss findings.
- Suggest changes and improvements.
- Communicate findings.

This kit contains enough materials for 16 pairs of students.
Each pair of students will need:

- 1 balance bar (30 cm dowel)
- 1 balance base (holey golf ball balls)
- 2 extension arms (10cm dowel)
- 5 weights (1 of each animal)
- 5 clips (attach loops to weights)
- 1 base (cup)
- 5 fold back clips

You may also need something to place your base (cup) on to add heigh – we used extra cups, a pile of books or placed our base on the edge of the table.

Safety

Please consider hazards from small pieces, clips and sticks while using this kit.
We recommend having each group on a separate table to stop bumps from other groups toppling the balancing structures.

Instructions

Humans balancing

Discuss:

- What makes something balance?
- What is gravity? What is the effect of gravity?
- What is the centre of balance?
- When might someone need to have good balance?
- What would happen if we weren't balanced when we walk?

Do: choose a balance activity from the *Humans Balancing* list at the end of this document.

- Acknowledge safety concerns from falling.
- Run the activity with the students. Some challenges will be harder for adults and men/women due to differences in their centre of gravity.

Discuss:

- What could you do/not do?
- Which balance activity was challenging?
- Why was it challenging? Link back to earlier discussion.

When an object is **balanced**, it is in a state of equilibrium. Any forces on the object are balanced by forces in the opposite direction.
The **centre of gravity**, also known as the **centre of balance,** is the average position of the force of gravity on an object. Sometimes it is at the object's geometric centre (e.g. the middle of a ruler), whereas other times it isn't (e.g. a ruler with an eraser on one end). An object can be balanced if it's supported directly under its centre of gravity.

The Art of Balancing – Design Challenge

Set-up: place all materials on tables, except extension arms. Students will work in pairs.

Discuss: Calder standing mobiles - https://calder.org/archive/all/works/standing-mobile/.
Have students form theories around why and how they balance.
Explain that students will be developing their own balancing sculptures.

Do: have students mark regular increments along the balancing bar.
Have students balance the ball and bar with **all** animal weights. The foldback clips can be used as additional weights.

Discuss:

- What information does the increment markings help us understand?
- What effect does the placement of the balance point (ball) and the extension arms have on balance?

Do: challenge students to repeat the first experiment but with the ball off centre. It should not be within 5cm of the middle of the balance bar.
Allow students plenty of tinker time to try balance the see-saw.

Discuss:

- What was the effect of changing the ball's location?
- What effect do you predict the additional extension arms will have?

Do: give the students an extension arm. Challenge them to add the arm to the balance bar by threading it through one of the holes in a weight. Rebalance the design with animals on all arms.

Do: have students document their designs and record where (cm/mm) the ball, arms and items were placed along the balance bar, making note of what worked and what didn't work.

Do: give students time to look at other groups designs and **discuss** their reasoning and choices.

Discuss: as a group discuss outcomes of explorations.

- What did the students try that did or didn't work?
- How did they refine ideas?
- What would they do next time?
- What things surprised them?

Going Further

There are many ways to stretch this activity across the STEM curriculum!
Our favourite links to the maths component.
Place the ball in the centre of the stick so it balances flat. What animals balance each other out and at what number markings do they sit? Can you figure out how much heavier each weight is compared to the lightest weight?

Hint: your students should be able to come up with a formula that looks something like this *1 + 2 + 3 = 2 + 4*

Humans Balancing

The following activities are our favourites to explore balance and centre of gravity.

One leg

Standing on one leg, experiment with holding your body in different positions. One arm outstretched, two arms, waving or still? Does the leg you are standing on make a difference? Can you stick your bottom out or lean to the side?

We can only keep our balance when our centre of gravity is over our feet. As we move our body our centre of gravity moves with us. If your centre of gravity isn't above your feet you will fall!

Leg Lift

Stand where you are, tilt you head slightly to one side of your body and then move the opposite leg off the ground and out to the side of your body. Stand next to a wall with one side of your body touching it. Place your ankle, knee, hip, shoulder, and head against the wall. Now try to lift your other foot off the ground without moving away from the wall.

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Pick-up trick

Stand with your back against the wall, feet together and heels against the wall. Place an object on the floor between your feet. Try to pick up the object on the floor without moving your feet or bending your knees.

When you stand straight against the wall, your centre of gravity is over your feet. When you bend forward, your centre of gravity shifts forward. In order to keep your balance, you must move your feet forward or your bum backwards. This would ensure that your centre of gravity is right above your feet to maintain stability. Since the rules of this challenge do not allow you to move your feet and the wall is behind you, there is no way to shift your centre of gravity to maintain balance while trying to pick up the object. If you insist on picking up the object, you will fall flat on your face.

Thumb Press

Place a chair against the wall so that it cannot slide backwards. Sit in the chair with your feet flat on the ground. Have a friend place a thumb in the middle of your forehead. Now try and stand up without pushing your partners hand away.

In this activity your centre of gravity is over the chair rather than over your feet, in order to get up you would need to shift your body forward by putting your head forward, but this is being prevented by the persons' thumb.

Balanced jump

Bend your knees slightly and hold on to the top of your foot. Can you jump backwards? Forwards? Up and down?

While bent over and holding on to your toes, you can jump backwards, but you won't be able to jump forward. When you jump you need to shift your centre of gravity in the direction you want to move, then you move your feet in the same direction to regain your balance. When you are holding onto your toes, jumping backwards is not a problem because you can use your heels to shift your weight. But you can’t jump forward because from your bent position you can’t move your weight or your centre of gravity forward!