SparkLab, Sciencentre

Maker Space: *Hanging in harmony*

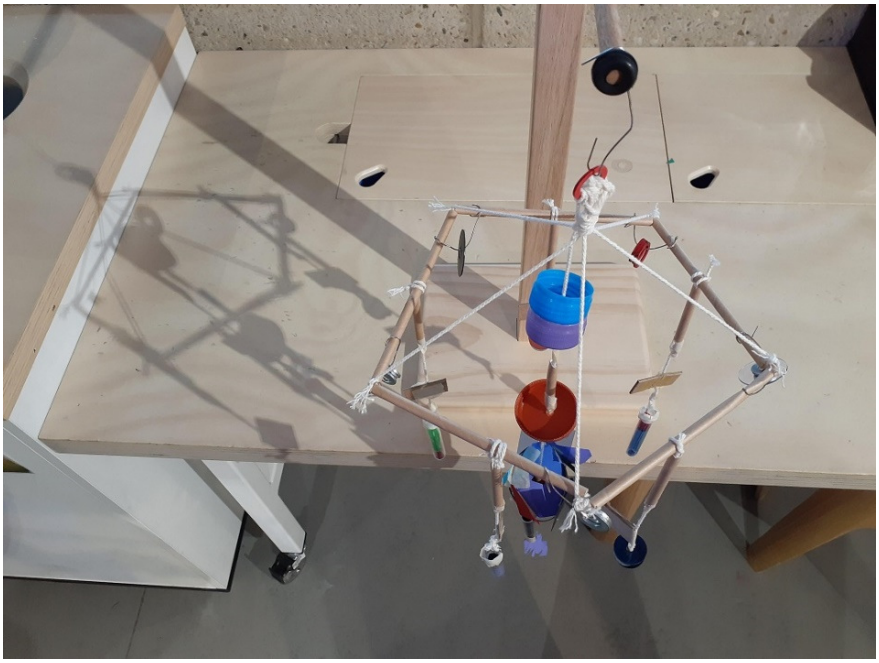
The Challenge

How will you make a balanced hanging mobile?

A twirling, twisting mobile is a thing of beauty as it spins in the breeze, casts a shadow or creates sound. Explore balance and how physical forces can affect the way your mobile moves.

Learning Outcomes

- Develop practical understanding through hands-on engagement with how physical forces affect the way that an object moves and how change to an objects motion is caused by unbalanced forces acting on it.
- Explore material properties; investigating and changing materials to find out what they do and how they could be used.
- Experiment with available materials, tools and equipment to creatively consider and solve problems that involve physical forces.
- Create a balanced hanging mobile with a specific purpose and/or audience in mind, giving consideration to particular needs, interests and environments.
- Increase understanding and confidence of the testing and design process; observing areas of the design that need improvement, posing a new design solution, making a change and observing the impact of that change.
- Feel and recognise success in implementing creative solutions to real world challenges and apply this approach in everyday life.
- Express enjoyment in engaging in the challenge and sharing ideas, understandings and successes with others.



What you will need:
Equipment

- scissors
- hole punch
- Stand to hang your design as you are making it. This could be a freestanding rig with a stable base or a rigid beam with room to build your creation below.

Design Materials

- paper straws
- twine/string - cotton or jute
- flexible armature wire
- paperclips
- flexible, flat, lightweight paper and plastic materials that can be cut into different shapes with scissors. E.g.
  - thin card (180-200gsm)
  - folder dividers/packaging
- Small objects with holes made from a variety of different materials including plastic, metal and wood. E.g.
  - buttons, lids, cotton reels
  - washers, keys, clasps
  - beads, seed pods, shells
- Translucent materials like lighting gels and cellophane to create coloured shadows
- **Top tip:** Look around for objects to repurpose in interesting ways before purchasing new materials.

Optional materials

- Drill or awl for adult use to safely make additional holes in harder materials
- Pliers to bend wires
- Ruler or measuring tape
- Scales

Design process

This activity follows a design process. Below are some questions that will help at each stage of the process.

Think of some solutions

- Have you seen something that hangs before, like a mobile? How did it move? What was it made from? Where was it hanging? What was it used for?
- Look at some images of hanging mobiles for inspiration – notice the different parts, shapes used and ways the parts are connected together.
- What ideas do you have for a design? How could your creation be used? What would you like it to do?
- Where will your mobile be hung? How will you make sure it is just right for that spot?
- Who might use this hanging design? How will you make sure it is just right for them? What do you think they might they need or want?

Make a prototype

- What materials will you need to build your design?
- What are the properties of the materials you have selected – what are they made of, what shape, size or weight are they, what can they do, how can they be changed and how can you use them in your design? How will these properties influence how these materials can be used?
- What size and shape will your different parts need to be? Big or small? Long or short? Round or flat?
- How would you like the shapes/parts of your design to hang? Would you like them to move or stay still?
- How could you join the different parts of your mobile together? Consider how the connections will affect the way your mobile moves.
- What part of your design are you finding tricky to build?

Test it out

- Test out your design - what do you notice? Look closely at the way the mobile is balanced, how it moves, the shadows it makes and the strength of your structure and connections.
- Does your design balance the way you want it to? What could you change so it does?
- Did anything unexpected happen? Has anything surprised you about making a hanging mobile today?
- What parts of your design worked really well? Are there any parts you would like to change?
- For an added challenge, try attaching another layer/support beam (above or below) – how does this change the way your mobile balances?

Improve your design

- How could you improve on your design? What would you change to make it even better and do exactly what you want it to do?
- What ideas could you incorporate from someone else's design? Talk to a friend or search online.
- If you started again, what would you do differently? What would you do the same? Create a record of your design, like a photo or drawing, to help guide future projects.
- Share with a friend how you problem-solved while you were making, to make sure your mobile balances.
- What advice would you give other people who want to make something like you?

Background information

Mobiles are an interesting demonstration of balanced forces. Any suspended parts must be balanced in order to achieve the desired shape or appearance. In addition, the different components of a hanging mobile (support beams, strings/wires, suspended shapes) all interact with each other - as well as the contact force of the air currents around them - causing them to gently move, twist and sway.

In accordance with Newton's Laws of Motion, a mobile will be at rest as long as the forces acting on the structure are balanced. Moving air can push on the suspended shapes of the mobile and cause them to move, creating a ripple effect of movement throughout the mobile, as all the parts are connected.

When building a balanced mobile, it is important to keep the suspended shapes in each layer balanced so that the support beam stays horizontal and is not pulled down in any one direction. Each support beam essentially acts like a seesaw – if more mass is hung on one end, gravity will pull the support down in that direction. To balance the support beam, one approach is to attach a counterbalance (one or more objects) of the same mass at the other end of the beam.

Moving (sliding) the object to a different place along the support will also cause a change to the overall balance. Small movements can make big changes to the way a mobile moves and balances. Objects of the same mass can be balanced by hanging them symmetrically from the support – at an equal distance from the pivot or fulcrum. Objects of different masses can be balanced by varying their distance from the fulcrum. Adding additional suspension points (i.e.at each end rather than just in the middle) will assist in spreading the load and make the mobile easier to balance overall. Designs with multiple layers of support beams increase complexity of constructing and balancing.

There are lots of different possibilities for hanging mobile design, with each design requiring varying levels of time, dexterity and problem solving to make.

Key Search Terms

Fulcrum, pivot, centre of mass; properties of materials; simple machines – lever.
Image search suggestions: hanging mobile sculpture; kinetic mobile; Alexander Calder (sculptor).

Images

Bedroom door sign

Great White Shark shaped from armature wire and blue background with mini coat hanger support beam.

Links to Australian Curriculum

Hanging in harmony can be adapted to suit a range of year levels and STEM subject areas, some key content links (and relevant elaborations) that can be explored as part of the program are listed below.

Year	Science Curriculum
F	**Chemical sciences** Objects are made of materials that have observable properties (ACSSU003).
1	**Chemical Sciences** Everyday materials can be physically changed in a variety of ways (ACSSU018)
2	**Physical sciences** A push or a pull affects how an object moves or changes shape (ACSSU033).
4	**Chemical sciences** Natural and processed materials have a range of physical properties that can influence their use (ACSSU074). **Physical sciences** Forces can be exerted by one object on another through direct contact or from a distance (ACSSU076).
7	**Physical sciences** Change to an object's motion is caused by unbalanced forces acting on the object, including Earth's gravitational attraction, acting on the object (ACSSU117).

Year	Design and Technologies Curriculum
F-2	**Design and Technologies** Explore how technologies use forces to create movement in products (ACTDEK002) Explore the characteristics and properties of materials and components that are used to produce designed solutions. (ACTDEK004).
3-4	**Design and Technologies** Investigate how forces and the properties of materials affect the behaviour of a product or system (ACTDEK011). Investigate suitability of materials, systems, components, tools and equipment for a range of purposes (ACTDEK013)
5-6	**Design and Technologies** Select appropriate materials, components, tools, equipment and techniques and apply safe procedures to make designed solutions (ACTDEP023)

Year	Maths Curriculum
F	**Measurement and Geometry** Use direct and indirect comparisons to decide which is longer, heavier or holds more, and explain reasoning in everyday language (ACMMG006)
1	**Measurement and Geometry** Recognise and classify 2D shapes and 3D objects using obvious features (ACMMG022)
2	**Measurement and Geometry** Describe and draw two-dimensional shapes (ACMMG042)
5	**Measurement and Geometry** Describe translations, reflections and rotations of two-dimensional shapes. Identify line and rotational symmetries. (ACMMG114)
6	**Measurement and Geometry** Investigate combinations of translations, reflections and rotations, without the use of digital technologies (ACMMG142)