SCIENCE MUSEUM GROUP

MYSTERY BOXES

TALKING	Ages 11–14 14–16	Topic WORKING SCIENTIFICALLY	45 MIN
	Skills used CURIOSITY • MAKING OBSERVATIONS • COMMUNICATION FINDING AND USING EVIDENCE • TEAMWORK		

Overview

The aim of this activity is to work out what's inside a set of Mystery Boxes without opening them. It explores 'working scientifically' and how a variety of skills and processes are used to generate scientific theories based on evidence.

Introduction

The activity highlights how STEM (science, technology, engineering and mathematics) is a creative, imaginative and social human endeavour. Science is a way of thinking, asking questions and observing the world around us. It is more than a body of information, and our understanding of how the world around us works is constantly evolving – there is so much more to be explored and discovered.

In science we are not able to simply 'open the box' and find a definitive answer to whether ideas are correct or not. Instead, we can use evidence from research to generate theories. These ideas or theories are open to future revision, or rejection, as our understanding of the world changes with the development of new testing methods and information.

Everyone has and uses the skills which are important for doing STEM subjects, every day. This activity shows that STEM is something that everyone can get involved with.

It also opens discussion of how the skills that are necessary for science are useful and transferable, and shows that studying STEM subjects can open the door to any job or career.

Museum links

This activity reflects how our museums and other informal science learning environments ignite curiosity around science, engineering, technology and maths by assisting discovery through active participation and social interaction.

Our museums are full of stories about the dreams, perseverance and creativity of the people behind ground-breaking inventions and discoveries – and how those innovations have been shaped and tinkered with over time to give us the knowledge and technology that we all benefit from today.

How to make a set of Mystery Boxes

Source six identical containers. Make sure that you can hear and distinguish different objects moving around inside them.

Good examples include:

- Plastic storage boxes
- Food cans
- Snack tubes

Put a (single) different object into each container. Use a range of shapes and materials, for example:

- Pasta
- Flour
- Marble
- Coin
- Sand
- Modelling clay
- Bottle cap
- Rubber ball
- Small toy
- Paperclip

Seal the filled boxes shut so that they can't be opened. You could solder or rivet metal boxes shut, or use duct/parcel tape.

You could also wrap the boxes once they are sealed.

Label the boxes (eg with numbers) so that each box can be easily identified.

Tip: A set of six boxes will work well for up to 24 people (one box per group of 3–4 people). Use fewer boxes for small groups or make a duplicate set if you want to run the activity with more people.

How to run the activity

You will need...

A large grid

A set of six Mystery Boxes

Marker pens

Observation sheets with sticky notes (one per group)

Follow these steps...

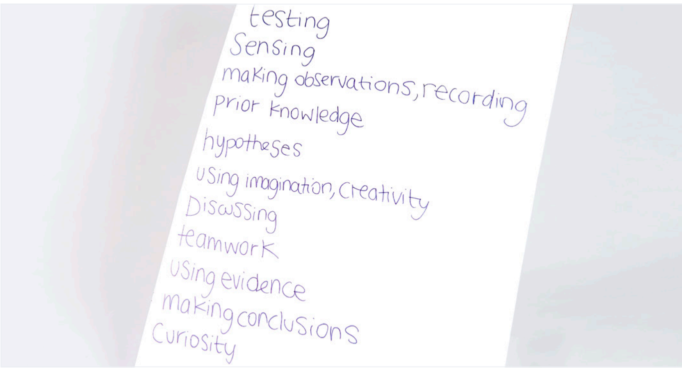
1 Setup

Give each group a Mystery Box and an observation sheet with sticky notes attached.

Allow them 2–3 minutes to explore the box in any way they want (eg shake it, feel its weight).

2 Making observations

Ask the groups to record all their observations as they work, then come up with their best idea of what they think is in the box, and write this down in marker pen on the sticky note. Repeat until all boxes have been investigated.



3 Skills and processes

Give groups 2 minutes to think about all the different skills and processes that they used to work out what was in the boxes. Record all responses.

Highlight that this list represents many of the skills that are used and developed through doing science.

4 Mystery Box conference

Get all groups to put their ‘best idea’ sticky notes on the grid.

Discuss each box and see if there is any agreement about what is in it. Where there are differences, get groups to present their evidence and allow them to change their minds (or not), considering the new evidence.

5 What’s inside the boxes?

Reveal that you don’t know what’s inside the boxes and that they are not going to be opened... because they are an analogy for science. It isn’t possible to ‘open the box’ in science to find a definitive answer. We can only form ideas and theories based on research evidence.

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Use the quotes on the next page to support this idea: science is always ongoing, and theories are open to future revision or even rejection as technological advances improve our evidence and our understanding of how things work.

Quotes to support the activity

After revealing that you will not open the boxes, and explaining why they are an analogy for science, you can use the following quotes to support that idea. You can also find some quotes of your own to use.

Remember – never open the boxes. The uncertainty about what's inside the boxes makes the activity memorable and reinforces the analogy.

'We all have natural curiosity. Science is a process of investigating, it's posing questions and coming up with a method.'

Sally Ride (1951–2012), first US woman in space

'Science is a history of corrected mistakes.'

Karl Popper (1902–94), philosopher of science

'The important thing is not to stop questioning.'

Albert Einstein (1879–1955), Nobel Prize-winning physicist and mathematician

'Science is a process by which you observe the universe and come to a view. There aren't any truths in science, just our best views of the way the universe works given the data set available at the time. Science is a process of replacing models with better models.'

Brian Cox (born 1968), TV presenter and award-winning physicist

Think and talk about...

- What could you do to get closer to finding out what's inside the box?
- Have your ideas about science/STEM changed through this activity?
- Why do you think imagination and creativity are so important for STEM?
- What are the different social, financial and ethical influences on STEM research and how do you think that a funding source could influence the results?
- What STEM ideas would you want to investigate further?
- How transferable are science skills? Use the list of skills generated in the activity to spark discussion about which ones are used in everyday life, such as in different hobbies, and consider how they could help with future aspirations.

Investigate...

- Test out the best ideas using a set of empty boxes (like scientific modelling).
- Research examples where scientific or engineering ideas have been revised over time, eg the structure of the atom.
- Look at examples of science news stories in the media. Review what information is presented as scientific 'fact' and what evidence is given to back up the story.
- Collect and display Mystery Boxes 'best ideas' from lots of groups, across your organisation, and see how often similar ideas about what's in the boxes come up.
- Talk to friends, family and people in your local community about the skills that they use in their work and everyday life. Use what you discover to reflect on the relevance of skills to STEM-related work and to other jobs and activities.

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MYSTERY BOXES
OBSERVATION SHEET

BOX 1	BOX 2
BOX 3	BOX 4
BOX 5	BOX 6