NATIONAL SCIENCE & ENGINEERING WEEK

nsew.org.uk

Sixty second science

Part of the British Science Association's National Science & Engineering Week activity pack series. **www.nsew.org.uk**

BIS | Department for Business Innovation & Skills

BRITISH SCIENCE ASSOCIATION

About this pack:

The aim

Sixty Second Science aims to promote participation in National Science & Engineering Week by offering ideas for science activities and challenges. These ideas are intended for a wide audience and where possible use easily accessible materials enabling the audience to repeat the activities at home. They are intended to stretch the imagination rather than provide a definitive list of activities so that organisers will take their own ideas further and create some novel events for National Science & Engineering Week.

The audience

The ideas in this activity pack have been designed to be flexible and adaptable to the needs of a range of audiences. You may wish to pilot test these activities on a sample audience prior to holding your National Science & Engineering Week event.

Science links

Many of the activities in Sixty Second Science link well with school curricula throughout the UK, both the National Curriculum in science and the Scottish 5–14 Guidelines in Environmental Studies. They encourage scientific enquiry with activities and investigations based around: Life Processes & Living Things, Materials & their Properties, Physical Processes, Earth & Space, Energy & Forces, Living Things and the Processes of Life.

Measuring sixty seconds

These short activities challenge participants to measure 60 seconds in many different ways.

Activity 1

Design a track to make a marble roll for exactly sixty seconds

Using simple materials like egg cartons, cardboard, plasticine, tape, etc. design and make a track for a marble to roll along. Try to make the marble roll for exactly 60 seconds.

Activity 2

Reversing the sands of time - design a sixty second timer

Make a cone using acetate, stiff paper or card and tape. It needs to have a small hole at one end so that it acts as a funnel.

Hang the funnel over a container that is large enough to contain the material that you are going to pour through the funnel.

Use sand or another material that will move through the funnel into the container below.

The challenge is to design a 60-second timer. As a group challenge, which timer is the closest to 60 seconds? Try out different materials that will flow through the funnel, experiment with funnels that have different sized holes. How does this timer compare with human estimation? You can use these timers later to time the fun-sized science activities!

Activity 4

Text messaging

How long does it take to type a set message and send it?

Are there any intergenerational differences - whats the difference between your grandparents and yourself. Think about why new technology might be challenging to the older generation.

Activity 3

Morse code messages

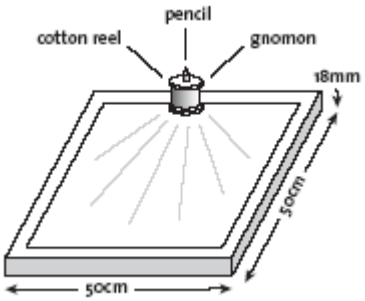
Morse code was created in the 1840s as way of communicating in aviation and amateur radio. It was still in use in naval communication until 1999! How long a Morse code message can be sent in just 60 seconds?

Activity 5

Can you measure sixty seconds on a sundial? (Hint: you'll need a very big one!)

How to build your sundial:

Use the following diagram to construct a sundial.



1. You will need 50 X 50 cm thick board (like block board or MDF, 18mm thick); a cotton reel, pencil stub about 6cm long and glue to attach the cotton reel to the board, blank paper that will fit on the board, blue-tack, a compass (fluid-filled type), pencil, and a watch or clock.

2. Fix the pencil to the top middle of the board as shown with glue, the cotton reel should fit over the pencil. This is the gnomon, the exact length of pencil you will need for this will depend where in the world you live; 4cm should be fine for the UK.

Align the sundial

3. Take your sundial outside early in the morning. Place it on a level surface where it will remain in sunlight all day. Place the compass exactly on the edge of the baseboard; turn the sundial so that the cotton reel is towards the south and the sides lie exactly north south. You now have a working sundial!

4. Stick the paper to the board with Blu-tack so that the gnomon is in the middle along the edge of the paper as shown and the edge of the paper is parallel to the edge of the baseboard. Write the date in the corner of the paper.

5. Mark the shadow of the tip of the gnomon on the paper and write the time beside it. Do this throughout the day, preferably on the hour and half-hour and at midday so that it is easy to interpret.

6. At the end of the day, before you remove the paper from the board, use a ruler to draw lines from the gnomon to each marked recording, so you produce a pattern of radiating lines which you can compare at different times of the year. When you read the time, remember to take British Summer Time into account (during British Summer Time, the sundial will be an hour behind your clock).

Once your sundial is working, here are some things to think about.

- When doesn't a sundial work?
- Does your sundial match your watch time? Why?
- If the earth rotates every 24 hours (approximately), how many degrees does the sun appear to move in one hour? In sixty seconds? (Hint: one full rotation of the earth is 360 degrees).
- The sun's diameter in the sky is about 0.5 degree. About how long does it take for the sun to appear to move its own diameter across the sky?
- Does a sundial work the same both north and south of the equator?
- What would be different about a sundial at the North Pole? The South Pole?

Now try these challenges:

- Can you design a water or candle clock that can measure exactly 60 seconds?
- Can you use a pendulum to measure 60 seconds?
- Can you make a 60 second timer that uses your pulse rate, escaping air or chemical reactions?

Fun-sized science activities

You will need a group or groups of participants, and different science activities that can each be completed in one minute for this type of event. Having a 60-second time limit will add an element of excitement to the event. Individually, or in small teams, participants complete a circuit of science activities. Participants have one minute at each station to complete a task, gather information, or complete an investigation or experiment. They should record their findings at the end of each minute and at the conclusion solve a problem/puzzle or compare with other groups/individuals.

Activity 6

Construct a paper aeroplane or parachute, boomerang or a water rocket that stays in the air for 60 seconds.

Activity 7

Launch a film canister rocket in 60 seconds

Your challenge is to achieve a 60-second delay between priming and lift off! Please do this activity on a table or bench, in an area that has a high roof, and where it doesn't matter if things get a little wet. Students will need to be supervised by adults during this activity.

Building your rocket:

You will need:

- a plastic film canister with a snug-fitting lid
- 1 Alka-Seltzer tablet
- some water (warm and cold).

Please do this activity on a table or bench, in an area that has a high roof, and where it doesn't matter if things get a little wet. Students will need to be supervised by adults during this activity.

You will need to do the experiment quite quickly so it is good to familiarise yourself with the following procedure without the Alka-Seltzer tablet first.

Stand the film canister upright with the lid off. Break your Alka-Seltzer tablet into quarters and place one quarter in the bottom of the canister. Add a little water to the canister, about 1/3 full or less (experiment with this). Now quickly fit the film canister lid onto the top and seal completely. Turn the whole canister upside down so that the lid is touching the table and wait….Your challenge is to aim for a 60 second delay between priming and lift off!

What happens?

The Alka-Seltzer tablet will react with the water and produce a gas as part of this reaction, as more gas is produced the pressure of the gas forces the lid and the canister to separate. The canister should launch high into the air. Now experiment using warm water or cold water, or experiment with the amount of water that you add to the Alka-Seltzer tablet.

Chemistry notes:

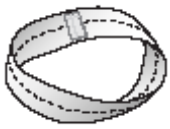
Alka-Seltzer tablets contain aspirin, sodium bicarbonate, citric acid (in solid form) and mono-calcium phosphate. When water is added to the Alka-Seltzer tablet the citric acid

ionises to produce hydrogen ions (H+ aq) which react with the bicarbonate (HCO3 aq) to produce carbon dioxide gas (CO2) and water (H2O). The reaction leaves a solution of sodium citrate, i.e. sodium ions and citrate ions in solution.

Activity 8

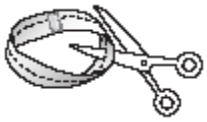
Puzzles that stretch the mind, for example maths puzzles, like a tangram or Möbius strip

Making a Möbius strip:



Take a strip of paper. Twist the paper once then join the two ends so that you make a circle with one twist. This is a Möbius strip. Draw a line along the middle of the strip, you will find that you can draw on the outside AND inside of the strip - without your pen leaving the paper!

Using scissors, cut along the line down the middle of the Möbius strip, what do you make? Repeat and repeat with the same Möbius strip – how many times can you do this and what can you make in 60 seconds?

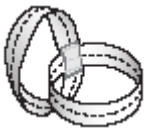


Variations:

- Give the Möbius strip two twists before joining the two ends together, then cut down the middle.

- Make a Möbius strip and cut one-third the width of the strip away from the edge. Keep cutting along this line until you come back to where you first started cutting. Have you made a necklace with a pendant?

- Tape a circular strip and a Möbius strip together so they are perpendicular. Cut down the middle of the circle, right through the join, then through the middle of the Möbius strip right around – can you make a square?



- Tape two Möbius strips together one perpendicular to the other, now cut down the middle of one, and then the other – what do you make? Try this when the Möbius strips are taped together so they are parallel.

Activity 9

Chromatography

You will need a collection of black pens, coffee filter paper or blotting paper, cups or beakers, water, Smarties and a dropper.

Mark a large dot with each pen near the bottom of the paper (approximately 1cm diameter). There should be a little space between the bottom of the paper and the dot.

Next stand the paper in a beaker or cup with a small amount of water so that the marked dots are just above the water. Watch the water soak up the paper and into the ink. What happens after 60 seconds?

Now try placing a Smartie stain or ink blob in the middle of the paper. Rest the paper on top of the beaker or cup and carefully drip water on the centre of the stain/ink blob. What happens after 60 seconds?

Activity 10

Bubbles

Make up your bubble mixture using detergent and warm water. You may also wish to add a little sugar or glycerine to this mixture. Experiment with the type and amount of detergent in the solution – you will need less of this than you imagine but each type of detergent will be different.

- How many bubbles can you blow in 60 seconds?
- Can you make a bubble last for 60 seconds?

Making your bubbles:

Make up your bubble mixture using detergent and warm water. You may also wish to add a little sugar or glycerine to this mixture. Experiment with the type and amount of detergent in the solution – you will need less of this than you imagine but each type of detergent will be different.

Recipe for bubbles:

Add warm water to a plastic container. Now carefully stir in the glycerine, sugar or corn syrup to the water. Start with a ratio of 1 part glycerine to 20 parts water. Dissolve the sugar in the water first.

Slowly add the detergent to the mixture. Start with a ratio of 1 part detergent to 10 parts water. The mixture should be well combined but not shaken – try not to create any froth on the top. (You may also like to try a ratio of 1 part detergent to 5 parts water)

Hint: Bubble solution gets better after it sits for a while, so make the mixture up a couple of hours, or the day before you want to use it.

Bubble wands

Bubble wands are readily available to buy, but you can make your own using pipe cleaners, straw and string, or wire coat hangers and string. If you are using wire then wrap string (or wool) around the frame. This will help to keep the bubble mixture on the frame and you should produce more bubbles. When making bubbles you can either blow air through the bubble frame if it is small enough, or wave the frame through the air.

Activity 11

How much water can you move in 60 seconds?

Use a set total volume of water and try different methods of transferring or transporting it.

Activity 12

Take a measurement of Pi in 60 seconds using people and string!

Pi (π) is equal to the circumference of a circle divided by the diameter of a circle.

To investigate the value of Pi wind string round the waist of an average person seven times. If you then stretch the string out in a long line you should be able to get twenty-two similar sized people standing along it because Pi = 22/7!

If participants stand shoulder to shoulder this works out quite well, or vice versa, the length of string of 22 participants goes around one waist seven times.

Activity 13
Make a Cartesian diver

Can you make the diver take as near as possible to 60 seconds to rise from the bottom of the bottle to the surface?

To make your Cartesian diver you will need:

- plastic pen lid (make sure the pen lid does not have a hole in the very tip) or a small test tube
- small ball of Plasticine
- plastic PET bottle (1L – 2L) with lid
- plastic jug and water

Place your pen lid or test tube in the jug with water to test that it floats. Pinch a little Plasticine and make a ball, attach this to the bottom of the pen or test tube so that it doesn't cover over the hole. Now test that the pen lid still floats. Experiment until the pen lid is floating upright in the water, Plasticine at the bottom and the tip of the pen lid barely above the surface of the water. This is your Cartesian diver.

Now fill your plastic bottle almost to the top with water, leaving about 5cm of air at the top of the bottle. Drop the pen lid with Plasticine into the water and attach the bottle lid tightly. When you squeeze the sides of the bottle the pen lid should sink to the bottom of the bottle. You may need to experiment with the amount of water in the bottle or with the Cartesian diver.

Can you make one where the diver takes as near as possible to 60 seconds to rise from the bottom of the bottle to the surface?

Why does the diver sink when you squeeze the sides of the bottle? There is a little air inside the tip of the pen lid, and when you put pressure on the bottle by squeezing it, this also squeezes the air in the pen lid. As the air in the pen lid is compressed the Cartesian diver will sink, it rises again when the air pressure goes back to normal, when you stop squeezing the bottle.

Activity 14
Build a structure in 60 seconds

Each team receives the same information to build a structure of a set shape (e.g. cube or pyramid) using given materials in 60 seconds. Teams then combine their structures at the end to build one very big version! For example, use pieces of short wooden dowel and sticky tape to make a triangle-based pyramid and then combine the pyramids to make one large one.

The British Science Association Young People's team use spaghetti and marshmallows for this challenge!

Activity 15
Balancing science

Can you balance on one leg for 60 seconds? Can you balance on one leg with a bag of sugar in one hand held out sideways?

Activity 16

How many?

How many balloons can you blow up?
How many websites can you visit?

Activity 17

Can you compose Sixty Second Science poetry?

Experiment with limericks and haiku (17 syllable poems).

Activity 18

Make a pulse meter

To make a pulse meter roll up a ball of Plasticine and place a matchstick into the Plasticine so that it sticks out of the ball. Next place the ball on the inside of your wrist where your pulse is. Now measure your pulse rate over 60 seconds. The pulse meter amplifies your pulse and makes counting easier. Check your pulse rate (count the number of heart beats in 60 seconds) then exercise for 60 seconds, and measure pulse rate again.

Challenge: What is the maximum number of steps you can take in one minute – on flat ground, up or down a hill? Estimate then measure how far you can walk or run in 60 seconds.

Extension activity: Measure the fitness of your school/community

- Ten activities that each take a minute.

Activity 19

How far can you go in a minute on various forms of transport?

Look at how far different things can travel in 60 seconds e.g. snails, bikes, cars, birds, and people. How efficient is each in proportion to their body size?

Sixty Second Science quiz

Use the British Science Association's Quiz Questions (see the British Science Association website www.nsew.org.uk) to run a quiz where participants have 60 seconds to complete each question, or make up your own questions. Here are some more ideas:

- How many scientists/inventions/ideas from the 20th century can you name in 60 seconds?
- Sixty Second Science anagrams.
- How many dinosaurs/trees etc can you name in 60 seconds?
- How many items can you name after looking at them for 60 seconds?
- What is your age in minutes?
- Incorporate games related to sixty seconds e.g. guess how far a bird can fly in 60 seconds.

Estimating sixty seconds

Participants estimate sixty seconds whilst engaging in an activity like:

- Speaking about... their favourite topic.
- Speaking to an audience about a topic that is chosen by the mediator.
- Completing a challenging puzzle.
- Sprinting, jogging or walking.
- Waiting for paint to dry or glue to set.
- Getting your legs waxed (ouch!)
- Waiting for an interview.
- Timing a boiling egg.
- Chewing food (cream crackers or chocolate!)
- Sitting outside on a cold wintry day.
- Sitting outside on a warm sunny day.
- Keeping a straight face.

Science links

This activity introduces estimation, aspects of psychology, and developing a fair test. Think about the following whilst doing these activities: How many times do you blink in 60 seconds? How many times do you swallow in 60 seconds? Some of the factors affecting this will be the dryness of the air, if there is any breeze, and others will be psychological.

Long-term time projects

Project 1

Research, write and produce a play about "The Big Bang"

What do scientists believe happened in the first sixty seconds of the Universe's creation? Explore the cultural significance of time and the ways that different cultures around the world measure time. Research a brief history of time; you might include aspects of geological and ecological time, and animal lifecycles. How did the introduction of railways affect standardising time across the nation?

Project 2

Write a rap!

A rap – in groups write a 60-second rap about your favourite science topic. Perform it to the rest of the class!

Project 3

Research this question:" Why do we use 60 and multiples of it to measure time, angles and longitude?"

Activity ideas and resource information:

The National Physical Laboratory provides beginners guides to measurement; they are also available as posters.

www.npl.co.uk/npl/publications/posters.html

Thank you for using Sixty Second Science!

We hope you enjoyed the activities within this pack. To help us to continue to provide new activity packs, we'd like to ask you to tell us a little about what you did for National Science & Engineering Week.

Please take a few minutes to fill in this form. If you used this activity pack for NSEW, send in this completed form and we will send you a National Science & Engineering Week Certificate.

Organisation: _____

Address: _____

_____

Postcode: _____

Tel: _____

Fax: _____

Email: _____

Which dates did you do National Science & Engineering Week activities on? _____
What did you do?

Please make any comments about this activity pack, National Science & Engineering Week and/or other possible topics for future packs (feel free to continue on a separate sheet of paper).

☐ **Tick this box** to be added to our mailing list. This will keep you up to date with NSEW, including grants, resources and activities. Your contact details will not be passed onto third parties.

Please return to:
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SW7 5BR

Would you like more?

If you enjoyed these activities and would like to do more then why not register for CREST ★ Investigators and receive a pack of further activities and investigations?

CREST ★ Investigators is a UK-wide award scheme that enables students to solve scientific problems through practical investigation. The activities focus on thinking about, talking about, and doing science. The activities develop students's scientific enquiry skills in an enjoyable context with links to the National Curriculum where appropriate.

For more information on how to register and receive your Crest ★ Investigator packs, visit our website at www.britishscienceassociation.org/creststar or call 020 7019 4943.