GENERATION SCIENCE

EDINBURGH SCIENCE LEARNING

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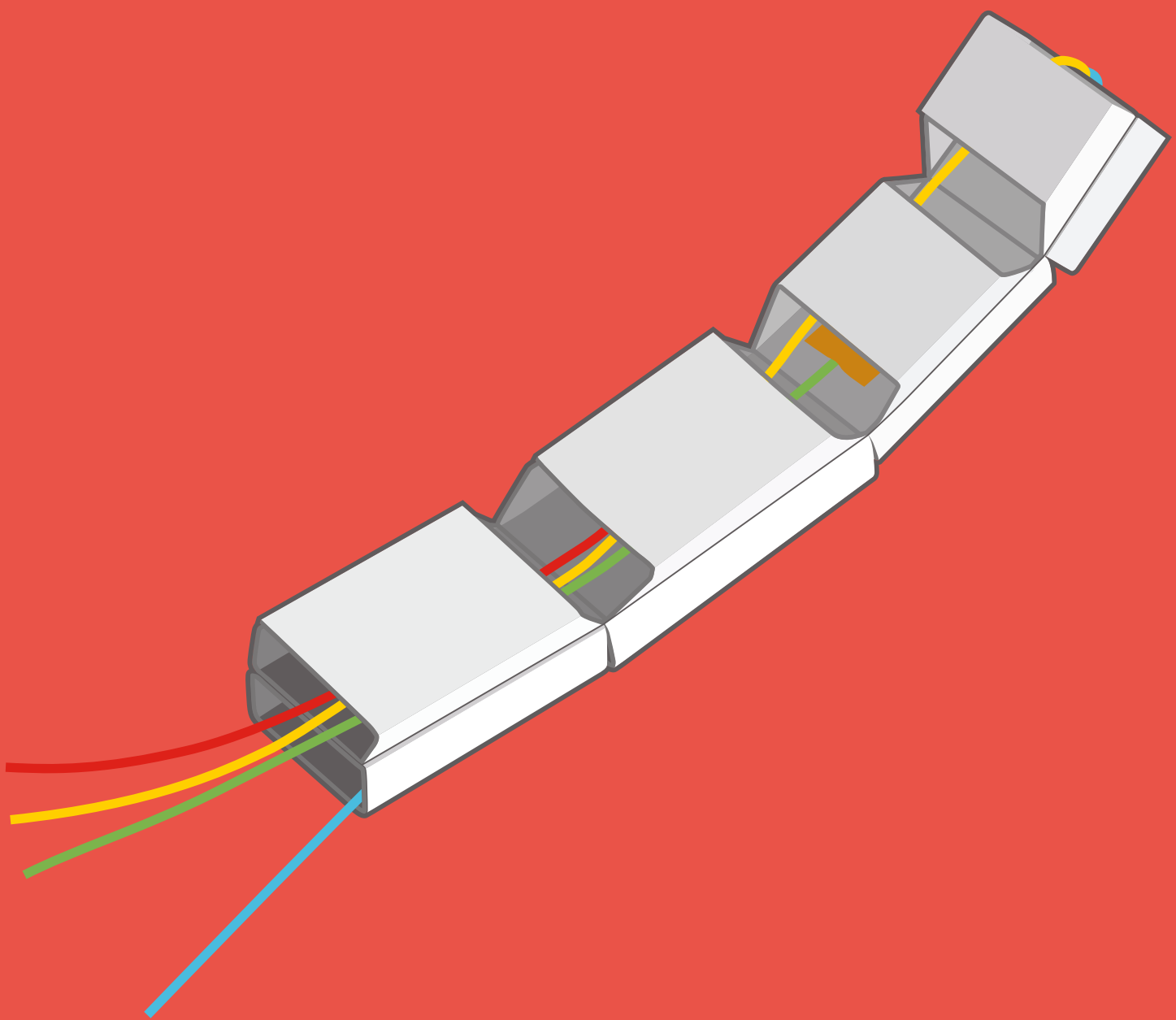
Make a Move



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Welcome!

...TO GENERATION SCIENCE 2022

MAKE A MOVE

Generation Science has been providing unique science experiences to schools across Scotland for over 30 years. Traditionally in-person experiences, the last few years has seen us broaden our horizons with a greater focus on supporting the teachers, as well as the pupils, to deliver unique, hands-on, fun experiences within the classroom.

Our *Generation Science* workshop boxes contain EVERYTHING – the equipment, instructions and digital links – you need to run your very own *Generation Science* experience in the classroom.

This STEM based lesson is built around the Curriculum for Excellence and includes links to videos of our expert science communication presenters, engaging activities and support resources packages.

Thank you for your ongoing interest and support of what we do and we hope you enjoy this experience as much as we enjoyed creating it.

Lastly, but by no means least, a huge thank you to our generous sponsors for their continuous support in helping to make all of this possible. Enjoy!

The Generation Science Team

CONTENTS

BOX CONTENTS

Please note, this kit contains materials which are suitable for children aged seven and above. All materials should be used under teacher guidance and supervision.

WORKSHOP KIT

1 x pulse oximeter
1 x collapsible hula hoop
1 x stopwatch
2 x hand strengtheners
16 x finger making instruction booklets
6 x resistance bands
1 x wobble board
1 x exercise ball
2 x stethoscopes
1 x poster

WORKSHOP CONSUMABLES

33 x finger piece A
33 x finger piece B
2 x boxes double-sided sticky tabs
33 x 30cm lengths red string
33 x 30 cm lengths blue string
33 x 30 cm lengths yellow string
33 x 30cm lengths green string
33 x challenge booklets
1 x packs of disinfectant wipes

MAKE A MOVE: BEFORE THE WORKSHOP

DETAILS

Target age group: P4–7

Minimum time required: 45–60 minutes

AT A GLANCE

Make a Move allows pupils to explore the movement of muscles and bones, and their control by the brain, through a series of physical tasks and a hands-on crafting activity.

Pupils will:

- Work individually and in pairs to complete challenges led by an on-screen presenter.
- Record and report individual results of physical challenges.
- Identify tasks that our brains find difficult and suggest how and why results could be improved.
- Create a working mechanical model of a finger using the materials provided.
- Compare and contrast how the mechanical model and real human fingers operate.
- Use an anatomical model to describe different parts of the musculoskeletal system.

SESSION OVERVIEW

Make a Move explores the coordination of movement by the central nervous system and the structure and function of the musculoskeletal system.

Pupils will follow along in a series of straightforward physical tasks which may be tricky to begin with but can be quickly improved with practice, and relate this process to the transmission of signals sent between the central nervous system (primarily the brain) and body parts (such as muscles).

In a sequence of challenges, pupils will be able to identify the role of sensory information in informing actions we perform; how reaction times can be improved as we strengthen connections in our nervous system; the role of the heart in the healthy function of tissue through oxygen transport; and how the human body balances and rebalances as we move.

By constructing a moving mechanical model of a finger, pupils will be able to visualize how tendons in their own hands move their own fingers. An anatomically correct model of a skeleton and an informative poster will also be included to supplement learning about the structure and function of various bones, muscles, tendons and joints.

The workshop is modular and can be run in any order depending on the needs of your class, although we have suggested a running order below. These-video led activities, run by our expert science communicator, should take about 60 minutes to complete. There are also additional activities with additional equipment for the pupils to explore and experiment with after the workshop.

A full breakdown is given below in 'During the Workshop'

1. INTRODUCTION	**Video**	General introduction to the series of *Make a Move* videos.
2. BAMBOOZLING YOUR BRAIN	**Video**	Pupils explore how the brain coordinates movements.
	Activity	Pupils undertake activities designed to test their coordination.
3. FINGER FINDING	**Video**	Pupils explore how our brain relies on cues from different parts of our body to coordinate movement.
	Activity	Pupils undertake a 'finger finding' challenge and record their results.
4. REACTION TIMES	**Video**	Pupils explore how signals are sent between our brain and body parts at different speeds.
	Activity	Pupils undertake a reaction time test and record their results.
5. PULSE RATE	**Video**	Pupils explore how the heart pumps blood around the body more quickly when we exercise.
	Activity	Pupils use pulse oximeters to record their pulse rate and oxygen levels before and after exercise.
6. CENTRE OF BALANCE	**Video**	Pupils are introduced to the concept of centre of balance.
	Activity	Pupils experiment with how they can make themselves more stable and less likely to lose their balance.
7. BUILD A MECHANICAL FINGER	**Video**	Demonstration of how to build the mechanical finger included in the kit.
	Activity	Pupils build their own mechanical finger and explore how the attached tendons make it move.

KEY LEARNING OUTCOMES

Pupils will be able to represent their current understanding as they:

- Explain that our body's movements are controlled and coordinated by the brain.
- Observe how the body responds to a range of different example stimuli and activities.
- Construct and use a mechanical model of a human finger.
- Recall key parts of the musculoskeletal system: bones, joints, muscles, tendons.
- Recognise how our musculoskeletal system allows us to move in a variety of different ways.

CURRICULUM LINKS

Make a Move complements the following experiences and outcomes:

SCN 1-12a: By researching, I can describe the position and function of the skeleton and major organs of the human body and discuss what I need to do to keep them healthy.

SCN 2-12a: By investigating some body systems and potential problems which they may develop, I can make informed decisions to help me to maintain my health and wellbeing.

SCN 2-12b: I have explored the structure and function of sensory organs to develop my understanding of body actions in response to outside conditions.

TEACHER BACKGROUND INFORMATION

The musculoskeletal system

The musculoskeletal system comprises of the bones, joints, muscles and tendons. The brain sends and receives messages to and from muscles through the nervous system, which consists of a network of cells called neurons.

Brain coordination and control

Our brain controls our movements. If we want to move an arm, leg or hand our brain must send a signal through a sequence of neurons to the muscles to contract in the correct order, and at the right time, to produce the movement. We must train our brains to give the correct instructions to our muscles and this training happens through practice. We have to practice movements to make them consistent and easy, just like learning to walk. The brain also controls unconscious movement, such as our heartbeat and breathing.

Muscles

Muscles pull on the bones, allowing us to move. The human body has more than 650 muscles and 206 bones. Muscles almost always work in pairs; one pulls on the bone by contracting (this shortens the muscle length) while the other one relaxes. Then, to move the bone in the opposite direction, they reverse roles. The muscles are connected to bones by tough, cord-like tissues called tendons, which allow them to pull on bones.

Hand anatomy

Our hand is made up of about 27 bones which are moved by muscles in the forearm. These muscles are connected to the bones of the fingers by long tendons. You might be able to see or feel these tendons moving if you wiggle your fingers.

EQUIPMENT

For the class:

Used with videos:

- 1 x pulse oximeter
- 1 x stopwatch
- 1 x collapsible hula hoop
- 16 x *'Build Your Own Mechanical Finger'* instruction booklets

Additional equipment:

- 1 x poster
- 2 x hand strengthener rings
- 6 x resistance bands
- 1 x wobble board
- 1 x exercise ball
- 2 x stethoscopes
- 1 x packet of disinfectant wipes
- 2 x AAA batteries

For each pupil:

- 1 x challenge booklet
- 1 x finger piece A template
- 1 x finger piece B template
- 15 x sticky pads
- 1 x 30 cm length of red yarn
- 1 x 30 cm length of blue yarn
- 1 x 30cm length of yellow yarn
- 1 x 30 cm length of green yarn
- 1 x 30cm ruler*

Please note all items marked * are not supplied in the *Generation Science* kit. If you are unable to source these, please get in touch with the *Generation Science* team. There is a full list of kit included in the box on p4 of this booklet.

PREPARATION

Before the session:

- Read this welcome booklet fully to familiarise yourself with the content.
- Check you can access the videos via the link supplied and that you can play them on your computer.
- Watch the '*Introduction*' video. This video introduces the presenter and summarises what the remaining videos are about. Watch this video first, and then you can watch the remaining ones in any order.
- Practice making a mechanical finger using the instructions and/or video to become familiar with the process and are able to help pupils where needed.
- For video-led activities:

– '*Finger Finding*': Check the stopwatch: Make sure it's switching on, ready to time pupils when they do the activity.
– '*Reaction Times*': Hand out rulers: Pupils will need a 30cm ruler. This can be one per pupil or one per pair.
– '*Pulse Rate*': Check the pulse oximeter: This clips on to your finger and has a small screen. Put it on your finger and press the button - it should switch on and after a few seconds, display numbers on the screen. Most models use two AAA batteries.
– '*Centre of Balance*': Build the hoop. Your hoop will arrive unassembled, but should be easy to put together.
– '*Make a Mechanical Finger*': Hand out the materials: The equipment required per pupil is detailed on the printed instructions.

HOW TO RUN A SESSION

We encourage you to use the equipment in your *Make a Move* box in whatever way suits you and your pupils best. The challenge booklets can be used with both the video-led challenges and for pupils to record their results in any other activities you come up with.

Each workshop should begin with the instruction video. You can then run the structured session suggested above, or an unstructured session in any order using the videos and the additional activities, some of which have accompanying pages in the challenge booklet. Details for how all these activities work can be found in the 'during the workshop' section. The additional kit provided includes: a poster, hand strengtheners, resistance bands, a wobble board, an exercise ball and stethoscopes.

Tips for running activities: Here are some tips that may help you in planning your sessions.

- **The videos are aimed at an audience of a full class.** When doing the video activities, we recommend doing them together as a class. However, some of the accompanying activities only require a couple of volunteers to complete.
- **Frame the challenges.** Creating a scenario for your class can help add context to the challenges and tasks. For example, you could treat the class as if they are competing in:

– a mini Olympic Games;
– a knockout tournament; or
– an annual class championship.

- **Set up stations around the class for activities that aren't video-led.** If possible, you can set up a range of activities and get the pupils to work in small groups to complete them. Then they can rotate round and try a new activity.

MAKE A MOVE: DURING THE WORKSHOP

LESSON PLAN

Details of the individual activities can be found below. They are described in the suggested order but can be completed as you wish. In the 'Why not try' section, we have suggested ways to frame the activity and short follow up activities to to emphasize the learning outcomes. Each section tells you if there is a video accompanying the activity.

SECTION	TEACHER GUIDANCE
Introduction	1. Play '*Introduction*' video. **Play this before watching any other videos.** This short video introduces the presenter, explains what pupils will learn from the activities in *Make a Move* and features teasers of what the other video activities are.
Bamboozling Your Brain Video Activity - Completed by whole class at once	1. Play *'Bamboozling Your Brain'* video. 2. Pause the video when prompted to try out activities or sort the class into pairs. 3. After the video has played, the pupils can repeat the three exercises from the video, 'head and tummy', 'hunter and rabbit', and 'mismatched fingers' to see if they become easier to complete. These exercises test their coordination skills and introduce the concept of the brain sending signals to muscles in order to coordinate movement. **Why not try:** • Framing an activity around identifying specialized skills that a) some members of the class have; b) some that everyone has and c) some that pupils won't learn until they're older. Ask why is this? What skills would you love to learn right now? • Creating a timeline of when people learn different skills. • Researching different parts of the brain and identifying what skills and functions they coordinate, e.g. medulla, Broca's area, hippocampus, amygdala.
Finger Finding Video Activity - Completed by whole class at once	1. Ensure that every pupil has a challenge booklet. 2. Play '*Finger Finding*' video. 3. Run the activity with the class, making sure that they record their results. This activity explores how our brain relies on cues from different parts of our body to coordinate our movement. By holding our hand out of sight and keeping it still, there are no visual or movement cues to inform us about precisely where our fingers are so it is more challenging than you expect. Stretch receptors in our muscles send signals to the medulla in our brain when we move, so wiggling your hand makes the task easier. **Why not try:** • Identifying different types of 'situation' and identify the different sensory inputs you rely on to make sense of that situation. For example, imagine you are asleep and something wakes you up. What woke you? Why is it useful that our body can react like this? What information did your brain receive that caused this to happen? • Working in pairs, recognizing and describing how different areas of skin, such as the back of your hand vs your fingertips, are more or less sensitive to sensory inputs. Why might we have more nerves in certain parts of the body?
Reaction Times Video Activity - Completed by whole class at once	1. Ensure that every pupil has a challenge booklet. 2. Ensure that every pupil has one 30cm ruler (or one between each pair if sharing). 3. Play '*Reaction Times*' video. 4. Run the activity with the class, making sure that they record their results. This activity emphasizes that signals are sent between our brain and different parts of our body at different speeds. Signals are sent more quickly when performing actions we have practiced. **Why not try:** • Designing a different reaction times experiment. What resources are needed? What data is recorded? What does it show? For example, you could stop something before it hits an obstacle; compare ability to perform a task with your left or right hand; results when there is background noise vs when it is silent.

SECTION	TEACHER GUIDANCE
Pulse Rate Video Activity - completed by one volunteer at a time	1. Ensure every pupil has a challenge booklet. 2. Make sure you have the pulse oximeter and stopwatch ready to go. 3. Play '*Pulse Rate*' video. 4. Feel for the pulse in your wrist and neck when prompted by the presenter (no need to pause). 5. Run the activity with the class, - pick a volunteer to come to the front; - take the first measurement; - use the stopwatch to time running on the spot for 10 seconds; and - take a second measurement. *NB: You can do this activity with other pupils whenever you have time, so they can record their own results.* This video focuses on how the heart pumps blood around the body more quickly when we exercise. This is because blood carries oxygen to tissue such as muscle, which is essential for it to function. The part of the brain called the medulla coordinates this but it does it without us having to think about it. **Why not try:** • Trying to find the pulse in your wrist and your neck. Count how many times you can feel it in 15 seconds and multiply this by 4 to get your beats per minute. Does this match up with the result gained from using a pulse oximeter? What are the benefits of using the pulse oximeter instead? What can medical staff learn from listening to our pulse? • Making graphs of different pupils' heart rates before and after different activities.
Centre of Balance Video Activity - Completed by two volunteers at a time	1. Ensure that every pupil has a challenge booklet. 2. Make sure that you have the hula hoop assembled. 3. Play '*Centre of Balance*' video. 4. Run the activity with class, making sure that they record their results. *NB: Pick either two sensible volunteers to do the activity with each other, or one volunteer who can do it with you.* This video introduces the idea that we have a centre of balance. When we are standing up this is located behind our belly button and can be thought of as an imaginary spot where we are most stable and unlikely to fall over. If it is pushed to the side we will lose our balance. It is harder to do this when our legs are wider apart. **Why not try:** • Comparing the centre of balance of different shaped objects and hypothesizing which will be more stable and which will fall, before testing your hypothesis. • Designing an invention, alien or tool that has its centre of balance in the middle or to the side. When might it be useful to have a centre of balance that isn't right in the middle? • Seeing who can hula for the longest!
Build a Mechanical Finger Video Activity - Completed by whole class at once	1. Hand out '*Build a Mechanical Finger*' instructions. These can be shared between groups or you may want to photocopy more. Pupils will follow along with the video but can refer to these if needed. 2. Play '*Build a Mechanical Finge*r' video. *NB: This will need to be paused between steps to ensure the class are all at the same stage of the video.* This making activity helps pupils to visualize how tendons attach to bones and move them in different ways (specifically curling and straightening out a finger). Tendons are found all over the body. The largest is the Achilles tendon, which attaches the calf muscle to the heel bone.
Poster (activity for one small group at a time)	The enclosed poster highlights and defines some examples of the bones, muscle, ligaments and tendons found in different parts of the body, to supplement the learning in the other activities. **Why not try:** • Remembering as much as you can from the poster by showing the class the poster for 30 seconds and then hiding it. What can they remember? Where were those body parts? What do they do? • Brainstorming in pairs to come up with a question about what they see on the poster. The class can discuss answers together or research them independently.

SECTION	TEACHER GUIDANCE
Hand Strengtheners (challenge card activity)	Grip strength is a measure of how much force you can exert through your hands. This power comes from the muscles in your forearms. Examples of this include squeezing objects like stress balls in your hands or hanging from objects such as monkey bars. There are three types of grip: crush, pinch and support. This allows us to press on, squeeze and hold objects, respectively. **Why not try:** • Defining the three types of grip strength and classifying activities that use each type. • Competing to try to close the strengtheners. Is it possible? • Looking at your hand, wrist and forearm as you squeeze the hand strengthener. What is moving inside your body when you grip it?
Resistance Bands (challenge card activity)	By gradually exerting more and more force on your muscles, they can grow stronger and stronger. One way to do this is by using tough resistance bands. When you pull on the bands, they exert force on your muscles. Gently stretching your muscles, for example through yoga or pilates, can also make them more flexible. **Why not try:** • Designing experiments to test how long pupils can pull on resistance bands in different poses. • Researching exercises that use specific muscle groups. • Demonstrating and communicating to their peers how to safely and effectively use resistance bands.
Wobble Board (challenge card activity)	Our abdominal muscles, or abs, are strong muscles located between the ribs and the pelvis that can help us to keep our balance. They also help to support our internal organs, keeping them in place. Our 'core' is the combination of the abdominal muscles combined with many others such as posterior (back), shoulder, and hip muscles. A strong core supports good balance and posture. **Why not try:** • Squatting or bending over while on the board and seeing who can pick up the most stuff off the floor in a set amount of time. • Catching the most balls without losing your balance. • Drawing or writing something while trying to balance.
Exercise Ball (challenge card activity)	An exercise ball can help to strengthen and stretch the lumbar muscles. These are large muscles at the base of our back which help keep us upright and move our torso. Sitting on an exercise ball also requires subtle movements by core muscles deeper in our body to keep us balanced. **Why not try:** • Sitting back-to-back as a pair, passing the ball around to each other in a circle; see how quickly you can complete a set number of passes. • Lying face down on the ball and trying to extend all of your limbs at once without falling. • Researching how exercise balls can be used by physiotherapists for rehabilitation.
Stethoscopes (challenge card activity)	Stethoscopes are used by medical professionals to listen to various organs in our body to identify if they are functioning normally. They are widely associated with listening to our heartbeat but can also be used to listen to the lungs to recognize if there are issues with our breathing and have been used to listen to bowel sounds to identify signs of difficulty digesting food. **Why not try:** • Measuring heart rate and comparing this to results from a pulse oximeter, comparing accuracy and ease of use. • Predicting how heart rate may vary before and after certain activities, and testing it, e.g. exercise, lunch, getting a fright! • Comparing heart rates between participants of different ages e.g. primary 1 to 7 and adult staff.

MAKE A MOVE: AFTER THE WORKSHOP

LESSON SUPPORT

The lesson support section gives you a list of links to videos and websites that you can use to talk more about this topic. We have suggested whether each link is useful to watch as a class, for young people to do at home or as an activity for you prepare. Finally, we have suggested two follow up activities you can do with classroom resources to expand on the learning outcomes.

FOLLOW-UP IDEAS

Explore:

A range of hands-on activities using simple materials from the Exploratorium, a science centre in San Francisco. *#Activity*

https://www.exploratorium.edu/snacks/subject/anatomy-and-physiology

Make:

Make Your Own Lungs: A video explaining how you can make a working model of inflating and deflating lungs using a plastic bottle, balloons, and plasticine. *#Activity*

https://www.youtube.com/watch?v=fybV8zIGyu8

Experiment:

Encourage pupils to design and execute their own experiments using the equipment enclosed in the kit. *#Activity #AtHome*

Record and Analyse:

Gather results from each pupil in the practical activities and use this data for a computing lesson, identifying how this data can be recorded and presented (tables, graphs, slideshows, etc). *#Activity*

Investigate:

Repeat activities after a set period of time (e.g. two weeks) and compare results. This can be continued to create a long-term study of developing skills. What might affect pupils' performances over time? How can these newly-developed skills be utilised in a real-life situation? *#Activity #AtHome*

USEFUL LINKS

DK Find Out: Human Body

An interactive page where you can delve into more depth about parts of the human body such as nerves, muscles, senses, and the heart through diagrams, pictures and videos. *#AtHome*

https://www.dkfindout.com/uk/human-body/

The Physiological Society: Animations

A short YouTube playlist of animations detailing different processes witnessed in the human body. *#WatchTogether #AtHome*

https://youtube.com/playlist?list=PLlql96GMwNGGTBFvxHhi4-4TNcpeXJb_y

National Geographic: Human Body 101

A 5 minute video detailing the different systems found in the body, including the musculoskeletal and nervous systems. It does cover the urinary and reproductive systems too – take note if considering sharing with classes! *#WatchTogether #AtHome*

https://www.youtube.com/watch?v=Ae4MadKPJC0

Understanding the Body

Some resources from The Science Museum in London explaining the ways we have improved our understanding of how the body works to help identify how to stay healthy and treat illnesses. *#AtHome*

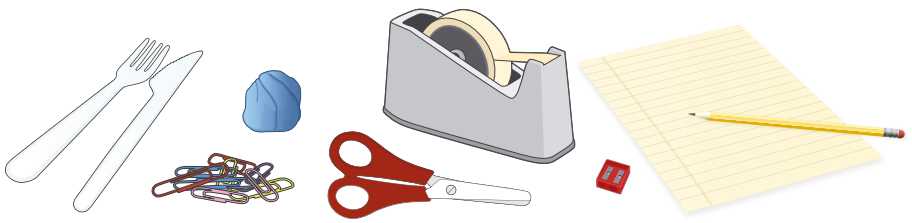
https://www.sciencemuseum.org.uk/objects-and-stories/understanding-body

FOLLOW UP ACTIVITY 1

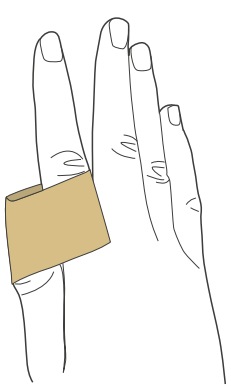
OPPOSABLE THUMB FUN

You will need:

- Masking tape or scotch tape
- Paper
- Pencils
- Plastic knife and fork
- Plasticine
- Paper clips

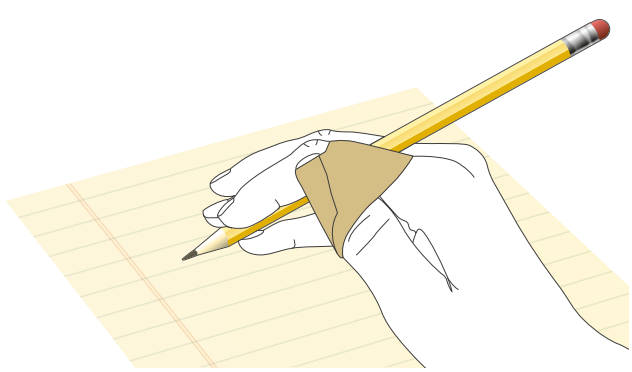


Step 1. Try these tasks and record whether you thought they were easy, medium, or difficult:	With opposable thumbs			With thumbs taped		
	Easy	Medium	Difficult	Easy	Medium	Difficult
Pick up a sheet of paper						
Pick up a pen or pencil from your table. Use it to write your name on the piece of paper						
Open a book and turn the pages one by one						
Use a plastic knife and fork to cut plasticine into small pieces						
Sharpen a pencil						
Cut a circle out of a piece of paper using scissors						
Pick up one paper clip, then clip two together						
Untie your shoelace, tie it again						
Unbutton and rebutton a piece of clothing that has buttons						
Zip up a jacket						



Step 2:

Have someone put a small amount of tape around the top of your thumb and the base of your first finger on both hands so you can no longer use your thumbs.



Step 3:

Try each of the tasks again and have a friend record how difficult you found them – What did you find?

Explanation

The human thumb is a special type of finger which is different from those of most other animals. Our thumbs are opposable. This means that they are able to move in such a way that you can press directly against the tips of your other fingers on the same hand. Your other fingers are unable to move like this. You can press them together side to side, but not like you did with your thumb.

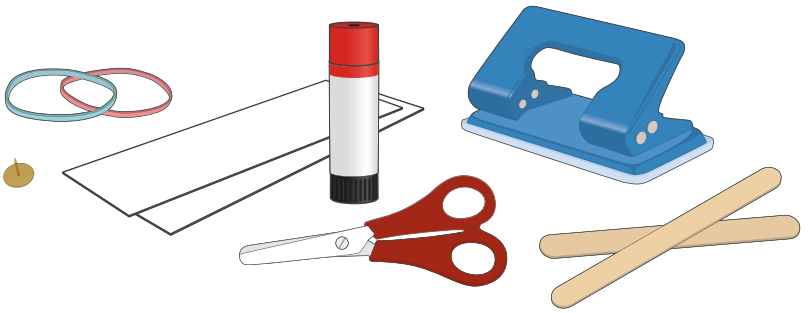
This movement enables us to hold and manipulate small objects as well as grip objects. It is the special movement of the thumb that allows us to complete more complex tasks such as tying a shoe lace or holding a knife and fork which many other animals would not be able to do.

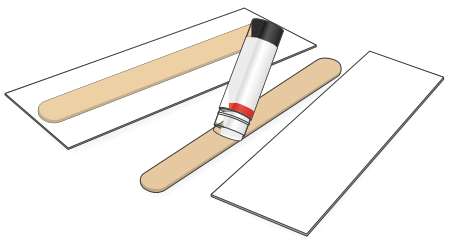
FOLLOW UP ACTIVITY 2

MAKE A MUSCLE

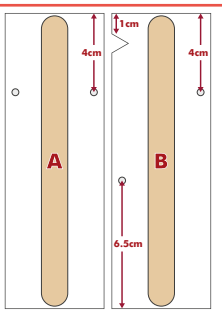
You will need:

- 2 pieces of stiff card or cardboard cut to 15cm by 5cm
- 2 lollipop/craft sticks
- 2 rubber bands – diameter approx. 8cm
- Hole punch
- Drawing pin
- Scissors
- Glue stick

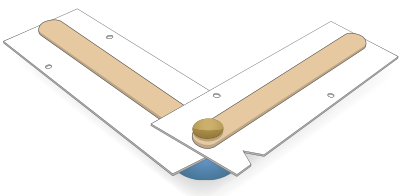




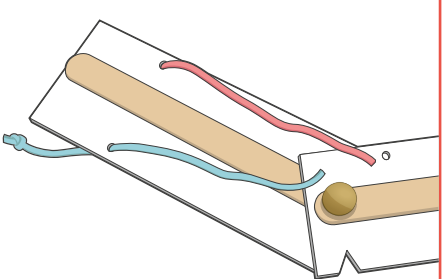
Step 1:
Glue each lollipop stick to the centre of each piece of card.



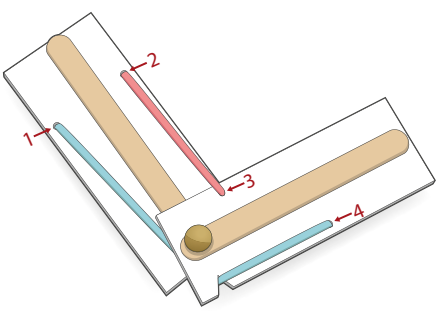
Step 2:
Use the diagram to measure and mark where the four holes are to be made and use the hole punch to make them in these positions. Use the scissors to cut a triangular notch as shown in the diagram on card B.



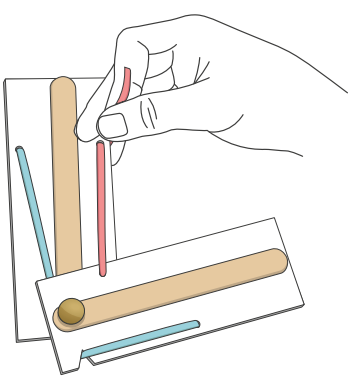
Step 3:
Place the bottom of lollipop stick B over the bottom of lollipop stick A. Push a drawing pin through both overlapping lollipop sticks to attach them. (Try using plasticine or blu-tac behind the lollipop sticks as this makes it easier and safer).



Step 4:
Cut both the rubber bands once. Thread each band through one of the holes on card A and tie each in a knot at the back so they can't move out of the holes.



Step 5:
Have the lollipop sticks at approximately 100° angle to one another. Thread the rubber band from hole 1 through hole 4 and tie off in a knot at the correct length to keep the arm at this position. Run this rubber band through the notch in card B. Put the other elastic band through hole 3 and tie off at the correct length.



Step 6:
Move the arm by pulling on the rubber bands. Pulling on one rubber band makes the arm bend, while pulling on the other makes the arm straighten.

Extension
Decorate your arm by drawing or labelling on bones, muscles and tendons.

Explanation

The human body has over 650 muscles. In this activity we can examine how the system in our upper arms causes the arm to move.

The elastic bands are acting a little bit like our muscles and the lollipop sticks like our bones. When we want to move our arm our brain sends a signal to the muscle making it contract so it gets shorter and fatter.

Muscles are attached to the bones with tendons and when the muscle contracts it pulls on the bone causing it to move.

To move the arm back again another muscle must contract to make a movement in the opposite direction.