05

The Smallpeice Trust

ENGINEERING @SCHOOL

The Prosthetic Hand Challenge

Subject: STEM/Engineering

Year group: 2-6

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Dare to imagine

#EngineeringAtSchool

PROSTHETIC HAND TEACHER GUIDANCE

This activity can be used as one of eight towards students obtaining the CREST SuperStar Award.

What Is CREST?

CREST is a nationally recognised scheme for student-led project work in the STEM subjects (science, technology, engineering and maths).

CREST gives young people aged 5–19 the chance to choose their own subject and methodology when completing their hands-on investigation.

CREST provides activities and project ideas for a range of ages, group size and abilities. From off-the-shelf, one-hour long challenges through to large-scale, student-led projects of over 70 hours work or more, CREST can be done by anyone.

What is CREST SuperStar?

SuperStar level is designed to be easy-to-run and low-cost for children typically aged 7-11 years. Children gain an Award by completing eight challenges.

You can download a CREST SuperStar passport template for your students to track their progress once you create an account via

www.crestawards.org/crest-superstar

ENTRY FEE per child: £1 UK / £4 International*

Within four weeks of payment, you will receive certificates and fabric badges to give out to your class.

LENGTH OF LESSON: 1-2 HOURS

How to make your Prosthetic Hand:

https://bit.ly/3c5DZsL

LESSON OVERVIEW

Students work in teams of "engineers" to design and build their own marble run out of everyday items. They test their prosthetic hand, evaluate their results, and present to the class.

Learning Objectives

During this lesson, students will:

- Design and construct a prosthetic hand
- Test and refine their designs
- Communicate their design process and results

Learning Outcomes

- To identify the different parts of a hand
- To understand the purpose of prosthetics
- To design and build models by using different materials and to test selected functional characteristic of the model built with the chosen materials

Key Vocabulary:

PROSTHETICS, HAND, JOINTS, MUSCLES, BONES, BIOMEDICAL ENGINEERING

Curriculum links

SCIENCE KEY STAGE 1

- Identify, name, draw and label the basic parts of the human body and say which part of the body is associated with each sense

SCIENCE KEY STAGE 2

- Identify that humans and some other animals have skeletons and muscles for support, protection and movement
- Working scientifically: asking relevant questions and using different types of scientific enquiries to answer them
- Working scientifically: setting up simple practical enquiries, comparative and fair tests
- Working scientifically: making systematic and careful observations and, where appropriate, taking accurate measurements using standard units, using a range of equipment, including thermometers and data loggers
- Working scientifically: gathering, recording, classifying and presenting data in a variety of ways to help in answering questions
- Working scientifically: recording findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables
- Working scientifically: using results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions

DESIGN & TECHNOLOGY KEY STAGE 2

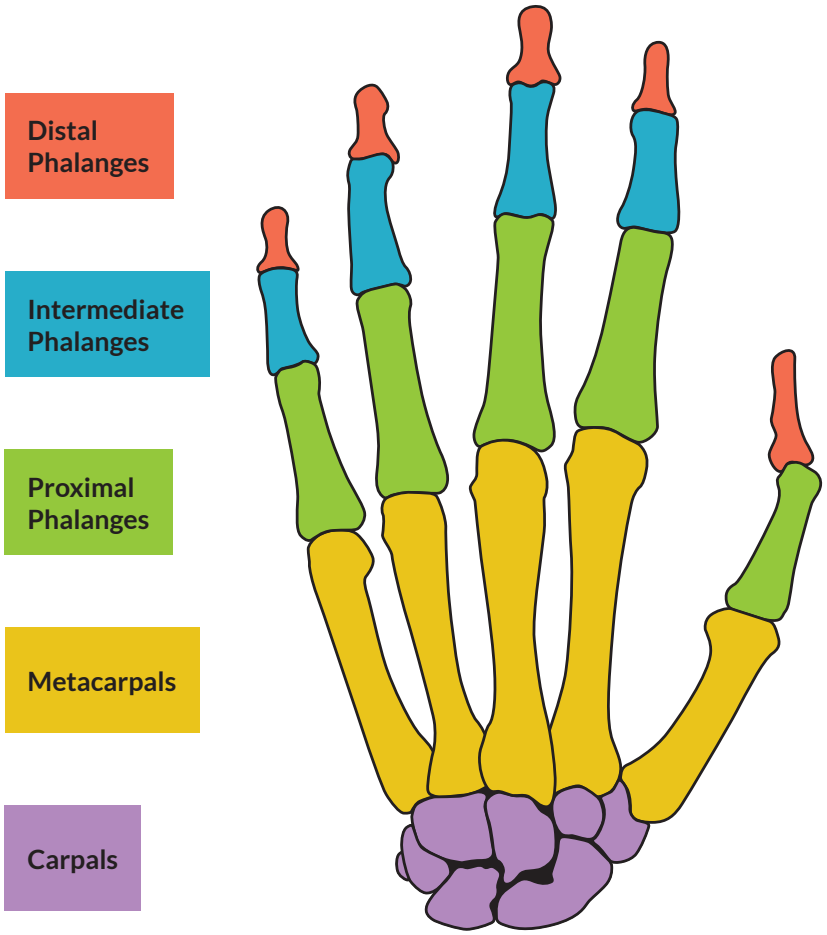
- Use research and develop design criteria to inform the design of innovative, functional, appealing products that are fit for purpose, aimed at individuals or groups
- Generate, develop, model and communicate their ideas through discussion, annotated sketches, cross-sectional and exploded diagrams, prototypes, pattern pieces and computer-aided design
- Select from and use a wider range of tools and equipment to perform practical tasks [for example, cutting, shaping, joining and finishing], accurately
- Apply their understanding of how to strengthen, stiffen and reinforce more complex structures

INTRODUCTION

Parts of a hand

Explain to students that: The hand is a part of the body that extends from the end of each arm. Hands are a feature of most primates, including humans, apes, and monkeys. The hand has a flat, wide palm. It also has five parts called digits—a thumb and four fingers. Bones and muscles inside the hand allow the digits to move in many useful ways.

The human hand contains 27 main bones. Each finger has three bones. The thumb has two. The palm of the hand has five bones. The wrist, which attaches the hand to the arm, has eight bones. There are also some small bones near the base of the digits.



What are prosthetics?

Explain to students that: A prosthesis is a device made to replace a missing human body part such as a hand. They are used by people who are missing body parts due to accidents, health problems (amputees) or being born without them. Originally, prostheses were simply pieces of wood (for example, wooden legs), but now they are made of lighter materials. Prosthetics are designed by biomedical engineers.

What are biomedical engineers?

Explain to students that: Biomedical engineers design, test, modify, and evaluate medical equipment used to interface or interact with the human body.

Materials

1. CARDBOARD
2. SELLOTAPE
3. SCISSORS
4. STRAWS
5. STRING

MAIN ACTIVITY

1. Students will need to work in a pair for this activity.

2. Explain that students must develop a prosthetic hand from everyday items.

3. Ask students to develop a plan for their prosthetic hand. They will need to decide and agree on the materials they will use, write/draw their plan, and present their plan to the class.

4. Show students the student activity sheet and explain that they will need to follow the instructions to make their prosthetic hand.

5. Student groups next execute their plans and build their prosthetic hand using the materials they have chosen. They may need to rethink their plan, request other materials, or start again if the materials chosen are not working.

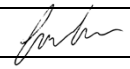
6. Next, teams will test their prosthetic hand. They can test the prosthetic hand by picking up different items. The final test should be to pick up a cup of water and pour it into another cup.

7. Teams complete an evaluation / reflection worksheet, and present to the class.

PLENARY (QUESTIONS TO ASK STUDENTS)

1. **Did you succeed in creating a prosthetic hand?**
2. **Which materials did you use for your prosthetic hand?**
3. **How many items did you manage to pick up with your prosthetic hand?**
4. **Which was the hardest item to pick up with your prosthetic hand?**
5. **Did you decide to revise your original design or request additional materials while in the construction phase? Why?**
6. **If you could have had access to materials that were different than those provided, what would your team have requested? Why?**
7. **Do you think engineers have to adapt their original plans during the construction of systems or products? Why might they?**
8. **If you had to do it all over again, how would your planned design change? Why?**
9. **What designs or methods did you see other teams try that you thought worked well?**
10. **Do you think you would have been able to complete this project easier if you were working alone? Explain…**

STEM Day Risk Assessment

Risk Assessment for	Engineering at School Projects
Assessment undertaken on	31/03/2020
Assessment undertaken by	Jessica Lee
Signed	

No.	Activity/area being assessed	Associated risk	Who is at risk?	Existing control measures in place?	Level of risk (low, medium, high)	Responsibility
1	General Activity and Workspace	**Slips, trips and falls:** Injury due to tripping over items	Students and adults	Activity supervised by adult supervisor. Deliverer reminds students about safety in video introduction.	M	Students and adults
2	Use of Materials: paper/card, plastic containers	**Injuries:** Injury due to paper cuts, cuts from sharp edges **Injuries:** Injury due to misuse	Students and adults	Activity supervised by adult supervisor.	L	Students and adults
3	Use of materials: elastic bands, sellotape, glue stick, blu-tack, small toys, paper fasteners, LEGO pieces, nuts & bolts or equivalent.	**Injuries:** Injury due to use as a missile **Slips, trips and falls:** Injury due to slipping on dropped items **Injuries:** Ingestion risk of choking.	Students and adults Students and adults Students and adults	Activity supervised by adult supervisor. Activity supervised by adult supervisor. Activity supervised by adult supervisor.	L	Students and adults
4	Use of materials: plastic, corrugated carboard	**Injuries:** Cuts from sharp edges	Students and adults	Activity supervised by adult supervisor.	L	Students and adults

No.	Activity/area being assessed	Associated risk	Who is at risk?	Existing control measures in place?	Level of risk (low, medium, high)	Responsibility
5	Use of sharp tools: Scissors, craft knives	**Injuries:** Cut to self	Students	Activity supervised by adult supervisor.	M	Students and adults
		Behaviour: Cut to others	Students and adults	Activity supervised by adult supervisor.	L	Students and adults
		Behaviour: Vandalism of property	School or home	Activity supervised by adult supervisor.	L	Students and adults
6	Testing of projects: bathtub, drop from height, items on floor	**Spillage of water on floor**: damage and injury due to slip	Students and adults	Activity supervised by adult supervisor.	L	Students and adults
		Slip, trip or fall: Injury due to falling from testing area, tripping over items in testing space	Students and adults	Activity supervised by adult supervisor.	L	Students and adults

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The Prosthetic Hand Challenge

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Suitable for ages: 5+

Time needed: 1hr+

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Dare to imagine

DESIGN A PROSTHETIC HAND

You are a team of engineers who have been given the challenge to design your own prosthetic hand out of everyday items. The prosthetic hand needs to be able to pick up different items.

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What is a Prosthetic Hand?

A prosthetic hand is an artificial device that replaces a missing hand. The hand may be missing due to injury or because the person was born without one.

PLANNING STAGE

In your team, discuss the problem you need to solve. Then develop and agree on a design for your prosthetic hand. You'll need to decide and agree what materials you want to use.

Draw your design in the box and label the different parts and materials you plan to use. Present your design to the class.

You may choose to revise your team's plan after you receive feedback from class.

PROSTHETIC HAND DESIGN & MATERIALS

MATERIALS

1. CARDBOARD
2. STRAWS
3. SELLOTAPE
4. SCISSORS
5. STRING

BUILDING STAGE 1 OF 3

1.

Draw around your hand and cut it out, making sure each finger is separate.

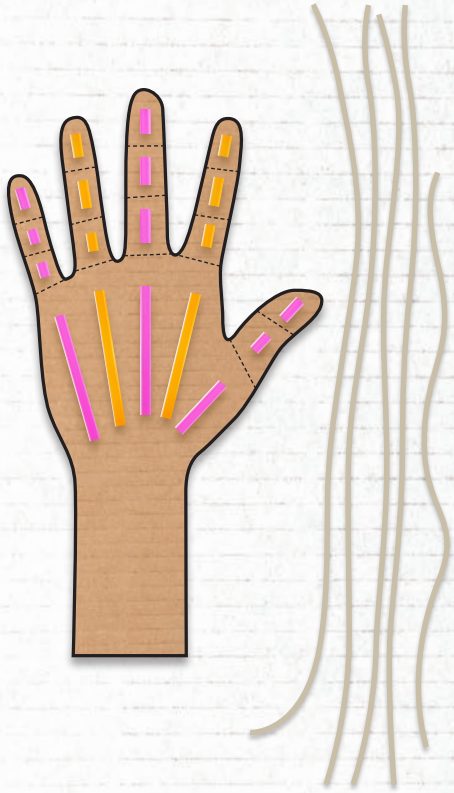
2.

Create joints on your fingers by marking them with pencil and folding along the line so that they can bend easily.

3.

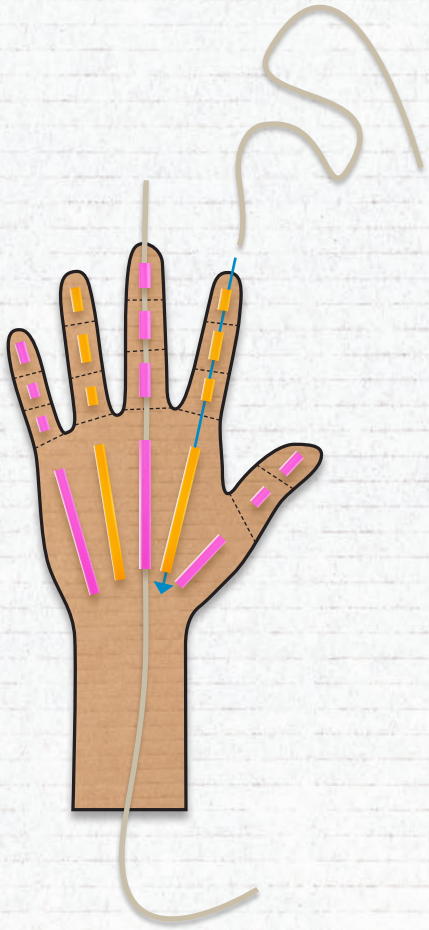
Cut a piece of straw for each section of the finger and stick them in place. Leave plenty of space between each straw for the finger to bend. You could use different coloured straws for each finger to help tell them apart.

BUILDING STAGE 2 OF 3



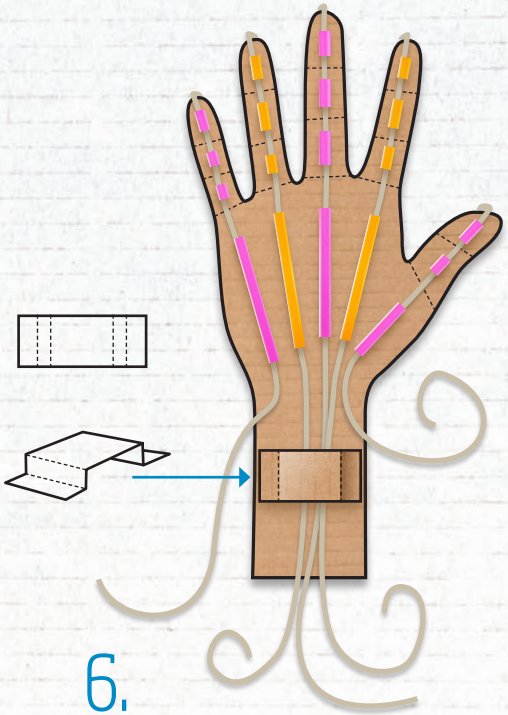
4.

Cut 5 pieces of string for each finger, they must be long enough to reach from the fingertip down to the bottom of the wrist with a lot left over.



5.

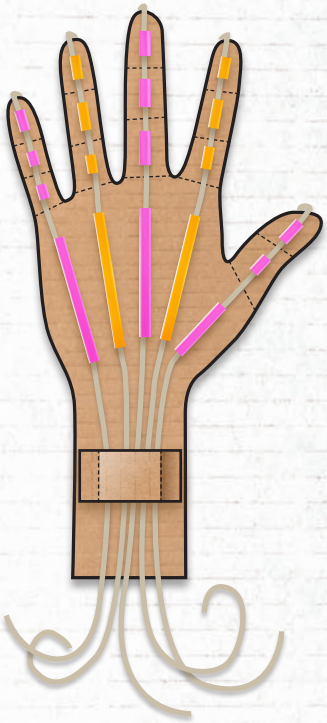
Thread the string through each straw piece on the finger. Repeat for all the fingers. Stick the top of the string to the back of the fingertips.



6.

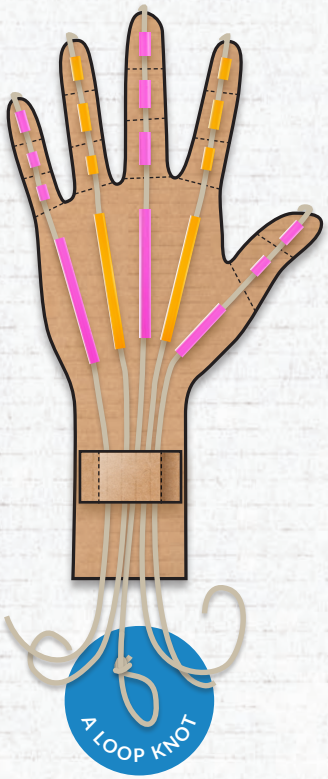
Create a small bridge out of cardboard and stick it to the wrist on your hand.

BUILDING STAGE 3 OF 3



7.

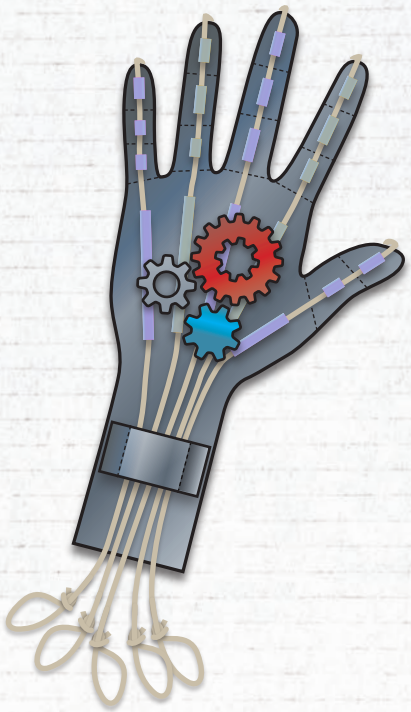
Thread all the strings through the tunnel under the bridge.



8.

Tie the end of the strings into a loop knot, with space for your fingers to go in at the end to control the mechanical hand. There are lots of ways to tie a loop knot.

(ask your teacher for help with this)



9.

Decorate your prosthetic hand.

Why not make it a robot hand, an extended grab arm, an animal's hand?

TESTING STAGE

Each team will test their prosthetic hand.
What items can you pick up?

PROSTHETIC HAND DATA

	Item	Weight
1		
2		
3		

EVALUATION STAGE 1 OF 2

Evaluate your team's results, complete the evaluation worksheet, and present your findings to the class.

Use this worksheet to evaluate your team's results in the Prosthetic Hand Challenge.

1. **Did you succeed in creating a prosthetic hand?**

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EVALUATION STAGE 2 OF 2

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