STEM LEARNING

BORN TO ENGINEER

BIONIC BOY

PRESENTATION

Bionic Boy

Baby Sol was born in March 2015 and had his arm amputated when he was ten days old because of a clot in his arm.

Ben Ryan, Sol's father, started to research prosthetics. He discovered that a prosthetic arm wouldn't be available for Sol until he was at least 12 months old – and even when Sol is a year old, the artificial arm would be cosmetic with no grabbing or holding action.

Although Ben had not trained to be an engineer, he was determined to help his son and this inspired him to design prototype arms that could be worn from a much earlier age. His aim was to create a light, attractive and personalised limb, all produced with a 3D printer.

Ben has founded the company **Ambionics** in order to develop this technology for the benefit of families across the world.

"My aim through Ambionics is to help children everywhere adopt and continue to use prosthetics into adulthood. Offering safe function with no small parts or batteries at the earliest possible age is key to achieving this." Ben Ryan

A prosthesis is a device that replaces a missing part of the human body (from Ancient Greek 'prosthesis': addition, application, attachment).

What other prosthetics are you aware of?

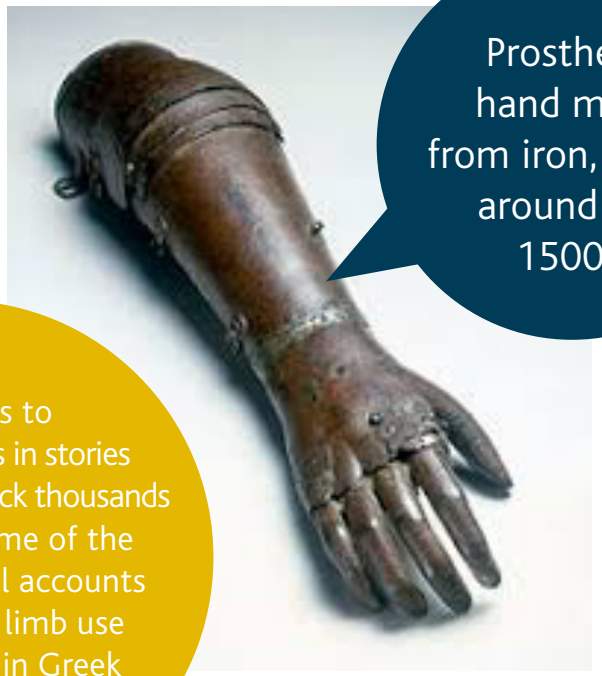

FJacquot*2004

Prosthetics in History

In the year 2000, researchers in Cairo, Egypt, found what they believe to be the oldest artificial body part – a prosthetic toe made of wood and leather found attached to the nearly 3,000-year-old mummified remains of an Egyptian woman.

This provides a good guide to how little prosthetic limbs have changed throughout history.

References to prosthetic limbs in stories and poems, date back thousands of years and some of the earliest historical accounts of a prosthetic limb use were recorded in Greek and Roman times.



Prosthetic hand made from iron, dating around the 1500s.

Queen Mary's Hospital, 1941

Artificial limbs started to be mass-produced in response to the enormous number of casualties in the Second World War. Technology continued to develop after the war with Queen Mary's Hospital in Roehampton, England, becoming an important centre for manufacturing limbs.

Take a look at Ben Ryan's video again, record your answers to the questions below

- What was Ben's engineering challenge?
- What engineering materials does Ben talk about during the video?
- What technology does he use to create the working arm for Sol?
- How did he develop Sol's arm? What stages of development did he go through?
- Before his son was born, Ben wasn't an engineer. What engineering skills do you think he needed to learn?
- What challenges has he encountered in trying to create a prosthetic arm for his son, Sol?

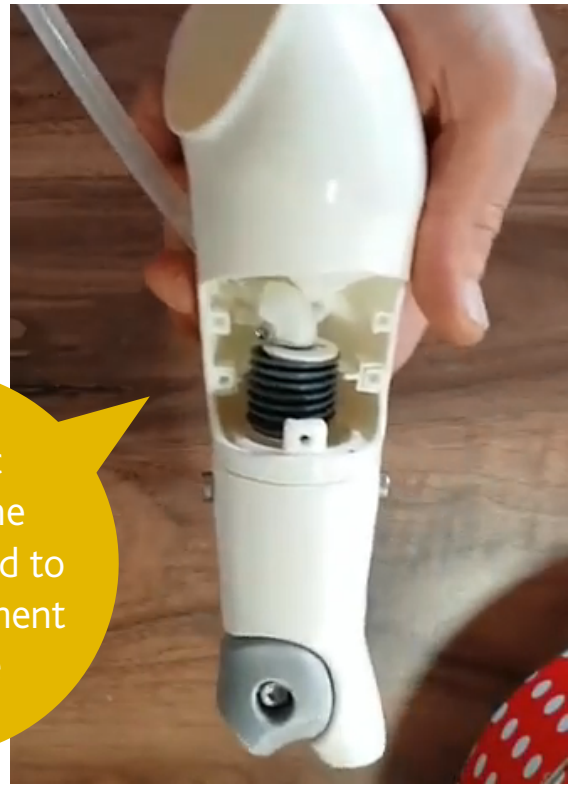
Inspired by nature - biomimicry

The moving hand that Ben developed is inspired by the way that spiders move their legs.

Spiders' legs naturally want to contract, moving them inwards.

The outward movement of the spiders' legs is controlled by the larger part of their body, which circulates fluid inside the body, flexing the legs hydraulically.

Hydraulic power is the control of fluid to create movement or a force



Your challenge

Sol is growing up – he is already 3 years old and is getting ready to start school soon.

Ben would like you to design a prosthetic arm that Sol can use when he is at school.

The designs that you create must be suitable for a child and must fit Sol comfortably.

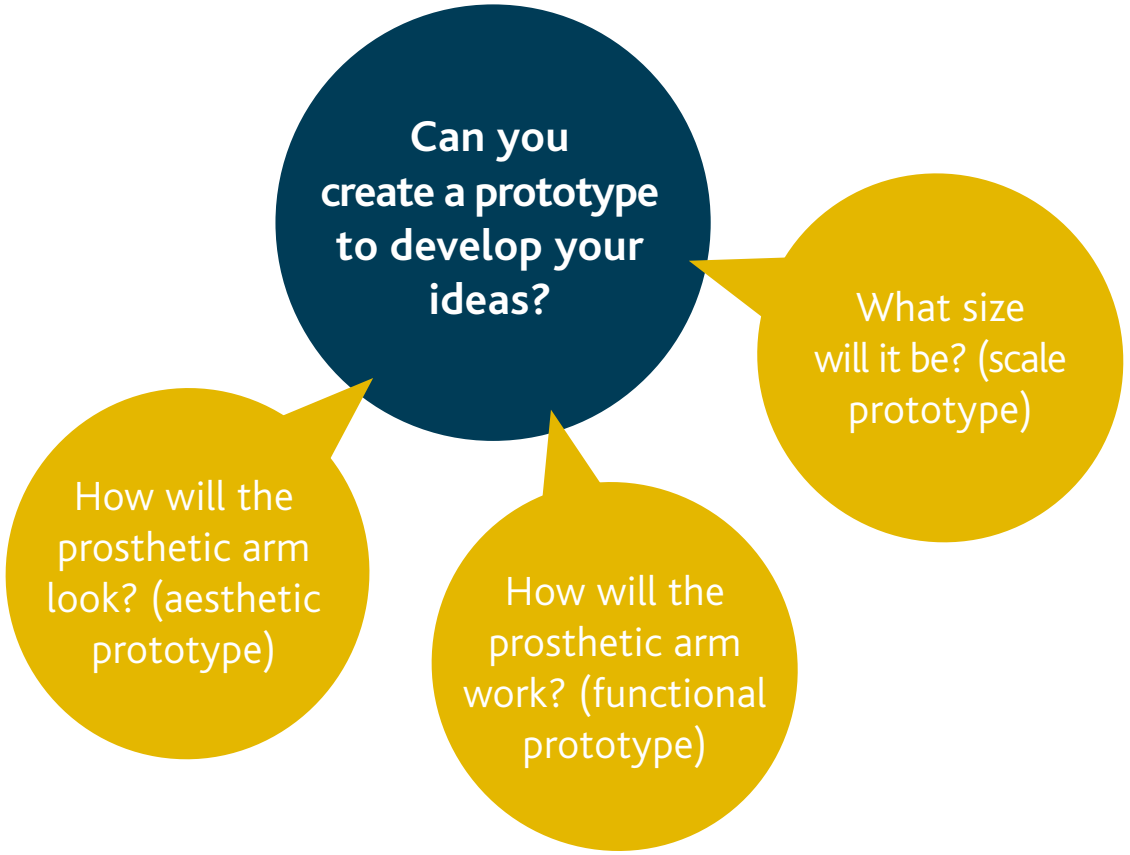
The prosthetic can have 'superhuman' functions, as long as they are safe for Sol to use.

Research

Before you design your prosthetic arm, you must think about who is going to use it and how they will use it.

- What kind of activities might Sol (and other similar-aged children) do when they get to primary school?
- What size will the prosthetic need to be to fit a younger school aged child?
- What materials will it need to be made from to withstand use over time?
- What might a child want it to look like (eg colour, shape)?
- What are the safety considerations for making something to be used by a child?
- Does it need to replicate a hand exactly or could it have some additional 'superhuman' ability?
- What technology will your hand need to function?

Prototype, evaluate, improve



- If your ideas involve technology, why not create an aesthetic prototype and explain how it would work if you had the technology available.
- You could model your idea using materials or create a virtual model using computer aided design (CAD).
- How have you tested and evaluated your ideas?
- What further tests might you need to do before developing your ideas further?

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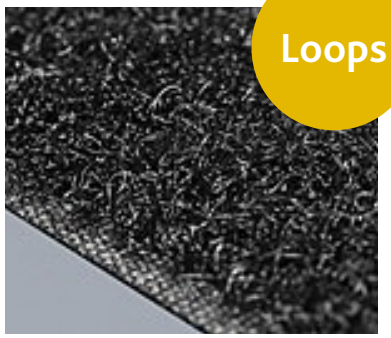
Extension Activity 1

Can you design a test that will help Ben to work out:

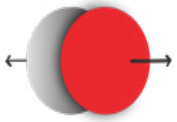
- Where the hook and loop should be located
- The maximum weight that Sol could carry

Did you know?

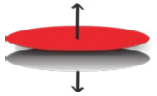
Hook and loop works by having two strips of material, one with lots of tiny hooks, and one with lots of thinner loops that the hooks can cling to when the two elements are pressed together... The hooks and loops in Velcro are commonly made from nylon and polyester with the hooks being more rigid and thicker than the loops.



Peel strength



Shear strength



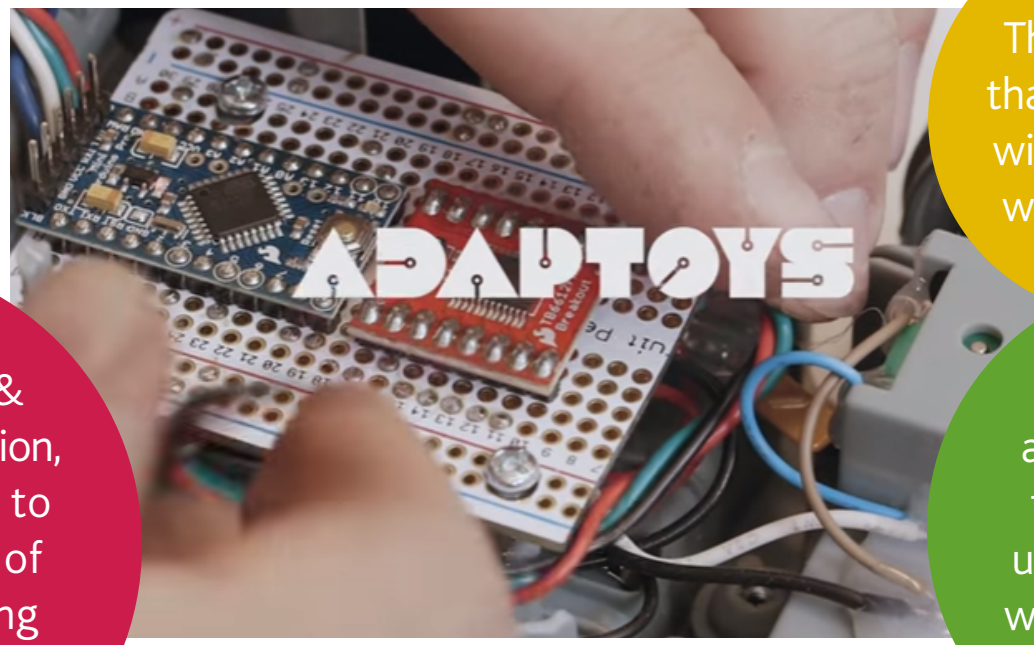
Tensions strength

Cycle life

Extension Activity 2

Adaptoys are adapted versions of popular toys that allow people with physical disabilities to experience the happiness of playing with their families.

The Christopher & Dana Reeve Foundation, who are dedicated to improving quality of life for people living with paralysis, created 'Adaptoys'.



Think of a toy that you played with when you were younger.

How can you adapt the toy so that it could be used by someone with an additional need?

Extension Activity 3

When someone picks up an object, they can judge how much force to use, because the brain gets feedback from the touch receptors in their hand. Artificial hands (eg for robots or for prosthetic limbs) also need a sensing system if they are to use the correct force.

- QTC is a rubber-like material containing tiny metal particles. It contains the metal nickel embedded in a polymer material.
- QTC stands for quantum tunnelling composite. When you squeeze it, its electrical resistance drops.
- QTC can act as a force sensor because it's a material whose resistance increases when it is squeezed.

Explore the behaviour of QTC

Can you make a tactile sensor using QTC?

Could QTC be used to give touch sensitivity in an artificial hand?