EDUCATION GUIDE

SUPER HUMAN

POWER OF TECHNOLOGY

CREATED BY scitech Perth • Australia

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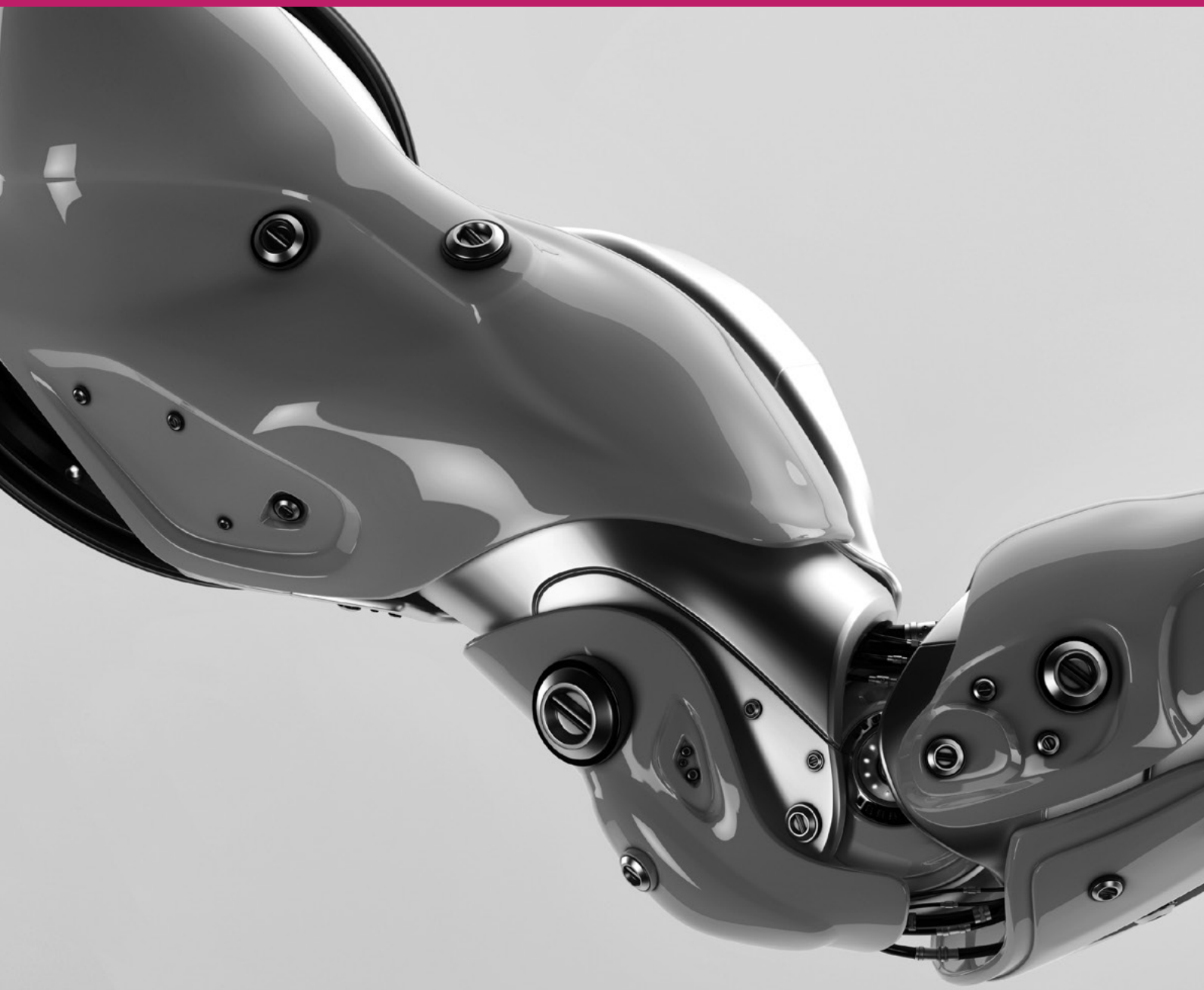
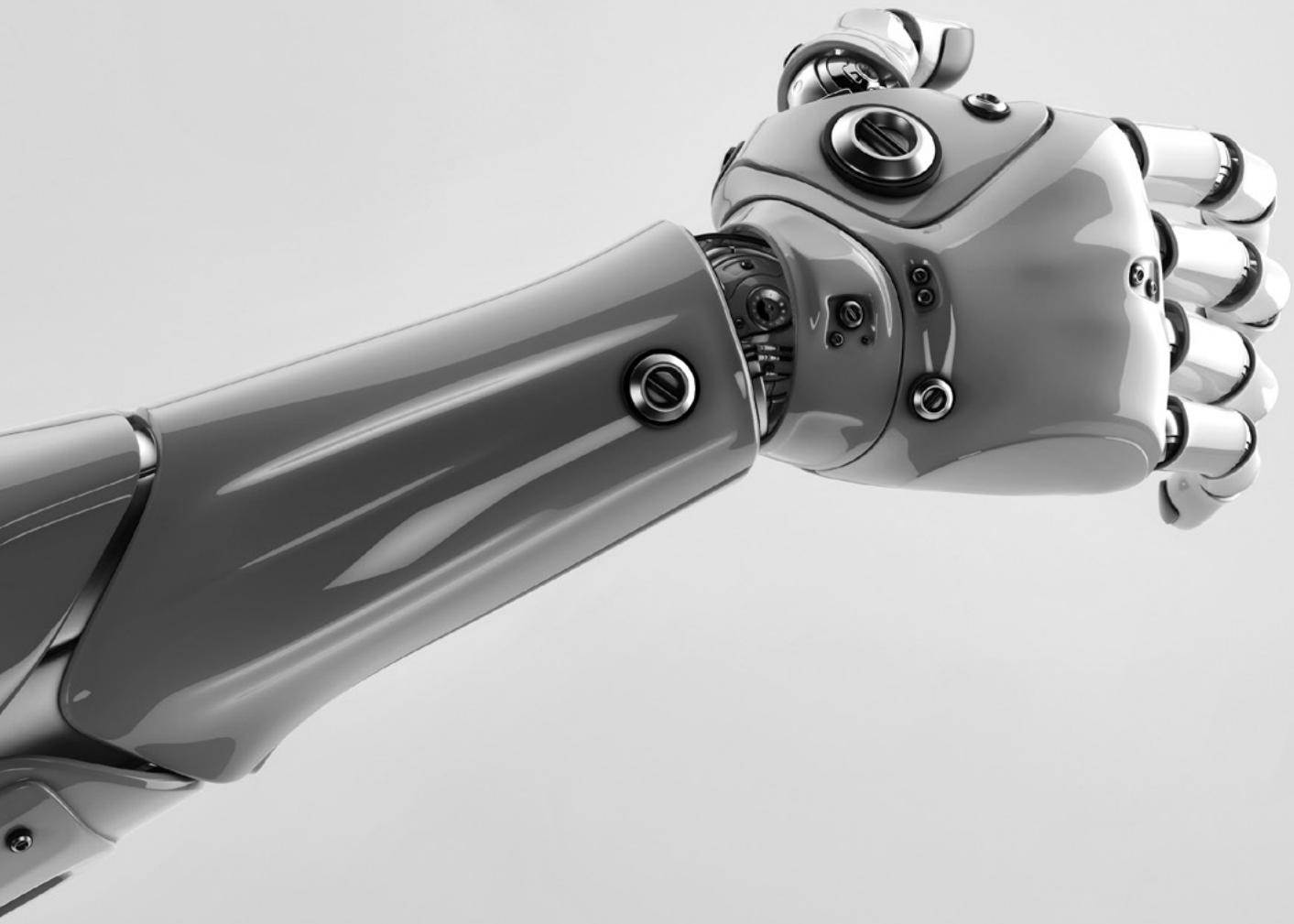




CONTENTS

EXHIBITION

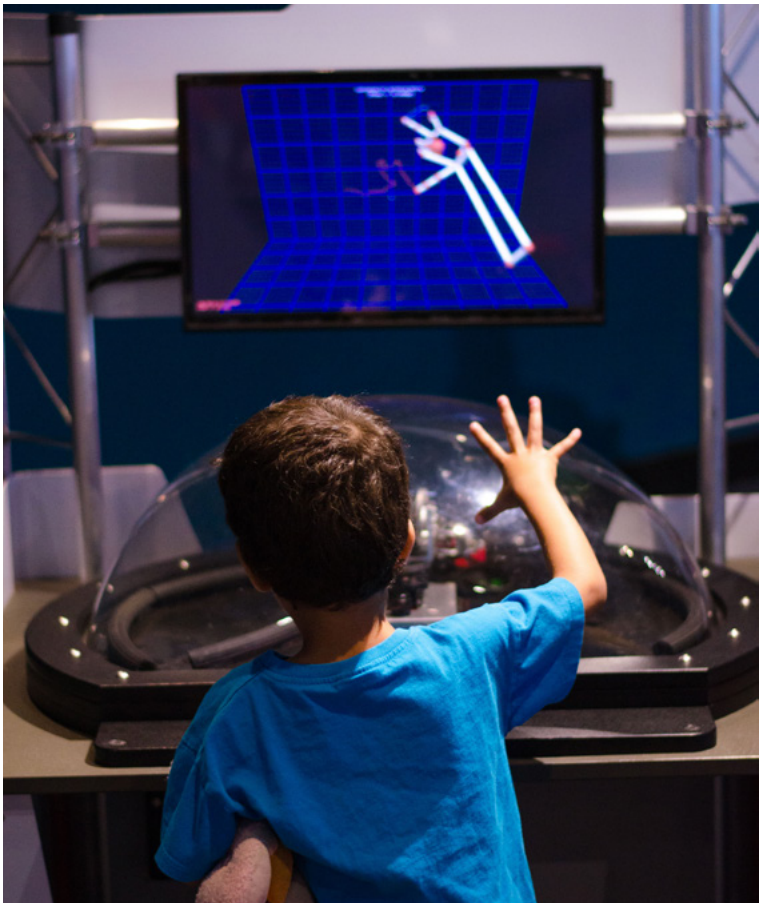
Using inspiration from nature and human ingenuity, experience how technology can enhance your body, increase your potential and equip you for the future.

Test your own limits as you run, sense, and navigate. Explore how technology can enhance your abilities and integrate with your body. Imagine your future: what choices will you make and how might they change your life?

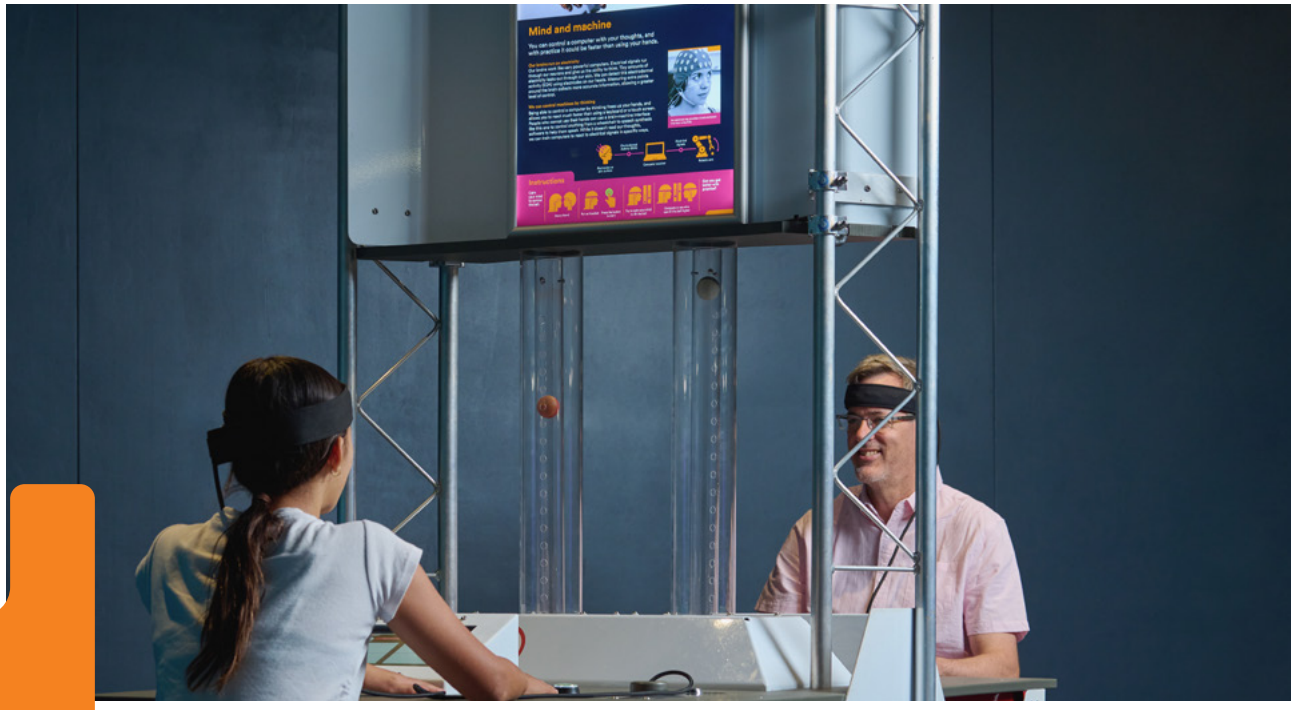
Experience the possibilities in Super Human!

Key messages:

- Understand the human body and how technology is being used to increase its potential
- See how nature is a good place to find inspiration for enhancements
- Understand how applying technology to the human body has changed the world
- Studying science leads to inspiring careers.



EXHIBITS



Mind Control

Compete against a friend using a brain-computer interface to control a ball using the power of your mind.

- Brain activity can be detected, measured, and interpreted
- Neural interfacing can enable people with condition affecting mobility such as cerebral palsy to interact with computers and their surroundings
- We all may soon be able to interact with technology using thoughts

Science links:
Neuroscience, computational science

Motion Control

Use a gesture interface to control a robot arm and move a ball.

- Teaching Artificial Intelligence (AI) to recognize human movements lets us interface with and control technology
- This new method of interaction has applications in medicine, workplaces and recreation

Science links:
Computational science (computer vision)

Statistics Box

How common are human augmentations? Use our statistics box to find out, and learn about how understanding our community can impact our health.

Science links: Mathematics, statistics, biology, innovation

Body Technology

Move a screen over a human body to interact with its systems. Investigate what you could augment in various areas of the body.

- Technological advances allow us to understand our bodies better
- Technological advances allow us to use more advanced medical treatments
- There are a multitude of technologies we can integrate into our bodies

Science links: Human biology, bioengineering, medical science

Lenses

Experiment with a number of different lenses and investigate their effect on what we can see.

- Lenses can correct or improve people's vision
- Animals have eyes with different features to give them various visual abilities

Science links: Optics, biology, bioengineering

Augmented Surgeon

Try to place augmented body parts into the correct areas of the body.

- Different technologies can be used in different parts of the body

Science links: Human biology, bioengineering, medical science

DNA Builder

Learn about how our DNA makes us human and explore the idea of genetic modification at this DNA construction station.

Science links: Human biology, biology, bioengineering

What to Augment

Share your ideas on how you would like to augment your body.

- Everyone can be an innovator
- There are always new ways to solve old problems

Science links: Innovation, bioengineering

Exoskeleton

Climb into an exoskeleton and control an on-screen avatar to investigate what you could do with enhanced strength.

- Exoskeleton technology has applications in medicine/rehabilitation
- Exoskeleton technology can help with load bearing in workplaces
- Exoskeleton technology has applications in space travel

Science links: Engineering, bioengineering, biology

Jet Pack

Put on a helmet and fly a virtual jetpack.

- Jet packs are a complicated development as there is no legislation for individual flight
- How would you use a jet pack to help people?

Science links: Physics, chemistry, engineering

Prosthetics

Use a sensor to control a prosthetic arm.

- Advances in technology are creating versatile, agile, personalized prosthetics with finer control than ever before
- These prosthetics are becoming more accessible to those who need them
- How would you improve upon existing prosthetic technology?

Science links: Bioengineering, human biology

Race against a Paralympian

- Sports prosthetics are developed using various disciplines, like material technologies, biomechanics, and electronics
- Prosthetics are advancing at a rate that they may soon surpass the ability of natural limbs

Science links: Exercise science, bioengineering, physiology

Bionic Eye

View the world through a bionic eye simulation.

- Stimulating the optic nerve can partially restore lost vision
- Potential to convert other types of EM radiation into visible light

Science links: Optics, biology, bioengineering, electrical engineering

Wind Tunnel

Test different accessories in a wind tunnel to see how they feel and perform.

- Biomechanics helps us develop new technologies
- Aerodynamics can help us move faster
- We have been chasing the dream of flight for thousands of years and have found a number of ways to achieve or mimic flight
- Nearly all engineering devices used to increase aerodynamics are borrowed from nature
- Situations where people want to achieve maximum aerodynamicy include skiing/jumping, motor and bicycling, base jumping, swimming

Science links: Physics, engineering, biology (biomimicry)

Train your Brain

Play a 'brain training' game and investigate how it might affect your performance.

- Brain training games have limited potential to improve your cognition
- Practice makes perfect – if you want to get better at something, practice doing it regularly

Science links: Neuroscience, cognitive science, behavioral science, psychology

Ethics Quiz

Consider ethical questions of body augmentation using a quiz controlled by your eyes' gaze.

- There are technologies that make some people question what it is that makes us human
- Is the ideology of abled vs disabled people out-dated?
- How far is too far with human augmentation?

Science links: Sociology, computational science (computer vision), philosophy of science

Braille

Try to read a Braille message using your sense of touch.

- Innovative ideas help to change lives
- World changing technology doesn't have to be expensive or complex, just useful
- Everyone can be an innovator

Science links: Human biology, innovation

Hearing Test

Test your hearing range and discover how technology can enhance your hearing.

- People can have varying hearing abilities
- People's hearing often declines as we age
- There are technologies to help people hear better if their hearing is damaged/ reduced
- Animals can hear different frequencies than humans
- Using technology to 'hear' sounds beyond human hearing has applications like ultrasound and sonar

Science links: Human biology, physics, bioengineering, medical science

Infrared Camera

View your world through an infrared camera and large screen.

- IR is an invisible wavelength of light
- We can use technology to see the world in IR
- The benefits of IR light include night vision, tracking, imaging, astronomy, heating, and meteorology
- Some organisms that can detect and see IR wavelengths may use it for hunting, navigation and communication

Science links: Physics, imaging science

Tunnel of Darkness

Explore your environment without using sight. Can you make your way through the tunnel using your other senses? Visitors on the outside of the tunnel can view friends in the tunnel using night vision cameras.

- There are circumstances where our natural senses can't help us
- We can use technology to help us when our natural senses fail

Science links: Biology, physics, imaging science

Cochlear Implant

Use a cochlear implant simulator to learn what the world sounds like with bionic ears and observe the difference between organic and bionic senses.

Science links: Human biology, innovation, acoustics

Photo Opportunity

Step into the shoes of a Paralympic athlete and capture a moment as a champion in motion.


Instructions
communicate

Learning unit

In this learning unit, you will compare existing technologies with things found in the school grounds, local park or backyard and examine how they could fulfill a human need.

Learning unit | Biomimicry (Grades 3-8)

Children will use an innovation process to imagine how humans could extend their abilities by learning from the natural world. By comparing existing technologies with things they might find in the school grounds, local park or their backyard, they will look at how they could fulfill a human need.

At the Exhibition students will find out about some amazing animals that scientists have drawn inspiration from. After the visit, they will have an opportunity to imagine, research and design their own biomimetic technology.

Objective:

- Students will use the innovation process to identify a need that is not currently being filled, source inspiration from nature about that need, and then come up with a design for a possible solution.

Science and Technology concepts addressed:

- **Adaptation:** Students will identify adaptations of plants and animals that help them to live effectively in their natural environment.
- **Innovation:** Students will identify how existing technologies fulfill needs, and will identify current needs to brainstorm ideas for future technologies.

Pre-visit activity

Technology in your Backyard

You will need pictures of the following.....

Velcro

An airplane

Camouflage clothing

A bicycle helmet

Solar panel

Strong or stretchy fabric

Plus

- Access to a park or school grounds with grass and trees (or if you do not have access to this, collect the scavenger hunt items beforehand and display around classroom).
- Clipboards, paper and pencils.

What to do:

- Place the technological items around the room in stations but do not show them to students yet. Take students outside on a scavenger hunt to find the following:
  - o A prickle or burr
  - o Something with a protective shell
  - o A bird
  - o Something that is camouflaged with its surroundings
  - o A spider web
- Return to the classroom and have students go around the room in groups and write down what needs each item fulfills and how it works - including any special features it has that are essential to it (i.e. Velcro has many tiny hooks on one side and loops on the other or an airplane has specially shaped wings). Which one of their scavenger hunt items is this like?
- Discuss what students found as a group.

Extension activity:

- Research what other technologies have been inspired by nature.

Post-visit activity

Inspired by Nature

You will need:

- Paper and plenty of art and construction materials for the students.

What to do:

- Begin by reflecting on some of the ways animals are different from humans, particularly in reference to the exhibition. For example, elephants can hear at very low pitches, bees can see UV light, insects have tough exoskeletons etc.
- Explain that they will be designing some new technologies based on nature. Go through the rubric to give students an idea of what is required.
- Discuss with students whether there are any special abilities they wish they had, or that they've seen a need for in someone else. Write a list on the board.
- Working from this list, brainstorm different animals that humans might want to mimic to overcome some of these needs.
- Students will choose a need they would like to address plus an animal feature they think would help overcome this need. Depending on your class you may want to do this as a group and have all students working on the same theme. Or you may want to give a little more freedom to choose. You may also want to give the students some ideas, or have them do a little research at this stage and then report back their findings to the class.

- Students will then come up with an idea for a piece of technology that can be worn or otherwise attached to the body that would allow humans to mimic the animal feature they have chosen.
- Have students draw, paint, or even build a model of this technology and then give an oral presentation about it to the class.

Rubric

	NEEDS WORK	WORKING TOWARDS	ACHIEVED
Innovation component	I have not identified a need that my technology should fill	I have identified a need but my technology does not fill it very well	I have identified a need and my technology fulfills that need
Presentation component	I mumble and do not make eye contact. I do not explain my technology clearly	I explain my technology clearly, but I mumble and do not make eye contact	I explain my technology clearly, I speak audibly and engagingly and make eye contact with the group
Art component	My model or drawing does not look like the technology I am describing	My model or drawing looks like the technology I am describing but is sloppy or messy	My model or drawing looks like the technology I am describing, is neat and looks good

Pre-visit activities

This section includes a number of activities that can be completed prior to your visit to get your students excited and familiar with the topics explored throughout the Human Potential exhibition.

Pre-visit activity | Everyday Bionics (grades 1-5)

What you need:

- A pair of glasses
- A contact lens
- Cold weather clothing such as gloves or a raincoat
- Hearing aids or a picture of hearing aids
- Smartwatch or picture of a smartwatch

What to do:

- Set up the items at stations around the classroom.
- Gather your students and have a brief discussion about what bionics means
- Talk about the fact that any technology designed to enhance what the human body can do can be thought of as bionics
- Send students in groups around the classroom and have them talk about or write down how each item could count as bionic – how does it enhance our natural abilities to make us able to do more?

Discuss and extend

- Have students survey their families to find out what sorts of technologies they might use to help them (glasses, hearing aids, etc)
- Do a bionics treasure hunt excursion in a public shopping area – how many examples can students find of specific items?

Pair of glasses

Contact lens

Smartwatch

Gloves

Hearing aid

Pre-visit activity | Bats and Moths Game (grades 1-4)

What you need:

A large outside or undercover area

- Four blindfolds
- Some soft balls or small bean bags (as many as possible)
- Tape, ribbon or marker cones
- Four buckets

What to do:

- Talk about how bats use echolocation (sound) to catch their food (moths).
- Tell students that they are going to pretend to be bats and moths, but instead of the bats bouncing sound to find the moths, they are going to use balls.
- Take them to the outside area and define a small square inside a larger square with the cones or tape.
- Choose four children to be "bats" and have them stand inside the small square, one facing in each direction. Give them each a bucket with some balls in it. Then put a blindfold on each student acting as a "bat." They must stand still and not turn around in any other direction.
- The rest of the class are "moths." Tell them to choose their own space anywhere within the large square and outside the small square. Then the moths must also stand still.
- On your mark, have the bats throw all their balls at once. If a ball comes to a moth, they hold onto it, but they don't chase it.
- Once all the balls are gone, any moth who has a ball returns it to the bucket it came from (should be the same side of the square as they were on). The moths should now all come together into a group and sit down.
- The bats may now remove their blindfolds and count how many balls were returned to their bucket. That is how many moths they "found" with that burst of sonar.
- Which side contained the most moths? How can you tell?
- Explain that this process happens many times a second, and bats can tell where the moth is because they know what direction they threw their sonar "ball."

Discuss and extend

- Learn about technologies that have been inspired by bats' abilities, like sonar. Can your students think of any more ways to use echolocation in technology?

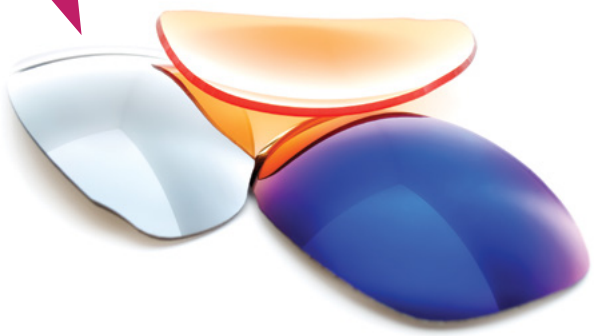
Pre-visit activity | Lenses (grades 1-10)

A lens is a transparent material with at least one curved side. A lens bends light rays and can change how things look in interesting and useful ways. Do this activity in pairs if you can gather enough lenses, otherwise larger groups are fine.

What you need (per group):

- 2 convex and 2 concave lenses
- White paper
- Flashlight
- Students' individual science books and writing materials.

Concave and convex lenses



White paper

Flashlight

What to do:

- Hand out lenses and allow students to play with the lenses and look through them at a few different objects. Discuss as a class what students noticed about the shape of the lenses and how the different lenses made things look.
- Have students shine the flashlights through the lenses and describe how the light bends, either in a discussion, in writing, or by drawing a picture. What happens if you move the flashlight closer and farther from the lens?
- Next ask students to try different combinations of lenses. Have them shine the flashlight through a convex and concave lens, through two concaves and two convexes. Again, have them describe what they notice.

Discuss and extend

- What might lenses be useful for? Have the students brainstorm and see if they can come up with examples of technology where lenses are used.
- Do a quiz where you show pictures of different technologies, and ask children to write down whether the lens in question is convex (e.g. in a magnifying glass) or concave (e.g. door peepholes). You can get trickier with glasses (which could be either depending on the visual defect) or technologies like cameras and telescopes, which use both.
- Have students do a research project on Galileo and the history of the telescope.

Writing materials

Pre-visit activity | Expanding our Senses (grades 3 and up)

What you need:

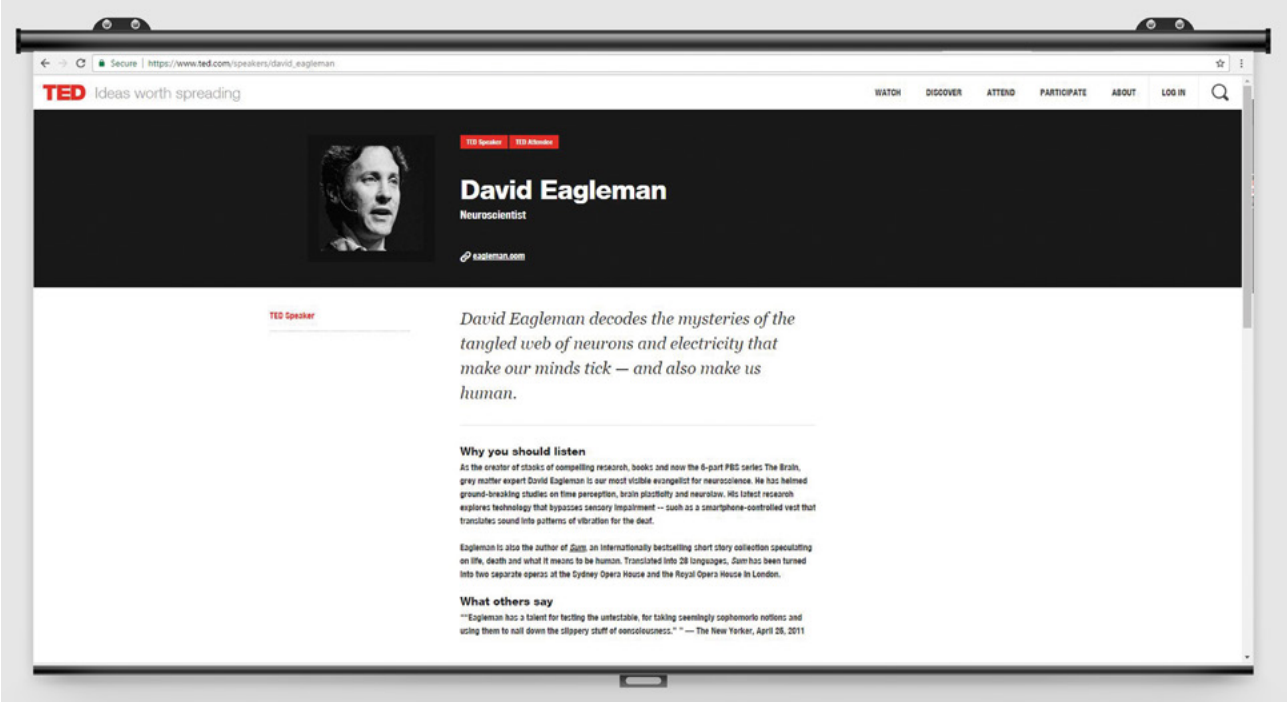
- Access to a screen that all students can see at once.

What to do:

- Watch the following TED talk: **www.ted.com/speakers/david_eagleman**
- Discuss with class:
  - o What does he mean by "umwelt?"
  - o What does he mean by sensory substitution?
  - o What could you use one of those vests for?
  - o What does he mean by sensory addition?
  - o What senses would you like to enhance or add to? Would there be any drawbacks?

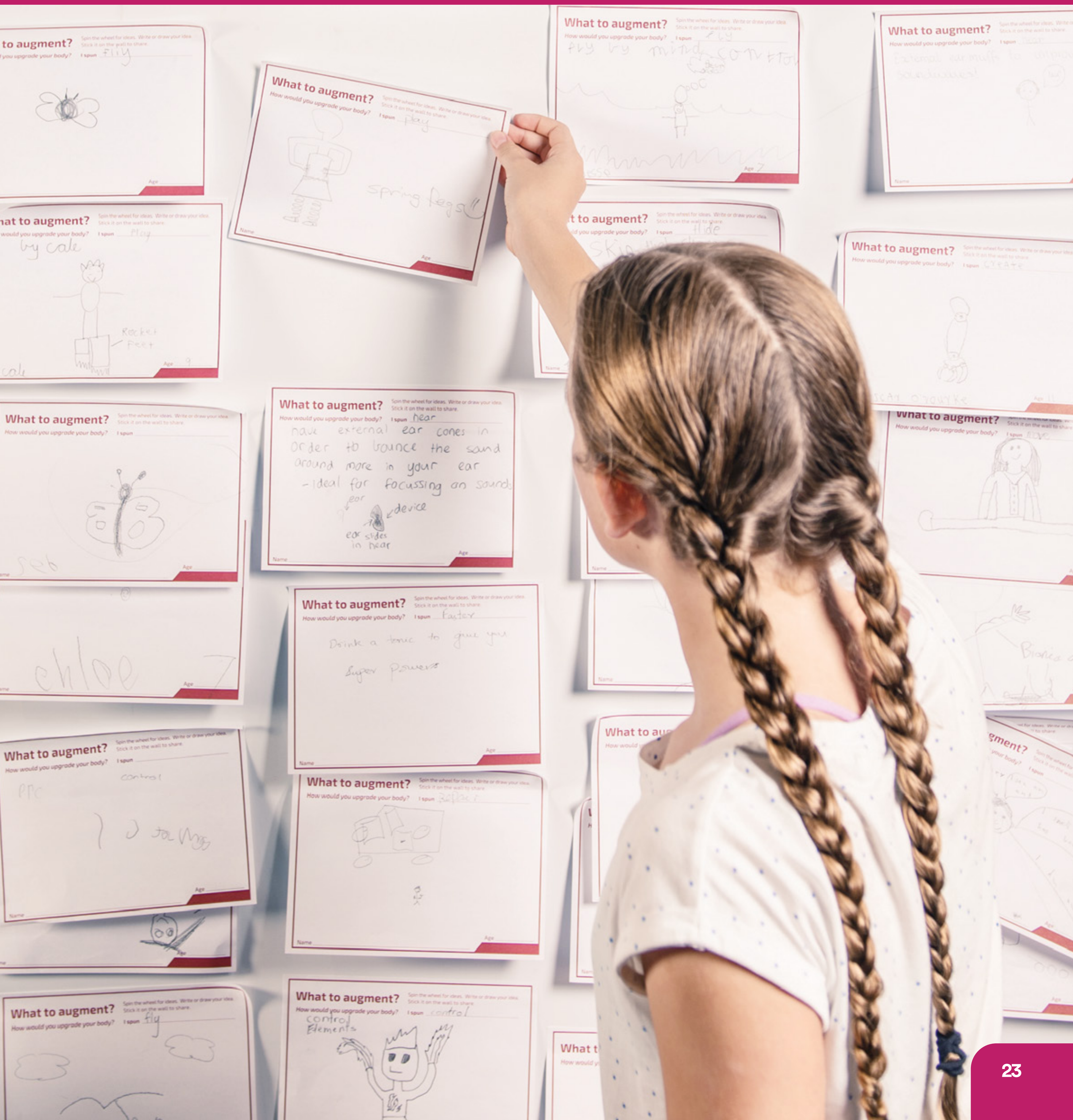
Discuss and extend

- Write a fictional news article about somebody who has used this technology.
- Have students write about or even make a model or another device that could do a similar thing with another sense.
- Have students write a piece of fiction about an imaginary sense substitution – maybe a boy who could smell with his feet, or a teacher who could see with the back of her head. The crazier the better!
- For middle or high school students, research the possibility of adding new senses and explore the scientific debate around this idea.
- Learn about how other animals/plants experience the world:
  - o EM waves different animals can sense – snakes sense infrared, bees sense ultraviolet.
  - o Hearing range of different animals - bats hear very high sounds, elephants hear very low sounds.
  - o Tastebuds on different animals – catfish have over 100,000 tastebuds located all over their bodies, not just on their tongues; flies have tastebuds on their feet.
  - o Smell receptors on different animals – snakes have them on their tongues, dogs have 300 million smell receptors in their noses.
  - o Animals that mainly use touch e.g. the star mole.
  - o Senses other animals have that we don't e.g. sharks can detect electrical signals, some birds can detect the magnetic field of the earth, narwhal tusks can sense the salinity of water.



In-visit activities

Use these activities to guide your students through the exhibition and extend what you have learned in the pre-visit activities.



In-visit activity

Lower Elementary Sample Worksheet (grades 1-3)

Welcome to Human Potential, a place where you can explore all the amazing things humans can do with technology. The questions below will help you to think about some of the exhibits. Head on in, have some fun, and write down all your great ideas!

Exoskeleton

1. What is one thing you did in the exoskeleton? _____

Wind Tunnel

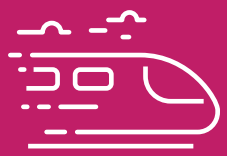
2. Draw the shape of one of the props you tried in the wind tunnel:

3. Name two things that are good at flying in the air: _____

_____

Did you know?

A kingfisher's beak is shaped so that it's great at slicing through air and water. Japan's ultra-fast bullet train is inspired by this clever bird, and its beak-like nose is what let's it get to such high speeds.



Infrared Camera

4. What color is your skin on the screen?_____

Camouflage

5. Draw an animal that is good at camouflaging (blending in). Write the name of the animal below.

This is a _____

In-visit activity | Lower Elementary Sample Worksheet (grades 1-3)

Tunnel of Darkness

6. What sense did you use to find your way through the tunnel? _____

UV Camera

7. Why is it important to wear sunscreen? _____

_____

Mind Control

8. Were you calm enough to levitate the ball? Yes No

Hearing Test

9. What was the highest pitch you could hear? _____

_____

Race

10. Could you go faster than the Paralympian? Yes No

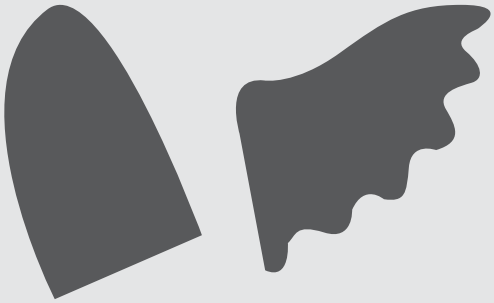
Lower Elementary Answer Key

Exoskeleton

1. What is one thing you did in the exoskeleton?
Possible answers include: walked around, picked something up, looked around.

Wind Tunnel

2. Draw the shape of one prop you tried in the wind tunnel.



3. Name two things that are good at flying in the air.
Possible answers include: flying animals (birds etc.) or machines (airplanes, helicopters etc.)

Infrared Camera

4. What color is your skin on the screen? Red, orange or yellow.

Camouflage

5. Draw an animal that is good at camouflaging (blending in). Write the name of the animal. Many possible answers.

Tunnel of Darkness

6. What sense did you use to find your way through the tunnel? Touch. Hearing also acceptable.

UV Camera

7. Why is it important to wear sunscreen?
To protect us from harmful types of sunlight (bonus if they write Ultraviolet).

Mind Control

8. Were you calm enough to levitate the ball?
Y/N Student's choice.

Hearing Test

9. What was the highest pitch you could hear? Student's choice. Answers should typically be in the range of 15-20 kHz.

Race

10. Could you go faster than the Paralympian?
Y/N Student's choice but it should almost certainly be no.

In-visit activity

Upper Elementary Sample Worksheet (grades 4-7)

Welcome to Human Potential, a place where you can explore a few of the many ways we can use technology to go faster be smarter and play harder. The questions below will help you think about some of the exhibits. Sometimes you might need to read the sign to get the answer, or just think about it. Head on in, have some fun, and write down all your great ideas!

Exoskeleton

1. What is one thing you could do in an exoskeleton that you couldn't do otherwise?_____

_____

Wind Tunnel

2. Name three places you have seen this shape before:  _____

_____

Infrared Camera

3. What color is hot in the infrared (IR) camera?_____

4. What is one situation when you would use an IR camera? _____

Tunnel of Darkness

5. What sense did you use to find your way through the tunnel?_____

6. When a blind person who can use echolocation listens to sounds, what part of their brain becomes active?

_____

Body Technology

7. Scientists have made special gloves that people can wear to help translate which language? (Hint: check the muscle layer).

_____

Braille

8. Write your name in Braille symbols in the space below.

Hearing Test

9. What was the highest pitch you could hear?_____

Lenses

10. Which lens makes an image appear on the screen? _____

Did you know?

Bats can hear the highest pitches of any mammal, because they use high-pitched squeaks to hunt their prey. The moths that they eat can hear even higher pitched sounds, as a defense strategy against the bats. Whenever a moth hears one of the bat's squeaks, it knows the bat has sensed it, and takes evasive maneuvers!

Lower Elementary Answer Key

Exoskeleton

1. What is one thing you could do in an exoskeleton than you couldn't do otherwise?
   Correct answers include: Picking up something very heavy; jumping from a high place, going into space; rescuing people from dangerous situations (e.g. firefighters); precision surgery.

Wind Tunnel

2. Name three places you have seen this shape before. **Any aerodynamic or hydrodynamic machine or animal with this shape is a good answer. For example: shark fins, airplane wings, some birds' wings; aerodynamic bike helmets, the nose of a bullet train etc.**

Infrared Camera

3. What color is hot in the infrared camera? **Red, yellow and orange are all acceptable answers.**

4. What is one situation when you would use an IR camera? **Possible answers include: Looking for a person at night (e.g. chasing a criminal, rescuing someone); security cameras; looking for night animals; screening for people and animals with illnesses or infections (e.g. during a flu risk at the airport); finding leaks in insulation etc.**

Tunnel of Darkness

5. What sense did you use to find your way through the tunnel? **Touch (possibly also hearing).**

6. When a blind person who can use echolocation listens to sounds, what part of their brain becomes active? **The part of the brain involved with sight in a sighted person.**

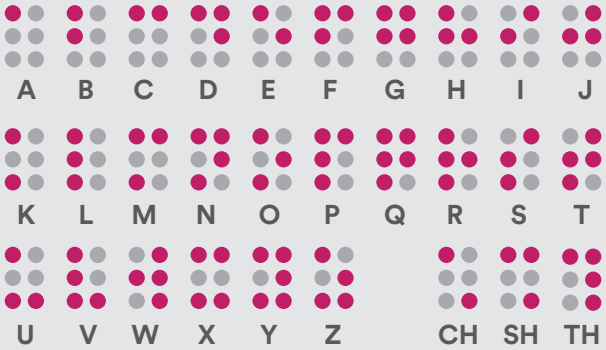
Body Technology

7. Scientists have made special gloves that people can wear to help translate which language? (Hint: check the muscle layer). **Sign language.**

Braille

8. Write your name in Braille symbols in the space below. **Use the graphic to check student answers.**

ALPHABET:



Hearing Test

9. What was the highest pitch you could hear? **Student's choice. Answers should typically be in the range of 15-20 kHz.**

Lenses

10. Which lens makes an image appear on the screen? **The polarized/polarizing lens.**

Post-visit activities

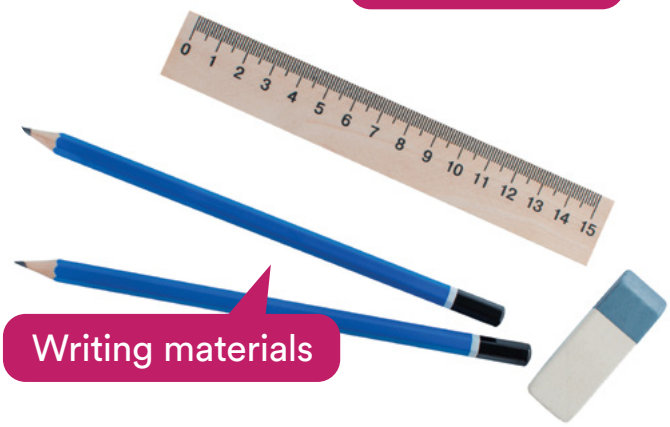
Continue your learning after your visit to the Human Potential exhibition with these post-visit activities.

Post-visit activity | Sunscreen comparison (grades 1-10)

This activity is a great way to make sunscreen's effects real to children. It is ideal to use as a structured science lesson for older students and can be simplified easily for younger students.

You will need:

- 1 piece of brightly colored construction paper per student (red or green is best)
- 1 pencil and ruler per student
- Q-tips – a few per sunscreen type
- Several different SPF levels of sunscreen
- 1-2 shallow dishes per sunscreen
- An area that will be reliably sunny for 3-4 hours.
- Things to weigh the paper down



What to do:

- Set the different sunscreens up at stations around the class. For ease of access, squeeze a large blob of sunscreen into a dish and supply q-tips. You may also wish to number the sunscreens to make labeling the sheets easier.
- Have students write their names on the back of their paper, then divide it into a grid with a pencil and ruler. How many squares the grid has will depend on how many types of sunscreen there are. Have one square for each type, plus one as a "control" square.
- Students will use the q-tips to swab sunscreen into the squares, first writing which sunscreen they are putting in each square. Ensure they cover the square thoroughly.
- Put the sheets outside in a sunny area and weight them down. Leave for at least 3-4 hours.
- In the meantime, have children write down their equipment, method and predictions. Or for a less formal lesson, simply discuss what they think might happen.
- Collect the sheets and have students write down or discuss their observations and conclusions.
- The sunscreen should have blocked the UV rays from reaching the paper and fading the pigment, leaving the control square faded, and the sunscreen squares retaining more of their original brightness.

For younger students

- Simply have students rub sunscreen into their hands and then make handprints and observe the changes, or they could do sunscreen finger painting.

Discuss and extend:

- Have the students research the different types of UV rays.
- Have students research color pigments and why they fade in the sun.
- Do the activity with something else; for example sunglass lenses or scraps of fabric.
- Take the sunscreen data you obtained and extend it by adding in price, allergen information, how much sun your location gets (or some other judge of location), and other relevant factors. Have a class discussion about when you might not necessarily need to or want to buy the very best sunscreen.

Post-visit activity | Bionics Webquest (grades 5 and up)

What you need:

- Internet access for the students
- The Bionics Webquest information sheet below.

What to do:

- Put the students into groups of four and assign each one a role – neurobiologist, engineer, biomechanic and occupational therapist.
- Explain that they will be working in their groups to complete a bionics related task.
- Give them the Webquest information sheet and let them get to it!
- When the students have completed their task, discuss with them what they learned, what they found difficult, and if there is anything more they are interested in pursuing.

Bionic webquest information sheet

Introduction

What is bionics? The word is made up of two parts: bio from the beginning of "biology" or the study of life, and nics from the end of "electronics." That might give you a bit of a clue as to what the word means – it's the application of electronics and engineering to biological systems.

With your group, brainstorm examples of bionics. What technologies copy nature? What are some ways that people use technology to enhance their bodies? You might be able to think of some very high tech examples, like brain implants that help people hear. Or they might be very ordinary: reading glasses are a good example of bionics!

Task

You and your group are a team of experts who have been tasked with developing a new bionic hand. You will need to work closely and share information to complete this task.

Your team will need to submit a simple drawing of your design with labels indicating key features including:

- How and where the hand is attached to the body.
- What can the hand do? What can it not do? (Think about shapes it can make, tasks it can do, and movements it can make.)
- What, if any, sensors does it have?

You will each be assigned a role and need to write a paragraph addressing the key question. These are:

- **Neurobiologist** – key question: How will the hand respond to what the person wants it to do? Think about: the nervous system and the muscles involved, as well as other ways of controlling electrical items, like voice control, bluetooth etc. How and where will it attach to the person's body and how will it receive signals from the person's nervous system? You will need to say how it will work – simply saying something like "the hand will attach to the muscles in the arm" is too vague.
- **Engineer** – key question: How will the hand be made and attached to the body? Think about what materials will you use, how it will move (motors, joints etc), how it will be powered, how you will make it affordable and what the manufacturing process will be.
- **Biomechanic** – key question: What does a a human hand do and how does your bionic hand compare? Think about the tasks we do that use our hands, the way the hand moves, how the hand is controlled by the muscles and ligaments of the arm. Also consider how a hand looks.
- **Occupational therapist** – key question: How will the person learn how to use their new hand? Think about the exercises they will need to do, what support they may need while they adjust, what the hand cannot do that the person will need to compensate for, what issues might there be with attaching the hand to the person?

Process

1. Research your area by visiting the web links designated for your role. If you feel you need more information you may search for other websites.
2. Share your findings with your group and see if you can answer some of each other's questions.
3. Design your hand and create a rough drawing with labels indicating some of the key features.
4. Write a paragraph each about the bionic hand that answers your key question.

Resources

General:

- https://www.ossur.com/en-us/prosthetics/touch-solutions
- https://www.ottobock.com/en-au/product/8E7*
- https://www.premierprosthetic.com/prosthetic-process/
- https://www.armdynamics.com/upper-limb-library/how-we-help-our-patients-learn-to-use-their-prosthesis

Bionics Webquest information sheet continued

For the Neurobiologist:

- https://www.wired.com/2012/02/nerve-prosthetics/
- https://science.howstuffworks.com/prosthetic-limb.htm
- http://www.dailymail.co.uk/sciencetech/article-2308015/The-prosthetic-hand-controlled-SMARTPHONE.html
- https://www.medicaldaily.com/prosthetic-controlled-using-myo-armband-thanks-johns-hopkins-university-and-370134

For the Engineer:

- https://www.madehow.com/Volume-1/Artificial-Limb.html
- https://www.openbionics.com/
- https://www.premierprosthetic.com/prosthetic-process/
- https://www.nextstepbionicsandprosthetics.com/
- https://asme.org/topics-resources/content/reaching-with-3d-printed-hands

For the Biomechanic:

- http://www.wired.co.uk/article/darpa-touch-sensitive-prosthetic
- http://www.medicaldaily.com/pulse/hand-anatomy-and-mechanics-how-human-thumb-works-356676
- https://www.youtube.com/watch?v=zyl6eoU-3Rg

For the Occupational therapist:

- http://armdynamics.com/pages/occupational-therapy
- http://www.rehabpub.com/
- https://www.msdmanuals.com/home/fundamentals/rehabilitation/rehabilitation-after-limb-amputation?query=after%20limb%20amputation%27
- http://www.oandplibrary.org/alp/chap11-01.asp

Evaluation

The highest possible grade for this task is 20. There is a group component and an individual component. You cannot pass simply by letting other people do the group part for you!

1. A group grade out of 8 for your labeled drawing. Breakdown as follows:
   - Drawing has informative labels (2 points)
   - Design is realistic in that it could conceivably be a real bionic hand either now or sometime in the future (2 points)
   - Design is practical and would be comfortable and easy to use (2 points)
   - The hand is designed to solve the problems faced by somebody with a missing hand and does so to a high degree (2 points)

2. An individual grade out of 12. Breakdown as follows:
   - Your paragraph addresses your key question (4 points)
   - Your paragraph is well-formed and you have used proper grammar and punctuation (3 points)
   - You worked well within the group and contributed to the overall project (5 points)

Post-visit activity

The Ethics of Biotechnology Debating Activity (grades 6-12)

What you need:

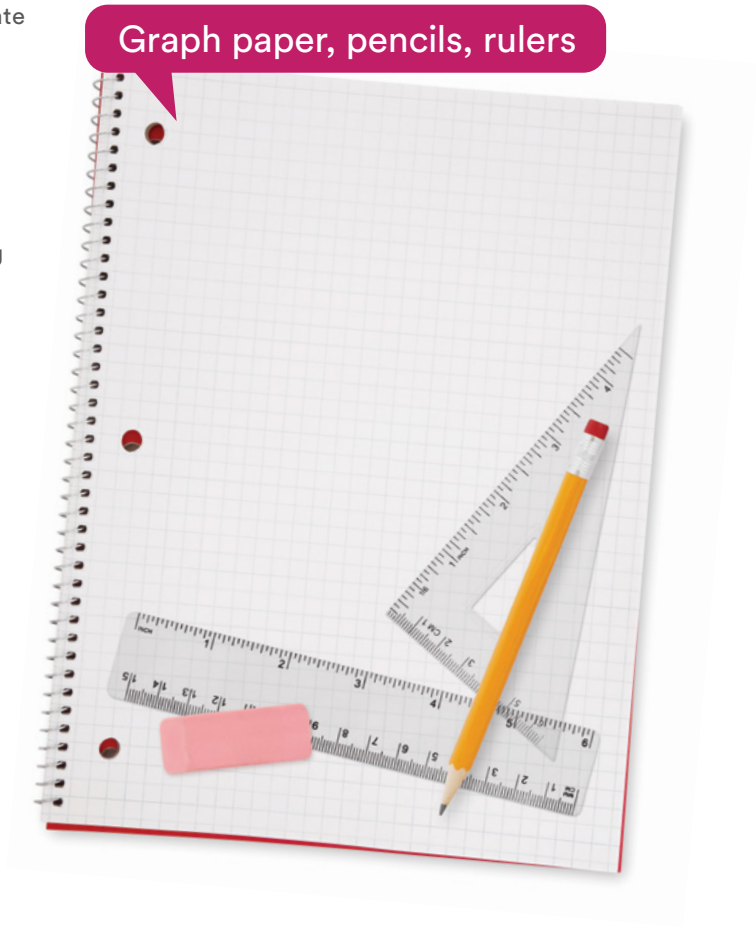
- Resources (online or hardcopy) so students can research.
- A debating rubric, guidelines or tips page to help students prepare.
- Stopwatch.
- Pens and paper for students and yourself.

What to do:

- Split students into teams of three.
- Two teams of three will be debating the same question. Distribute the questions and make sure each team knows whether they are arguing the negative or positive side.
- Some possible questions:
  - People with prosthetics should be allowed to run in the abled Olympics.
  - People should be allowed to replace their healthy working legs with prosthetics.
  - Workplaces should microchip their employees.
  - Bionic eyes that can capture video and still images should be banned.
- Give students plenty of time to prepare (a week is a good amount of time). Then hold the debate!
- Use the stopwatch to time the speeches (3-5 minutes is ideal) and let the students know when they have one minute left.
- Give students pen and paper so they can make notes for their rebuttals.

Post-visit activity | Hearing ranges (grades 2-10)

In this activity, children collect data and use it to create graphs and statistics.



You will need:

- Graph paper, pencils and rulers
- Audio files of different pitches. These are easily found on Youtube. Searching for "20Hz to 20kHz (Human Audio Spectrum)" will yield the audio along with a video of the wave frequency changing

What to do:

- Play a range of different frequencies, starting low and getting higher. Have students write down which frequency they hear first (the lowest frequency they hear) and at which frequency they can no longer hear the sound. For older students, you can assign them this part to do as homework or individually in the class with headphones.
- Gather all the results and if appropriate have students calculate the mean, average and median of the class's hearing range – without your own results included and then with them included. Does it make any difference?
- Have students create bar graphs showing the hearing ranges of some or all of the class.
- For young students, make a class pictograph. Put some frequency ranges along the bottom, and have each student put a picture of themselves or other marker in the correct range.

Discuss and extend

- Compare the class' average range with that of some other animals, like elephants or bats. Create a display about this information
- Have students test other friends and family members and graph those results as well
- Learn about how ears work
- Learn about hearing aids and other hearing technologies such as cochlear implants
- Learn some words in your country's sign language

NOTES

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