Modelling the human hand

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TRiPP Unit of Work – Modelling the Human Hand

Year 9 Science

Modelling the Human Hand

TRiPP project overview and link –

During my TRiPP experience I worked on a project to develop an extremely thin, flexible conducting wire. My project was to build the extruder that would create this wire and test the optimum parameters to produce the best quality wire.

This project was part of a larger research project to develop new materials and technology to emulate the human hand for eventual use in robotics applications. The project aimed to develop specific structures to emulate all the different structures within the hand – my wires were to emulate the function and form of nerve cells.

In this unit, students are given a similar challenge and are required to come up with novel ways to best emulate the human hand using materials available to them. It is hoped that students will be able to iteratively improve their models from rudimentary models that present a simplistic model of the outer shape of the hand into more complex iterations which could include muscle structures, tendons, ligaments, nerves, fatty deposits, skin and other structures, eventually leading to a model which not only looks like a human hand but also shares some functional similarities.

Students will evaluate their models against both the structure and functions of the human hand.

The documentary "NOVA – Rise of the Robots" can be used as a stimulus to this unit, with a follow up discussion regarding the purpose of robots and how they can imitate humans.

Nature of the problem –

Students are investigating how to effectively model both the structure and function of a human hand. Prior knowledge of the human body is important. Typically students will study cells, tissues, organs and organ systems in Year 8, this unit is therefore targeted at a Year 9 level, with students developing their understanding of how these structures act in a coordinated manner to perform tasks.
Students will learn more specific knowledge of the structure of the hand and will develop their knowledge of the nervous system and how it helps to coordinate body movements. They will also develop making skills and analytical and evaluative skills as they iteratively improve their designs.
The problem ties into the field of robotics, and is a genuine real-world problem. Students have the opportunity to ask their own questions and develop solutions to these questions within the context of the project.

Suitable Year Levels and subject area –

The unit of work is developed as a cross curricular unit targeting science and technology curriculum links. There are elements of mathematics and digital technologies that can be built in; however, they aren't the main focus of this unit. If resources were available a more specific robotics approach could be taken, developing and programming a robotic hand.

Curriculum Links – Science

Multi-cellular organisms rely on coordinated and interdependent internal systems to respond to changes to their environment(ACSSU175)

Scientific understanding, including models and theories, is contestable and is refined over time through a process of review by the scientific community (ACSHE157)

Advances in scientific understanding often rely on developments in technology and technological advances are often linked to scientific discoveries (ACSHE158)

Formulate questions or hypotheses that can be investigated scientifically (ACSIS164)

Plan, select and use appropriate investigation types, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods (ACSIS165)

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Select and use appropriate equipment, including digital technologies, to collect and record data systematically and accurately (ACSIS166)

Use knowledge of scientific concepts to draw conclusions that are consistent with evidence (ACSIS170)

Evaluate conclusions, including identifying sources of uncertainty and possible alternative explanations, and describe specific ways to improve the quality of the data (ACSIS171)

Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations (ACSIS174)

Curriculum Links – Technology

Investigate and make judgments on how the characteristics and properties of materials are combined with force, motion and energy to create engineered solutions (ACTDEK043)

Investigate and make judgments on how the characteristics and properties of materials, systems, components, tools and equipment can be combined to create designed solutions (ACTDEK046)

Develop, modify and communicate design ideas by applying design thinking, creativity, innovation and enterprise skills of increasing sophistication (ACTDEP049)

Work flexibly to effectively and safely test, select, justify and use appropriate technologies and processes to make designed solutions (ACTDEP050)

Evaluate design ideas, processes and solutions against comprehensive criteria for success recognising the need for sustainability (ACTDEP051)

Develop project plans using digital technologies to plan and manage projects individually and collaboratively taking into consideration time, cost, risk and production processes (ACTDEP052)

Learning Objectives –

- Students will learn how different parts of the body work together.
- Students will learn the parts of the hand and their functions.
- Students will learn about forces.
- Students will learn about recent developments in robotics and technology.
- Students will learn about prototyping.
- Students will learn teamwork skills.
- Students will learn communication skills.
- Students will learn modelling skills.
- Students will learn evaluation skills.

Assessment –
Students are to develop a design portfolio which demonstrates the links between their model and the human hand. Their portfolio will include a literature review outlining the students' research into the structure of the hand and plans on how they want to emulate this structure. Students will develop experiments to test the function of their hands to evaluate their model against the structure and function of the human hand. Students will keep a project diary (written, photo elicitation, voice or video diary) to help them reflect on their design process and will develop an information poster about their final design to present at a design fair.

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Week	Topic	Student Tick List	Assessment and Resources
Week 1	**Introduction** Students watch NOVA - Rise of the Robots documentary (https://www.youtube.com/watch?v=BZVekI8B-NU – 1:27:49 – Specific section on hands: 21:20-27:15) and have a teacher facilitated class discussion on the purpose of robots and the challenges surrounding their use for completing human jobs. Teacher then gives out the assessment task and students work to define the problem they have to address and develop a timeline and action plan for how to address it (using the template provided). **Research** Students research the human hand, developing an understanding of the different structures and their functions within the hand. They use this to begin their literature review for their portfolios. **Designing tests for function** Students outline the key structure and functions of the hand and design tests to evaluate their models against these features.		NOVA – Rise of the Robots Documentary Design portfolio and project poster assessment task Computers
Week 2	**Collective Prototyping** Students complete a protostorm activity, using as many materials to come up with fast and rough prototype hands or parts of hands. This is followed by a collaborative review and evaluation of the prototypes using a SWOT analysis. **Individual Prototype** Based on their SWOT analysis, students develop an individual (or small groups) prototype of their final hand model.		A variety of materials to use and evaluate – recycled materials where possible Robotics equipment (Arduino) depending on the class experience/time
Week 3	**Testing and refining** Students use their tests to evaluate their hands, conduct further research and make iterative improvements on their models.		
Week 4	**Testing and refining** Students use their tests to evaluate their hands, conduct further research and make iterative improvements on their models.		
Week 5	**Evaluation** Students complete a final evaluation of their model and outline possible extensions and improvements that could be made. **Portfolio** Students work on their portfolio assessment task for submission.		
Week 6	**Portfolio** Students work on their portfolio assessment task for submission. **Poster** Students develop their posters to be ready for the design fair presentation. **Design fair** The unit is finished with a futures design fair where students present their designs and posters to the school community and local engineers and roboticists as guests.		Large Poster Card

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Possible design ideas:

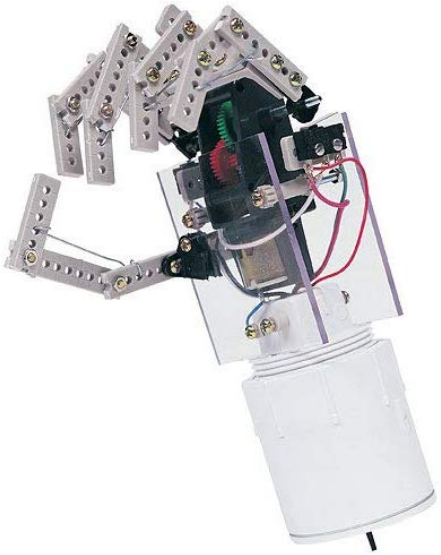

Image Sources:

https://www.carolina.com/teacher-resources/Interactive/flex-and-extend-modeling-a-human-hand/tr29416.tr

https://www.pinterest.com.au/pin/448319337876877857/

https://www.instructables.com/id/Mechanical-Hand-using-only-fast-food-straws-Stra/

https://www.sciencebuddies.org/stem-activities/build-a-robot-hand

https://www.amazon.co.uk/LewanSoul-Programmable-Feedback-Parameter-Programming/dp/B0793PFGCY

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