# Unit 2 AOS2 SAC 2.2 Options project

### Task Outline Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

In this task you will be given the opportunity to develop a deeper understanding of an area of interest from a selection of eighteen options. You will explore the related physics and use this physics to develop an interactive lesson for students in grades 3 – 5. The focus of the task will be on developing your skills in research, making sense of challenging concepts and being able to communicate these ideas.

### SAC conditions

* You will be working in a group of two to three students.
* Each group member will select an individual research question and will then develop their own lesson plan and interactive activity.
* You will be assessed on your research grid, the connection of your ideas and how well your activity demonstrates the key ideas from your topic.

### Key knowledge descriptors

The key knowledge descriptors for each option topics can be found on SEQTA.

### Communicating physics

* evaluate validity of sources of information
* apply physics concepts specific to the investigation: definitions of key terms; and use of appropriate scientific terminology, conventions and representations
* apply the use of data representations, models and theories in organising and explaining observed phenomena and physics concepts, and discuss the limitations of the explanations
* discuss the influence of sociocultural, economic, legal and political factors relevant to the selected issue or application
* apply physics understanding to justify a stance, opinion or solution to the selected issue or application.

## Assessment Rubric

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **1** | **2** | **3** | **4** |
| **evaluates evidence** | finds evidence and lists in research grid | evidence is relevant to the selected topic | explains validity of evidence by considering bias and expertise of authors |  |
| **analyses evidence** | Includes a range of a source in research grid | defines evidence as primary, secondary or tertiary sources | uses multiple types of evidence sources | makes connections between evidence by using mind map |
| **evaluates ideas** | discusses ideas in each dot point separately | Identifies links between ideas | Explains how your research links to the entire option topic |  |
| **References sources** | Lists sources in own style | Includes references, in-text citations in required style |  |  |
| **Uses resources** | uses activities in lesson | uses activities relevant to option topic | explains ideas using activity | creates and builds a resource for lesson |
| **Plans lesson** | Lists activities and ideas in lesson plan | explains how an activity supports the teaching of the content | creates a lesson which builds on group members lessons |  |

## Timeline

|  |  |  |  |
| --- | --- | --- | --- |
| Lesson  | Task | Description | Date |
| 1 | Introduction | Select options topic  | 6 June |
| 2 | Research | Select set of questions and key knowledge descriptors.Begin research, find references  | 13 June |
| 3 | Research | Summarise and paraphrase information in the research grid | 14 June |
| 4 | Research | Evaluate the validity of resources | 14 June |
| 5 | Create mind map | Connects ideas in a mind map | 17 June |
| 6 | Design lesson | Use lesson template to plan an activity for students | 20 June |
| 7 | Designs resources and activities | Create interactive activity and order materials  | 21 June |
| 8 | Designs resources and activities | Create interactive activity and order materials  | 21 June |
| 9 | Creates resources | Prepare resources for activity | 24 June |
| 10 | Creates resources | Prepare resources for activity | 27 June |
| 11 | Presentations | Round robin student presentations and assessment | 28 June |
| 12 | Presentations | Round robin student presentations and assessment | 28 June |

## Research Guide

*Reference: This material is based on information from the Learning Centre, University of Sydney (2000) Developing and Supporting an Argument, date accessed 31st August 2015.*

During the research phase, it is important to use different types of sources and identify whether the evidence is valid. This information needs to be included in the Research Grid and is explained using the following questions.

### Question 1. What type of sources and evidence is suitable to use in my research?

Sources can be divided into three main groups.

|  |
| --- |
| * **Primary sources** are original materials.

e.g. laboratory notes, survey research, letters, diaries and photos. * **Secondary sources** are evaluations of primary sources.

e.g. scientific reports, journal articles, magazine articles and newspaper articles. * **Tertiary sources** are a compilation of both primary and secondary sources.

e.g. website, general textbooks, encyclopaedias and technical manuals.  |

In the discipline of Science, evidence is also divided into the categories; scientific and non-scientific.

|  |
| --- |
| * **Scientific evidence**
	+ journal articles, textbooks and encyclopaedias that are based on research data
* **Non-scientific evidence**
	+ personal experiences, opinions and anecdotes – This type of evidence is often in blog sites, magazines for the general community and the media.
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### Question 2: How can I identify whether the evidence is valid?

Not all evidence is equally valid or reliable and is often dependent on where it is from. It is important to check the credentials of the author(s) to determine whether the evidence is valid.

Evidence can be from;

* government agency    -  personal blog     -   commercial company     - media article

### Question 3: How can I reference my sources?

All the information used in the Research Grid and the poster must be referenced using the Harvard Style.

**An example of how to reference in Harvard style for an encyclopedia**

* author (date) title of article, book title, web address (URL), [date accessed].
* Note: You only need to include the first part of the url in your reference.
1. Williams (2016) Multiple Myeloma, Encyclopedia Britannica, [www.school.eb.com.au](http://school.eb.com.au/levels/high/article/54243), [date accessed 6th April 2020].

In your text you need to use numbers in square brackets to indicate in-text citations.

###  Option Topic

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### Set number: \_\_\_\_\_\_\_\_\_\_\_\_

Research question: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Key knowledge dot points

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Explain how your research links to the entire option topic (complete after you have completed your research grid).

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### Instructions how to complete research grid

1. Find a source that helps to answer your research question and the key knowledge dot points.
2. Identify whether the source is primary, secondary or tertiary. Also, whether it is scientific or non-scientific.
3. Evaluate the validity of the source.
4. Paraphrase the information from the source. One row in the research grid is used for each source.
5. Highlight the text with different colours to show the links between the paraphrased information in the source.

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| --- | --- | --- | --- |
| Source | PrimarySecondaryTertiary | ScientificNon-scientific | Evaluate validity of sourceWhat are the author’s credentials and is the author affiliated with a recognized research institution? Has the content been peer-reviewed or edited by a publisher?Is there any bias?  |
| Lee FH et al., (2015) A Population-Based 16-Year Study on the Risk Factors of Surgery of bone grafts *Medicine,* [www.ncbi.gov](http://www.ncbi.gov), [date accessed 12 June 2024] | *This is a secondary resource as scientists are reporting the results of their own research.* | *This is a scientific article as it based on research data* | * The authors all have a PhD in areas related to this topic and  are a part of a medical team in Baltimore called NCBI.
* This article presents their opinion and findings from their own research. The artical may still be bias in that only results from group of people is reported However, the evidence is likely to be valid as was published after 16 years of research.
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| Paraphrased information |
| The information is paraphrased in the students own words to prevent plagiarismPeople prone to contracting an infection post surgery were seen to be males of an older age (roughly 40 or older) has a longer hospital stay, had a lower income or suffered from a “chronic disease (tuberculosis [TB]; diabetes mellitus [DM]; acquired immunodeficiency syndrome [AIDS])Postoperative recipient graft site infection is a possible risk factor when receiving a bone graft. Using a study of 1.3 million people who underwent bone graft surgeries from 1997-2013 shows that 3% of these people contracted the infection.   |
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## Mind map

Create a mind map to show how the information is connected.

## Lesson plan

### Instructions

1. You need to plan an activity using the Lesson Plan template provided.
2. The activity must incorporate interactive resources that will help to consolidate students understanding.
3. Your target audience are primary school students in years 3 - 5

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| --- | --- | --- |
| **Key Ideas**  | **Description of resources and activities**  | **Evaluate and link activities and resources to content** 1. Evaluate the relevance of the activity or resources to the overall aim of the lesson.
2. Identify the links between the content covered in the lesson and how the activity or resources supports the teaching of the content.
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|  |  |  |
| --- | --- | --- |
| **Key Ideas**  | **Description of resources and activities**  | **Evaluate and link activities and resources to content** 1. Evaluate the relevance of the activity or resources to the overall aim of the lesson.
2. Identify the links between the content covered in the lesson and how the activity or resources supports the teaching of the content.
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## 11 Physics SAC 2.2 Unit 2 AOS2 Option Topics

### Option 2 How do fusion and fission compare as viable nuclear energy power sources?

Fission and fusion are nuclear reactions that produce relatively large quantities of energy from comparatively small quantities of fuel. Students explore fission and fusion reactions as power sources.

### Set 1

Research question: What is the viability of using fission and fusion nuclear power as an energy source including a comparison and evaluation of its benefits and risks?

### Key knowledge dot points

* explain nuclear fusion reactions of proton-proton and deuterium-tritium with reference to:
* reactants, products and energy production
* availability of reactants
* energy production compared with mass of fuel
* explain nuclear fission reactions of 235U and 239Pu with reference to:
* fission initiation by slow and fast neutrons respectively
* products of fission including typical unstable fission fragments and energy
* radiation produced by unstable fission fragments
* describe the energy transfers and transformations in the systems that convert nuclear energy into thermal energy for subsequent power generation

### Set 2

Research question: How does fusion and fission reactions compare in terms of the availability of reactants, the percentage of the mass that is transformed into energy and environmental impacts?

### Key knowledge dot points

* explain nuclear fusion reactions of proton-proton and deuterium-tritium with reference to:
* reactants, products and energy production
* availability of reactants
* energy production compared with mass of fuel
* explain nuclear fission reactions of 235U and 239Pu with reference to:
* fission initiation by slow and fast neutrons respectively
* products of fission including typical unstable fission fragments and energy
* radiation produced by unstable fission fragments
* describe neutron absorption in 238U, including formation of 239Pu
* explain the risks and benefits for society of using nuclear energy as a power source

### Option 3 How do heavy things fly?

Students explore the aerospace principles that underpin the development of controlled powered flight and the application of these principles to aerospace design. Students observe how different forces affect flight.

### Set 1

Research question: How can aircraft generate lift when flying upside down?

### Key knowledge dot points

* model the forces acting on an aircraft in flight as:
* the force due to gravity, acting at the centre of mass
* thrust
* lift, 
* drag, 
* explain the production of aerodynamic lift with reference to:
* Bernoulli’s principle and pressure differences
* conservation of momentum and downwash

### Set 2

Research question: What changes in aerodynamic behaviour occurs at supersonic speeds? Research the effect on compressibility, shock wave formation and increase in drag

### Key knowledge dot points

* model the forces acting on an aircraft in flight as:
* the force due to gravity, acting at the centre of mass
* thrust
* lift, 
* drag, 
* compare contributions to aerodynamic drag, including skin friction, form and lift-induced

### Set 3

Research question: How can flight concepts be used to improve lift in boomerangs, kites or helicopters?

### Key knowledge dot points

* model the forces acting on an aircraft in flight as:
* the force due to gravity, acting at the centre of mass
* thrust
* lift, 
* drag, 
* explain the production of thrust with reference to Newton’s laws of motion
* apply balance of forces and torques with reference to Newton’s laws of motion to the different stages of flight and the control of the aircraft

### Option 7 How does the human body use electricity?

Students explore the role of electrical responses in nerve transmission, in sensation, and in the heart to understand concepts including resistance, the generation of action potentials and neural transmission. They consider the effects of current through the body.

### Set 1

Research question: What is the electrodermal response and how is it used in polygraphs or biotherapy feedback?

### Key knowledge dot points

* describe the nervous system as the control of the function of the human body through electrical processes of nerve cells (through an action potential) and chemical transfer between nerve cells (through neurotransmitters diffusing across synapses)
* model an action potential as a short-lasting electrical event across the cell membrane in response to a stimulus, including reference to the roles of ion channels (leakage and voltage gated) in changing membrane potentials during the processes of depolarisation, repolarisation, hyperpolarisation and return to resting state
* explain why people have different electrical resistances with reference to comparison of the resistances in human bone, fat, muscle, nerves and skin

### Set 2

Research question: What is neuroplasticity and how is this used in the detection of light and perception of colour by photoreceptors in the eye?

### Key knowledge dot points

* describe the nervous system as the control of the function of the human body through electrical processes of nerve cells (through an action potential) and chemical transfer between nerve cells (through neurotransmitters diffusing across synapses)
* model an action potential as a short-lasting electrical event across the cell membrane in response to a stimulus, including reference to the roles of ion channels (leakage and voltage gated) in changing membrane potentials during the processes of depolarisation, repolarisation, hyperpolarisation and return to resting state
* explain how vision is determined by the retina-brain interaction and the importance of visual plasticity in optometric rehabilitation.

### Set 3

Research question: How can the brain be used to control electrical devices?

### Key knowledge dot points

* describe the nervous system as the control of the function of the human body through electrical processes of nerve cells (through an action potential) and chemical transfer between nerve cells (through neurotransmitters diffusing across synapses)
* model an action potential as a short-lasting electrical event across the cell membrane in response to a stimulus, including reference to the roles of ion channels (leakage and voltage gated) in changing membrane potentials during the processes of depolarisation, repolarisation, hyperpolarisation and return to resting state
* describe the effects of current through, and potential difference across, the human body

### Option 10 How do instruments make music?

Students examine how the wave model is applied in the design and development of musical instruments. They explore concepts including sound intensity, sound intensity levels, resonance and timbre.

### Set 1

Research question: How does the human voice box act as a resonance chamber with vibration provided by the vocal chords?

### Key knowledge dot points

* describe sound as the transmission of energy via longitudinal pressure waves and distinguish between sound intensity (W.m-2) and sound intensity level (dB)
* calculate sound intensity at different distances from a source using an inverse square law
* explain resonance and identify it as related to the natural frequency of an object, and analyse the unique sound of an instrument as a consequence of multiple resonances created by the instrument and described as timbre
* investigate and explain a variety of musical instruments with reference to the similarities and differences of sound production between instrument types (brass, string, woodwind and percussion) and how they compare with the human voice

### Set 2

Research question: What are the similarities and differences between the way percussion drums, wind instruments and string instruments create music?

### Key knowledge dot points

* describe sound as the transmission of energy via longitudinal pressure waves and distinguish between sound intensity (W.m-2) and sound intensity level (dB)
* calculate sound intensity at different distances from a source using an inverse square law
* explain resonance and identify it as related to the natural frequency of an object, and analyse the unique sound of an instrument as a consequence of multiple resonances created by the instrument and described as timbre
* investigate and explain a variety of musical instruments with reference to the similarities and differences of sound production between instrument types (brass, string, woodwind and percussion) and how they compare with the human voice

### Option 13 How do astrophysicists investigate stars and black holes?

Students examine the birth, life and death of stars in the Universe. They explore how the properties of starlight can provide information, including the star’s distance from Earth, its temperature, composition, age and future.

### Set 1

Research question: How has space research led to the hypothesis and subsequent identification of black holes?

### Key knowledge dot points

* apply methods used to investigate the light from stars and for measurements of the distances to stars and galaxies
* identify the properties of stars, including luminosity, radius and mass, temperature and spectral type, and explain how these properties are used to classify stars
* explain the event horizon of a black hole and use to calculate the Schwarzschild radius

### Set 2

Research question: What is the lifecycle of stars and what prevents all tars from dying as black holes?

### Key knowledge dot points

* apply methods used to investigate the light from stars and for measurements of the distances to stars and galaxies
* identify the properties of stars, including luminosity, radius and mass, temperature and spectral type, and explain how these properties are used to classify stars
* distinguish between the different nuclear fusion phenomena that occur in stars of various sizes
* apply the Hertzsprung–Russell diagram as a tool to describe the evolution and death of stars with differing initial mass

## Lesson Plan- student example

**Instructions**

1. You need to plan an activity using the Lesson Plan template provided.
2. The activity must incorporate interactive resources that will help to consolidate students understanding.
3. Your target audience are primary school students in years 3 - 5

This example is for the topic:

Forces that act on the human body:

### Set 4 - Materials used to replace body parts

* Investigate the development of artificial materials and structures for use in prosthetics, including external prostheses for the replacement of lost limbs, and internal prostheses such as hip or valve replacements
* Identify the difficulties and problems with implanting materials within the human body
* Compare the performance of artificial limbs with natural limbs with reference to function and longevity.

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| ***Key Ideas***  | ***Description of resources and activities***  | ***Evaluate and link activities and resources to content*** 1. Evaluate the relevance of the activity or resources to the overall aim of the lesson.
2. Identify the links between the content covered in the lesson and how the activity or resources supports the teaching of the content.
 |
|   investigate the development of artificial materials and structures for use in prosthetics, including external prostheses for the replacement of lost limbs, and internal prostheses such as hip or valve replacements                          compare the performance of artificial limbs with natural limbs with reference to function and longevity.    | * First, ask students:
* "Did you know that we can make fake arms and legs for when people lose their arm or leg in an accident or if they get sick?"
* There are a lot of body parts that we can make to help people, like ears, some organs, and we are even working on making a bionic eye.
* Sometimes they even use fake body parts for character makeup and costumes in movies!
* "Have you seen the Paralympics? They have some very high tech arms and legs! (Don't show the whole video)
* [The Most Memorable Paralympic Moments Over the Years | Paralympic Games](https://www.youtube.com/watch?v=XnZX0HkxRbg)

 * But they weren't always that good. Look at how they changed as we got better at the science:

 * "We got better at making them when we understood what materials to use that were most like how the body actually works"
* "would you like to make a prosthetic hand that works like your real hand?"
* "If you didn’t have your hand, how could you control it?! That's the trickiest part of the science behind making prosthetics"
* [How to Make a Robotic Hand - HCPL STEM](https://www.youtube.com/watch?v=e1c095iTIqs)
* Help students to make robotic hand>
* Try to use robot hand to pick up a ball/small box

  * Ask student if they think it works as well as their real hand? If not, how could we make it better?
* Discuss what kind of things would make the fake hand wear out quickly. Why is it so hard to make a fake hand that is as good as our real hand?
* We are always inventing new materials and ways to design things to make better prosthetics!
 |  -This introduction intends to help students to find things that they already know or have seen, to help them understand the idea of prosthetic body parts. This should work because people understand things better when they have seen something like it or of a similar topic before.  -By showing a video of highlights from Paralympics, students who haven't seen Paralympic athletes before can see how the prosthetic limbs can be used for amazing things. The video might also help students to visualise the prosthetic limbs. This is important for students who haven't seen any prosthetics before, or didn't know what they were.  -Students might realise that the first "peg leg" is like a pirate's leg, which might help them to understand where they know something like this from. By showing the picture of the legs through the ages, students might be able to see the different materials being used, and understand that different shapes have been used. This intends to help students to see that as we understand more and can get better materials, we can make better prosthetics, which is the main message of the first dot point in this set.  -Students have a go at making a "bionic hand" using strings. By connecting the structure and function of their real hand to the bionic hand, they might understand how important the design and materials need to be, which is an important consideration for all three dot points. Asking how would they control it invites the students to think about the complexity and truly amazing work that scientists do to implant prosthetics into the body (point 2).   -Finishing on the high note that we are always inventing and discovering new ways to do things allows students to wonder about what else could happen, encouraging them to be curious and to look into the topic further when they are ready, and reinforces the idea that development of prosthetics (dot point 1) is an ongoing project for humans.  |