Searching for Iron Ore– Teacher Resource

Intended Use of Resources

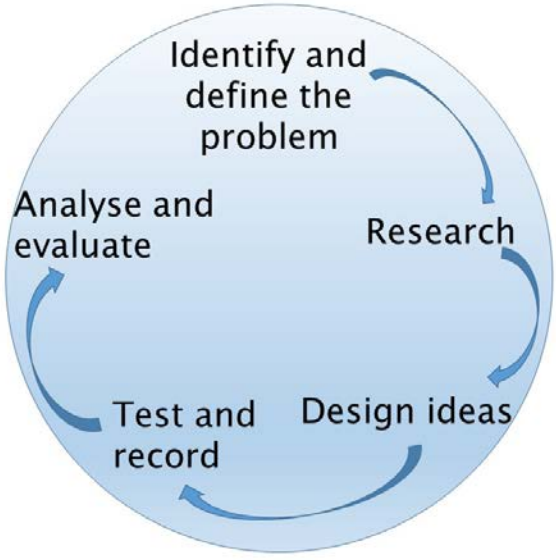
This project has been designed so that teachers from different STEM areas can pick and choose sections relevant to their subject area to work on. All activities in this package do not need to be completed to get value from the package – each activity can be completed as a stand-alone or can be approached, as a team, as a larger project. The package has potential to be extended into a much longer project to include curriculum points from different STEM subjects.

There are three **student workbooks - Open, Guided and Scaffolded,** that go alongside this resource; all have the same suggestions for activities, however, they have been written and edited to provide differentiated learning options to support good teaching practice**.** Teachers may pick and choose which versions they give which students, and may wish to edit them further to address their learning needs. Due to the differentiation of the workbooks, the **Open** activities will enable more syllabus links to be addressed, which is why each activity has its own syllabus links key. However, if you wish to give a truly open ended investigation then you could just give the students the challenge and background information section of the Student Booklet.

The Woodside Australian Science Project (WASP) STEM resources aim to be accessible and supportive for teachers and students, please contact us if you have questions, feedback, require assistance or would like to arrange an incursion or a professional development workshop - www.wasp.edu.au.

The Student Challenge

There has been a lot of activity around your local area, with geologists coming and going. There has been whispers of iron through the community and some people are even talking about the mining company wanting to buy lots of the land in the area for a possible mine. You are keen to find out if this could be true and want to know if your land could be worth a lot more than you thought, so decide to do some geological exploration yourself.



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Background Information

Western Australia is famous worldwide for its resources and mining industry. However, due to its isolation and low population, it can be quite a difficult place to get around – with limited road access and difficulty in maintaining supplies. Australia as a whole is very old and stable geologically speaking, with some of the oldest minerals in the world being found in rocks in WA. This means that most of the surface is deeply weathered and chemically altered, making it difficult for geologists to find rock outcrops and identify them easily.
In the past, geological mapping was carried out by very enthusiastic geologists, who loved to be in the field. They would note any rock outcrops they found and describe them in detail, eventually creating a map by inferring what was in between the outcrops (like a complicated dot-to-dot). Amazingly this has been carried out in Western Australia, despite the challenges highlighted. These maps were then used to analyse if it may be worth re-visiting the areas to look for resources.

Figure 1. An enthusiastic geologist, standing next to a rock outcrop on a mapping excursion.

More recently, the system of geological mapping has changed, so that geophysical exploration occurs first. There are two main geophysical surveys which are used to locate iron ore due to the properties of the ore which help it stand out from surrounding rocks, the first of which is a gravity survey. In simple terms, bodies with larger mass will have a stronger gravitational pull, for example the Suns has a strong pull on the planets in the solar system. Iron is a relatively dense mineral and so rocks that are rich in iron will have a larger gravitational pull, than surrounding rocks. Using this principle, geophysicists can use data to determine the areas of denser rock and help locate potential iron ore sites.
The second geophysical technique which is also very helpful for locating iron ore, is locating magnetic anomalies. For a large scale investigation, an aeroplane carrying a magnetometer, will fly over an area collecting data. Where there is a high reading on the magnetometer this indicates magnetic materials are below. There are a lot of metals which have magnetic properties, iron being one of them. Therefore, an area with a high magnetic anomaly may indicated iron ore.
These surveys can be carried out from the air, and so can cover a much larger area in a fraction of the time, making them particularly useful in areas difficult to reach, such as WA and northern Queensland. These surveys can highlight any areas that look “interesting” for certain prospectors. Companies will then send in their exploration geologists to the areas of interest to complete the more traditional style geological mapping and sampling.

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Activities

This booklet contains extra information on each activity, including syllabus links the overall activity objective, suggestions for recommended equipment or alternative ways to run investigations as well as useful resources and website links*.

The syllabus links have been colour coded. These links to the Australian Curriculum are also relevant to the Western Australian Syllabus. – Please see the colour key below:

Covered in Scaffolded, Guided and Open Student Booklet
Covered in Guided and Open Student Booklet
Covered in Open Student Booklet
Italics – WA syllabus for DT and D and T

List of activities

**Please note that these were accessed in February 2018 – these addresses may change slightly, we would be grateful if you could let us know if these sites are no longer accessible.*

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Background Research

Objective

Students will gain some background information into iron ore – how it formed, where it can be found in WA and how much it is worth.
The background questions should lead them to start thinking about how they could find iron ore in the field, how they might identify it and how much they could get for any iron ore that they do find. They are "teaser" questions which students will be able to find out more about through the other activities. Therefore if you do not have time to complete all the activities you may wish to add further research to the background questions.

Australian Syllabus links	
Science	ACSSU153 Sedimentary, igneous and metamorphic rocks contain minerals and are formed by processes that occur within Earth over a variety of timescales. ACSSU225 Chemical change involves substances reacting to form new substances.
Digital Technologies	ACTDIP025 Acquire data from a range of sources and evaluate authenticity, accuracy and timelines.
Design and Technology	ACTDEK034 Analyse ways to produce designed solutions through electing and combining characteristics and properties of materials, systems, components, tools and equipment. ACTEDEK031 Analyse how motion, force and energy are used to manipulate and control electromechanical systems when designing simple, engineered solutions.
Mathematics	ACMSP284 Investigate techniques for collecting data, including census, sampling and observation

Useful websites

WASP rocks and minerals resources and posters:
http://www.wasp.edu.au/mod/page/view.php?id=87

Spot price and historical charts of the iron ore price, there are also resources at the bottom of the page including a map of Australia's major mines:
https://www.marketindex.com.au/iron-ore

Iron Ore fact sheet:
http://www.oresomeresources.com/resources_view/resource/factsheet_iron_ore

Earth's exploration methods: https://www.britannica.com/topic/Earth-exploration#ref57241

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Properties of Iron Ore

Objective

Students will complete numerous physical tests and make observations of different types of metals/metallic minerals, and compare their properties. They will gain an understanding of some properties which are specific to iron/iron ore so that they can identify it.
The suggested tests include: float/ sink, oxidation, reactivity with acid and water, magnetism, and electrical conductivity. If testing for conductivity, it is useful to add a globe into the circuit, not only does this act as an extra visual stimulus to demonstrate if the material is conductive or not, but it also adds extra resistance.

Australian Syllabus Links	
Science	ACSSU225 Chemical change involves substances reacting to form new substances. ACSIS146 Reflect on scientific investigations including evaluation the quality of the data collected, and identifying improvements. ACSIS140 Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed. ACSIS141 Measure and control variables, select equipment appropriate to the task and collect data with accuracy. ACSIS145 Summarise data, from students' own investigations and secondary sources, and use scientific understanding to identify relationships and draw conclusions based on evidence.
Design and Technology	ACTDEP035 Critique needs or opportunities for designing and investigate, analyse and select from a range of materials, components, tools, equipment and processes to develop design ideas.

Useful websites

Testing properties of materials animation:
http://www.oresomeresources.com/resources_view/resource/powerpoint_mineral_exploration

BBC bitesize properties of materials animation, revision and test:
https://www.bbc.co.uk/education/topics/zgvbkqt

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Analysing Geophysical Maps

Objective

Students will use Geographical Information Systems to look for areas in Western Australia with high gravitational and magnetic anomalies and relate that to possible locations where iron ore can be found. They will determine what is already being mined or explored for in their area to strengthen their argument that there probably is/isn't iron ore in their area. Students will gain a better understanding of the properties ofIlron ore and how it can be looked for using geophysical methods.

Australian Syllabus Links	
Science	ACSSU153 Sedimentary, igneous and metamorphic rocks contain minerals and are formed by processes that occur within Earth over a variety of timescales. ACSIS145 Summarise data, from students' own investigations and secondary sources, and use scientific understanding to identify relationships and draw conclusions based on evidence. ACSHE226 Science knowledge can develop through collaboration across the disciplines of science and the contributions of people from a range of cultures.
Digital technologies	ACTDIP025 Acquire data from a range of sources and evaluate authenticity, accuracy and timelines ACTDIP026 Analyse and visualise data using a range of software to create information, and use structured data to model objects or events.

Useful websites and resources

Short (3 min) detailed video on how magnetic surveys are conducted:
https://www.youtube.com/watch?v=AZyNIGFHsE4

Short (2 min) video on how gravity surveys are conducted:
https://www.youtube.com/watch?v=9P6GEpxFtSY

Geophysical maps of Western Australia can be viewed and downloaded on the Geological Survey WA website: http://www.dmp.wa.gov.au/Geological-Survey/Regional-geophysical-survey-data-1392.aspx

PowerPoint with some pictures of geophysical investigation techniques:
http://www.oresomeresources.com/resources_view/resource/powerpoint_mineral_exploration

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Modelling a Magnetic Survey

Objective

Students will carry out a miniature magnetic survey, passing magnets/magnetic field sensors over an area where magnets have been buried in sand, to try and find where they are buried.

This activity can be done via numerous methods. If using the magnet suspended by an elastic band method it can be difficult to note the deflection and requires a very strong magnet to make much difference. It is also more pronounced if magnets are buried instead of iron ore. It is best to test the pull first, before giving the equipment to the students as if it is not strong enough the experiment will not work. Lego Mindstorms and Pasco have magnetic field sensor accessories available, this would give more obvious results and would also enable more integration of digital technologies into the classroom. It could be possible to add a sensor onto a robotic arm and code the arm to stop a certain points so that readings can be taken.

Australian Syllabus Links	
Science	ACSIS140 Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed. ACSIS141 Measure and control variables, select equipment appropriate to the task and collect data with accuracy. ACSIS145 Summarise data, from students' own investigations and secondary sources, and use scientific understanding to identify relationships and draw conclusions based on evidence. ACSIS146 Reflect on scientific investigations including evaluation the quality of the data collected, and identifying improvements.
Digital and Technologies	ACTDIP026 Analyse and visualise data using a range of software to create information, and use structured data to model objects or events. ACTDIP027 Define and decompose real-world problems taking into account functional requirements and economic, environmental, social, technical and usability constraints. ACTDIP031 Evaluate how student solutions and existing information systems meet needs, are innovative and take account of future risks and sustainability. ACTDIP030 Implement and modify programs with user interfaces involving branching, iteration and functions in a general-purpose programming language.

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Design and Technology	ACTDEK034 Analyse ways to produce designed solutions through selecting and combining characteristics and properties of materials, systems, components, tools and equipment. ACTDEP035: Critique needs or opportunities for designing and investigate, analyse and select from a range of materials, components, tools, equipment and processes to develop design ideas. ACDTEP036 Generate, develop, test and communicate design ideas, plans and processes for various audiences using appropriate technical terms and technologies including graphical representation techniques. ACTDEP037 Select and justify choices of materials, components, tools, equipment and techniques to effectively and safely make designed solutions. ACTDEP039 Use project management process when working individually and collaboratively to coordinate production of designed solutions.
Mathematics	ACMNA183 Carry out the four operations with rational numbers and integers, using efficient mental and written strategies and appropriate digital technologies ACMNA189 Solve problems involving profit and loss, with and without digital technologies.

Useful websites and resources:

Iron Ore fact sheet:
http://www.oresomeresources.com/resources_view/resource/factsheet_iron_ore

Earth's exploration methods: https://www.britannica.com/topic/Earth-exploration#ref57241

Short (3 min) detailed video on how magnetic surveys are conducted:
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