

YEAR 4 STEM Project 1

Science Technology Engineering and Mathematics
(STEM) Project - Teacher's Guide



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How To Use This Resource

The PALMS STEM projects are designed to be used either to supplement normal science lessons in the Earth and Space Science area or to be used as stand-alone projects with science classes, STEM clubs or extension classes.

They are organised using the following sequence:

1. The Challenge
2. Find Out More and Get Thinking
3. Ways To Meet The Challenge
4. Could It Be Better?
5. Report Back To Base

The projects are designed to be completed independently by students although teacher supervision, especially when using equipment such as 3D printers, is strongly recommended.

To clarify with students what skills they need to be using when working on STEM projects, an accompanying PowerPoint presentation titled '[What do STEM Skills look like?](#)' has been prepared. This should be discussed with the students before starting the main project. It should be reinforced with the students that we are not asking them to think of ways to address the scenarios presented in this resource, but to identify the skills they would use. The STEM skills discussed here align with the WA Department of Education definitions found here:

<https://www.education.wa.edu.au/what-is-stem->

Students will be asked at the end of the project to identify which STEM skills they have used, to increase their overall understanding of the importance of these skills.





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A series of project maps for the STEM project have also been created to allow teachers and students to clearly see some of the many aspects that could be investigated as part of the project. These are included as Appendix 1. There is a full STEM project map which may be too overwhelming for some students at first so there are also a series of more focused maps (numbered 1-5) included.

This project map could be used in several ways:

- For students to choose one specific aspect of the larger project to work on
- For teachers to choose one branch for the class to work on, as a theme for the whole class
- As a thinking prompt for any other aspects of the larger project that could be investigated - the project map is definitely not exhaustive!





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Landscapes, Life & Fire

The Challenge

Bushfires have affected the Australian continent for millions of years, including shaping the evolution of our native flora. In more recent times, Australia continues an annual battle that has now become known as the bushfire season. Other countries also experience the widespread and often devastating effects of bushfires or forest fires as they may be known.

Conversely, Australian Aboriginal people use fire to expertly manage the local landscape and to assist with sourcing food. Increasingly, the way Indigenous people use fire is being included in modern methods of landscape management to prevent bushfire catastrophes.

The effects of bushfires encompass both our natural and built environments. There are many ways that STEM can be applied to learn more about bushfires and to propose solutions. These solutions may come from numerous and varied fields such as microbiology, materials science, mathematical modelling, soil science, engineering and chemistry to name but a few.

This STEM Project will focus on proposing solutions to reduce impacts of bushfires on landscapes and life.



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Photo: South Australian Country Fire Service ([Wikipedia Commons](#))

Before starting this project with students, it is important to consider the following:

- Some students may have personal experience of bushfires and this project may trigger traumatic memories. Speaking with parents and caregivers will assist in deciding whether this project is suitable for all students.
- The focus of this project is to propose solutions for bushfire recovery. As such, fires should not be lit (especially by students) and areas of bush affected by fire should not be entered without proper authorisation. Any testing of solutions involving burning should be done in controlled situations by adults, only after appropriate risk assessments have been conducted.

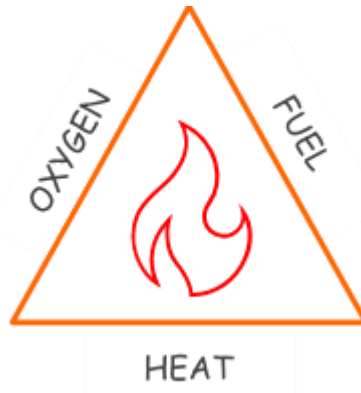


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Fire is caused by a chemical reaction called combustion and it requires three components to occur - oxygen, fuel, and heat (ignition). This can be represented by a diagram called the fire triangle. If any one of these components are missing, fire will not occur.



Recognising the fire triangle, along with the knowledge that heated air becomes less dense and rises, can help us to understand how bushfires start, spread and how they may be stopped.

A bushfire is defined as "a fire burning in the bush (= a wild area of land) that is difficult to control and sometimes spreads quickly."

<https://dictionary.cambridge.org/dictionary/english/bushfire>

In other parts of the world, they may be called forest fires or wildfires. In this project, the term bushfire and fire may be used interchangeably.



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The terrain of an area affects the speed and direction of a bushfire. For example, if a fire starts at the bottom of a hill, the heated air above the fire will travel up the slope, preheating the vegetation higher up (the fuel). This means that the fire can travel swiftly up a hill as the fuel catches fire more quickly.

Hilly or mountainous areas also often create their own local wind patterns which can affect the speed and direction of fires also. The direction that a slope faces will also affect how a fire behaves in that area. If the slope faces the Sun for most of the day, the area will tend to dry out more quickly than a slope mostly in the shade. This means the vegetation on the sunny side will burn more easily. This will also influence the type of vegetation that grows and how lush it is, again affecting how a fire will behave in the area.

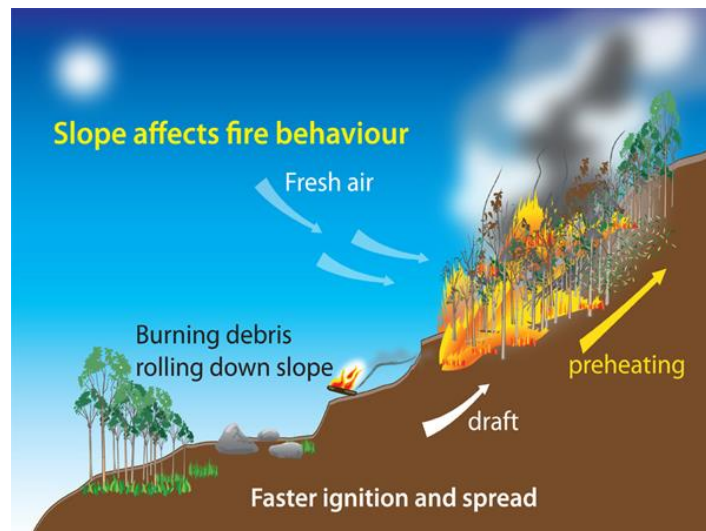


Image: WA Dept Biodiversity, Conservation and Attractions ([Parks and Wildlife Service](#))

This highlights the importance of local area knowledge in both preventing and fighting fires. In Australia, volunteer fire brigades provide this local knowledge as they usually live in the area they volunteer in.



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When vegetation is removed from an area, by fire or other means, it can become vulnerable to erosion. Erosion may occur when wind or water (usually from rainfall) moves across the burnt landscape, removing the soil as it goes. This soil would usually be held in place by roots and plant structures, but it becomes vulnerable once these are removed. Erosion of soil in an area, particularly the topsoil layer, can delay regeneration of plants as dormant seeds and vital nutrients are contained in the soil that washes or blows away.



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If it rains after a bushfire, local water sources can be affected. The fine ash particles resulting from a fire, as well as eroded soil, washing into waterways such as creeks, rivers and lakes can degrade the water quality. The ash and soil in runoff that enters waterways can change the water nutrient balance and increase turbidity (cloudiness).

This could have a knock-on effect for any aquatic animals and plants in the area if the waterways are not sufficiently flushed by further rainfall. It



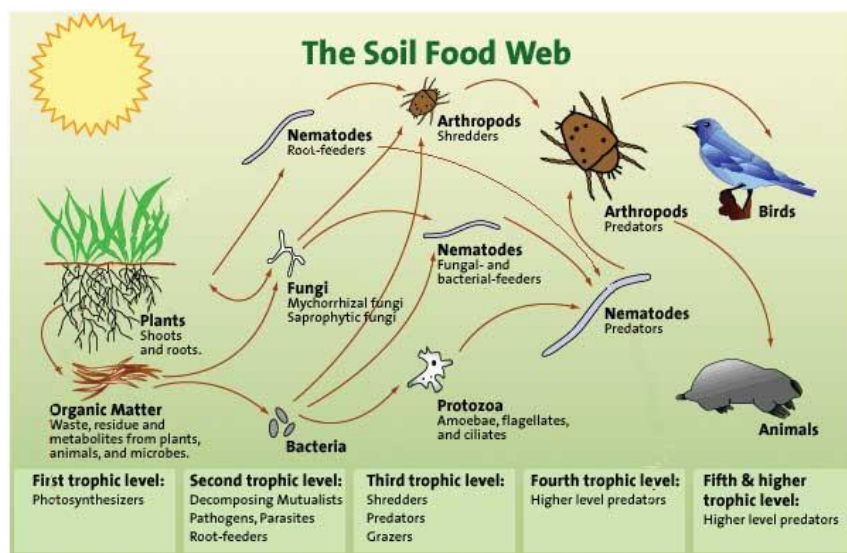
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can also affect water supplies for human populations when bushfires occur in water catchment areas.

The soil itself can also be affected by fire. The effect of bushfires on soil will depend on the intensity or heat generated by the fire. Low intensity bushfires may cause the essential living organisms such as bacteria in soil to die. High intensity fires can change the chemistry of the soil by changing the amount of nutrients, such as carbon, phosphorus and nitrogen, and the pH (acidity level).



Soil food web diagram from [Soil Food Web Institute](#)

The ash from fires can also be beneficial to soil, adding nutrients and increasing the fertility. The nutrients in ash tend to be more easily dissolved in water though so may be washed away by rain.

Soil can also develop a kind of water-repellent coating after some fires which will decrease the water holding capacity of the soil. As well as decreasing the amount of water available for plants, this water-repellence can also increase the risk of soil erosion.





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Bushfires have an obvious effect on native animal species with those unable to flee the fires being injured or losing their lives. Bushfires wipe out habitats and food sources also. The bushfires in the summer of 2019/2020 in Australia were particularly devastating, with some estimates saying that more than one billion animals were killed. Wildlife rescue organisations were extremely busy treating injured wildlife and finding safe areas to return them to.

The 2019/2020 Australian bushfires were certainly some of the worst seen in the country's history. This ABC story summarises some of the fires, their causes and effects.

<https://www.abc.net.au/news/2020-02-19/australia-bushfires-how-heat-and-drought-created-a-tinderbox/11976134?nw=0>

As natural environments start to recover from bushfires, native flora and fauna may have to contend with invasive and feral species for food and shelter. Weeds can often take over bushland and feral animals take over viable habitat. Predation by feral animals may also increase. This leads to a loss of biodiversity and endangers native species populations.

Management of these issues often requires intervention from government departments and environmental groups.



Bridal Creeper (Weed) Image: [Kangaroo Island NRM](#)



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As Australia has a very long history of bushfires, some native flora species have adapted to cope with fire, some even rely on fire to open seed pods or to germinate. The woody seed pods of some Banksia species protect their seeds from the heat of bushfires. There are fossil records of Banksia species dating back 60 million years, so they have had plenty of time to adapt to harsh Australian conditions. Banksia seed pods won't open until they have been exposed to high temperatures like in a bushfire.



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Some gums trees have small buds under their bark which is thick enough to protect them from fires. This allows the buds to sprout all along the tree trunk, not just at the ends of branches, which can help a tree recover from fire. They may also have some of these buds stored under the surface of the soil (called lignotubers) to protect them from fire.



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Ongoing research in Western Australia has found that some species require a certain chemical found in bushfire smoke to germinate. Over 400 native species have been found to benefit from being exposed to smoke. It is now common to apply 'smoke water' to seeds of many native plants to help them germinate. Smoke water is water that has had smoke from burning native plants bubbled through it, dissolving the required chemical into the water.

Australian Aboriginals have been using fire to manage their local landscapes for thousands of years. One of the many reasons they burn the bush is to encourage new plant growth to harvest the plants for food and encourage animals into an area so they may be hunted. Bush tomatoes are an example of a bush tucker plant that is encouraged to grow by burning.

Areas are also burned by Aboriginal people in patches to create natural firebreaks that reduce the severity of bushfires later in the season. This lessens the impact on both Aboriginal people and wildlife.

As well as the natural environment, humans and the built environment are greatly impacted by bushfires and the devastation they cause. There are the immediate threats to life from the fire but other aspects such as air pollution also affect people. Smoke and particulates from fires affect air quality and can impact the health of people in the immediate vicinity of the fire but also further away as the smoke is dispersed by wind. During the devastating bushfires in the summer of 2019, smoke from Eastern Australia drifted across the Tasman Sea and affected the air quality in New Zealand. Bushfires can also add carbon dioxide to the atmosphere, contributing to global atmospheric levels of this greenhouse gas.

The built-up environment of towns and cities such as houses, buildings and other infrastructure can be damaged or destroyed by bushfires also. This must be considered in town planning, building design and building materials



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in areas at risk of bushfire. The required infrastructure and human resources to fight bushfires has to be considered as well as the clothing and equipment needed to protect firefighters.



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This project has been broken into four main areas:

- Landscape and bushfires
- Soil and bushfires
- Materials and bushfires
- Living things and bushfires

These areas are then further broken down into smaller areas which are outlined in the STEM project maps 1-5 (Appendix 1).

A list of keywords for this project is also provided (Appendix 2).

Links to the Australian Curriculum are outlined in Appendix 3. Due to the nature of this project, not all curriculum points will be covered by all students.



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Find Out More and Get Thinking

Students will need to know a bit more about what causes bushfires and how different living and non-living aspects of the environment are affected.

Listed below are some stimulus questions and links to articles and videos that will help get students thinking about the problem. You could either ask students to research one or more of these questions themselves or prepare some material yourself to present to the class. Note that most links are to websites pitched at adult readers so may need to be assessed for suitability before asking students to use them independently.

*What is a **bushfire**? What **causes** them?*

- A simple explanation of bushfires and their causes
<https://www.natgeokids.com/au/discover/geography/physical-geography/what-is-a-bushfire/>

*What is the **fire triangle**? What are the **three things needed** for a fire to burn?*

- Cool Australia article including a video on the fire triangle and how bushfires are caused
<https://www.coolaustralia.org/curious-kids-how-do-bushfires-start/>

*How do fires **behave** in **hilly** or **mountainous** areas compared to **flat** areas?*

- WA Parks and Wildlife Service webpage on fire behaviour
<https://www.dpaw.wa.gov.au/management/fire/fire-and-the-environment/48-fire-behaviour>

*What is **soil**? What are the **different layers** in soil?*

- Link to videos of PALMS and Australian Earth Science Education soil layer activities
<https://youtu.be/ljW7jbCulGo>
https://youtu.be/Q4UDqP3_AwY
- Video about what soil is, including humus explanation





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<https://www.youtube.com/watch?v=if29mjcd5bc>

- Simple facts and video about soil

<https://easyscienceforkids.com/all-about-soil/>

What are the living things in soil humus and what is their 'job'?

- Explanation of humus

<https://www.nationalgeographic.org/encyclopedia/humus/>

- Teacher reference page on soil microbes

<https://www.soils4teachers.org/biology-life-soil>

- Simple explanation from NZ Science Learning Hub

<https://www.sciencelearn.org.nz/resources/890-what-is-in-soil>

- ABC Education video on living things in soil

<https://education.abc.net.au/home#!/media/104056/soil-healthy-dirt-makes-healthy-plants>

What effect do bushfires have on soil? What parts of the soil can be affected?

- ABC Gardening Australia article on bushfires effect on soil

<https://www.abc.net.au/gardening/impact-of-fires-on-soil/11951568>

- Agriculture Victoria webpage on Fire and Soil Health

http://vro.agriculture.vic.gov.au/dpi/vro/vrosite.nsf/pages/soilhealth_toolbox_farmers_fire

- Fact sheet from Soil Science Australia

<https://www.soilscienceaustralia.org.au/wp-content/uploads/2020/01/202003-FACT-SHEET-Soil-fire-impacts-and-management.pdf>

What is erosion? Why does this happen after a bushfire? What other effects can erosion cause?

- Simple explanation of soil erosion https://kids.kiddle.co/Soil_erosion

- Impacts of bushfires. Explanation of erosion towards bottom of





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page. Warning: images of dead wildlife

<https://www.bushfirefront.org.au/home/fire-facts/impacts-of-bushfires/>

- National Geographic webpage on erosion
<https://www.nationalgeographic.org/encyclopedia/erosion/>
- CSIRO article on the impacts on waterways
<https://blog.csiro.au/the-relief-of-rain-after-bushfires/>

*What are **weeds**? Why are weeds a **problem** in areas recovering from bushfires?*

- Webpage on tackling weeds and feral animal species after bushfires
https://www.naturalresources.sa.gov.au/kangarooisland/land-and-water/fire-management/Bushfires_and_weeds
- Weeding to help recovery from bushfires
<https://theconversation.com/pulling-out-weeds-is-the-best-thing-you-can-do-to-help-nature-recover-from-the-fires-130296>

*How have some **banksia** plants adapted to recover from bushfires? What do their **seed pods** need to open?*

- Wikipedia page (Response to fire section) on Ecology of Banksia
https://en.wikipedia.org/wiki/Ecology_of_Banksia
- Plant fact sheet from Gold Coast Regional Botanic Gardens
<https://www.goldcoast.qld.gov.au/documents/bf/remarkable-world-plants.pdf>

*What other ways have **Australian plants** adapted to cope with **regular bushfires**? E.g. Why is some tree **bark** so **thick**?*

- YouTube video made by a student explaining native plant adaptations
<https://www.youtube.com/watch?v=Z4Ur8ky-Q2I&t=177s>
- Scientists from Kings Park WA are researching how some plants require smoke to germinate <https://www.bgpa.wa.gov.au/about->





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[us/information/research/seed-conservation/smoke-to-sow-and-grow](https://www.abc.net.au/news/2020-01-09/indigenous-cultural-fire-burning-method-has-benefits-experts-say/11853096)

How do Aboriginal people use fire to manage their local environment?

- ABC article on cultural burning <https://www.abc.net.au/news/2020-01-09/indigenous-cultural-fire-burning-method-has-benefits-experts-say/11853096>
- Video from Cool Australia <https://www.youtube.com/watch?v=UJKdZpRbzMk>
- ACARA Australian Curriculum elaborations on Indigenous peoples fire management of land in Year 4 section <https://australiancurriculum.edu.au/media/5653/ccp-tbi-f-6-ver5-online.pdf>

What are the health hazards of bushfire smoke?

- WA Department of Health webpage https://healthywa.wa.gov.au/Articles/S_T/Smoke-hazard-from-bushfires

How can you make a building fire resistant? What should you think about in the design and the materials it is built from?

- Article on designing a fire-resistant building <https://www.thefifthestate.com.au/innovation/residential-2/how-to-design-your-house-for-fire-resistance-and-sustainability/>
- ABC News article on fire-resistant homes <https://www.abc.net.au/news/2019-12-29/houses-need-to-be-built-to-withstand-bushfires/11809934>
- Architecture article about 'Karri House' design in WA <https://www.architectureanddesign.com.au/projects/houses/addressing-a-national-problem-karri-fire-house-by#>
- Guide for existing houses from WA Dept of Fire and Emergency Services



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https://www.dfes.wa.gov.au/safetyinformation/fire/bushfire/BushfireManualsandGuides/DFES_Bushfire-Homeowners_Survival_Manual.pdf

How are **firefighting trucks** designed to **protect** firefighters during bushfires?

- Video showing drill of Victorian Country Fire Authority (CFA) firefighters demonstrating heat blankets and sprays on trucks
https://youtu.be/KxG1sUxR_6c
- Longer video showing testing in simulated bushfire
https://www.youtube.com/watch?time_continue=1&v=4ONQSjkRWi8&feature=emb_logo
- CSIRO article on research into fire truck protection technology
<https://blog.csiro.au/fire-truck-burnovers/>

What special **clothing** do **firefighters** wear to **protect** them from **fire**?

What **materials** is the clothing made from?

- List of clothing for NSW firefighters
<https://www.fire.nsw.gov.au/page.php?id=164>
- Video of American firefighter putting on clothing
<https://youtu.be/74wm6IO6BQA>
- US webpage for kids on what a firefighter wears
<https://www.oakharbor.org/fire/page/what-does-firefighter-look>
- Wikipedia page on firefighter clothing (named bunker gear)
https://en.wikipedia.org/wiki/Bunker_gear
- History of uniforms of London Fire Brigade <https://www.london-fire.gov.uk/museum/history-and-stories/firefighters-uniforms/>
- There are many chemically treated fabrics available that firefighters' uniforms may be made from. A search for 'firefighter clothing' will lead to many businesses selling this clothing and some will give details on the fabrics used.





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What is a bushfire resistant garden? Which species of plants are best at resisting fire?

- Information page from South Australia on bushfire resistant gardens <https://www.stateflora.sa.gov.au/the-australian-garden/why-choose-native-plants/bushfire-resistance>
- Comprehensive list of bushfire resistant plant species <https://apsvic.org.au/fire-resistant-and-retardant-plants/>
- CSIRO webpage on re-building a garden after bushfires including tips on design and fire resistant species <https://blog.csiro.au/five-tips-for-replanting-after-bushfires/>
- Webpage on bushfire garden recovery including how to help the soil <https://sophiespatch.com.au/2020/01/03/bush-fire-garden-recovery/>

A good reference for teachers is the free to download [Bushfires: A Geography resource for Australian students](#) from the Geography Teachers' Association of Victoria Inc. Aimed at lower secondary students, it explains many aspects of bushfires, their behaviour and impacts in easily understandable language.

These teaching resources for the [Charles Darwin University \(NT\) online course on Fire Ecology and Management](#) contain lots of information on the history of fires in the top end, effects and current management practices and are another good reference for teachers.

An additional resource about bushfires has been developed by the WA Department of Fire and Emergency Services (DFES). It is called [Bushfire Patrol](#) and is designed for students in Years 4-6, with area specific resources for students in the South West and North West land divisions.





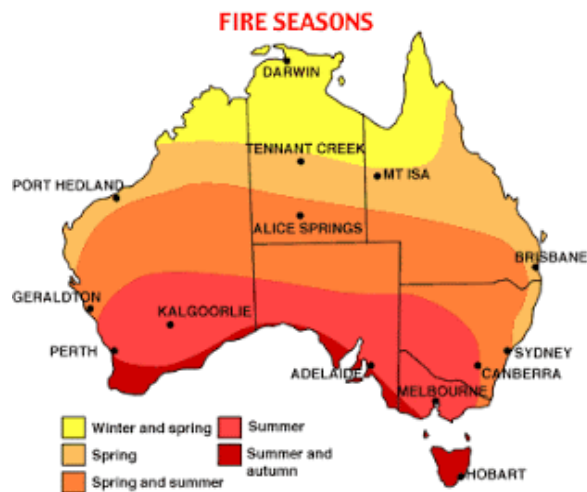
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The five modules are designed to help students understand bushfires and to be prepared.

The Australian Bureau of Meteorology [Fire Weather Knowledge Centre](#) webpage contains lots of information about how weather relates to fire along with current forecasts and warnings.

This [list of citizen science projects](#) put together by the Australian Citizen Science Association and the Atlas of Living Australia may also be of interest to your class. They can get involved with assisting with bushfire recovery and resilience through science projects.

A STEM project research worksheet has been provided in the student booklet of this PALMS STEM project. This gives students the opportunity to consider and research the broader issues. If you have chosen a particular section of the broader STEM project map this should be the focus of their research.



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Ways to Meet the Challenge

Before starting to work on meeting the challenge, it is important that students are very clear on what specific problem they are going to be solving. So they can limit the scope of their project and make it achievable. As previously mentioned, this project has been broken into four main areas:

- Landscape and bushfires
- Soil and bushfires
- Materials and bushfires
- Living things and bushfires

You may like to ask students to choose one of these areas (or assign them one) or perhaps tell the class that they will all be working on one of these four areas and assign each group a more specific point to work on, collaborating with other groups to solve the main problem as a class.

At this stage, students should spend **at least one lesson** brainstorming and refining their ideas. It should be stressed that thinking through and refining their ideas is a really important step that should be given enough time as they will be very keen to jump in and start building things or doing experiments. Thinking more about the way they can solve a problem will help them to understand the problem more fully, which will ultimately lead to a better solution, and it is a more efficient use of resources. If possible, it would be good to spend another lesson on this step before allowing the students to move on.

Once they have thought more about their specific problem, they may identify that they need more information. In this case, they could be given another copy of the STEM project research worksheet guide to assist. Once they have thoroughly thought through a possible solution to their problem (and conducted any further research they need to), they may then move on to building prototypes, designing experiments, testing and reviewing. This process is likely to take several lessons, but it is also important to give students clear deadlines they must meet to enhance their chances of finishing the project.





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Remind students that prototypes do not need to be perfect and are a representation of what a final product may look like. For some sections listed, the students may not be able to make a working prototype but may produce a detailed diagram or map to illustrate their solution. Some students may need to carry out some trials or experiments growing plants to test their ideas on aspects, such as levels of ash in soil and exposure to smoke. This will obviously take a longer period of time so it may not be possible to work on the project continuously.

Below we have listed some prompts for a couple of the areas listed in the STEM Project Map for Landscapes, Life & Fire to give you an idea of how projects may be structured. As mentioned previously, students may come up with other areas they would like to investigate. Not all areas have been expanded like this, to allow teachers some freedom in tailoring the project to their students.

Safety note: Some investigations that students may design for this project could require ash, soil or other materials that have been burnt. Otherwise, they may need testing materials to be exposed to heat or fire. Investigations using heat from safer sources, such as hair dryers or heaters, should be encouraged.

Materials should not be collected from bushfire areas but be prepared by responsible adults in controlled environments. Ash and burnt wood may be collected from extinguished campfires or wood-fuelled heaters.

Students carrying out investigations with soil should wear the appropriate PPE (personal protective equipment) such as gloves and dust masks and wash hands thoroughly when finished.

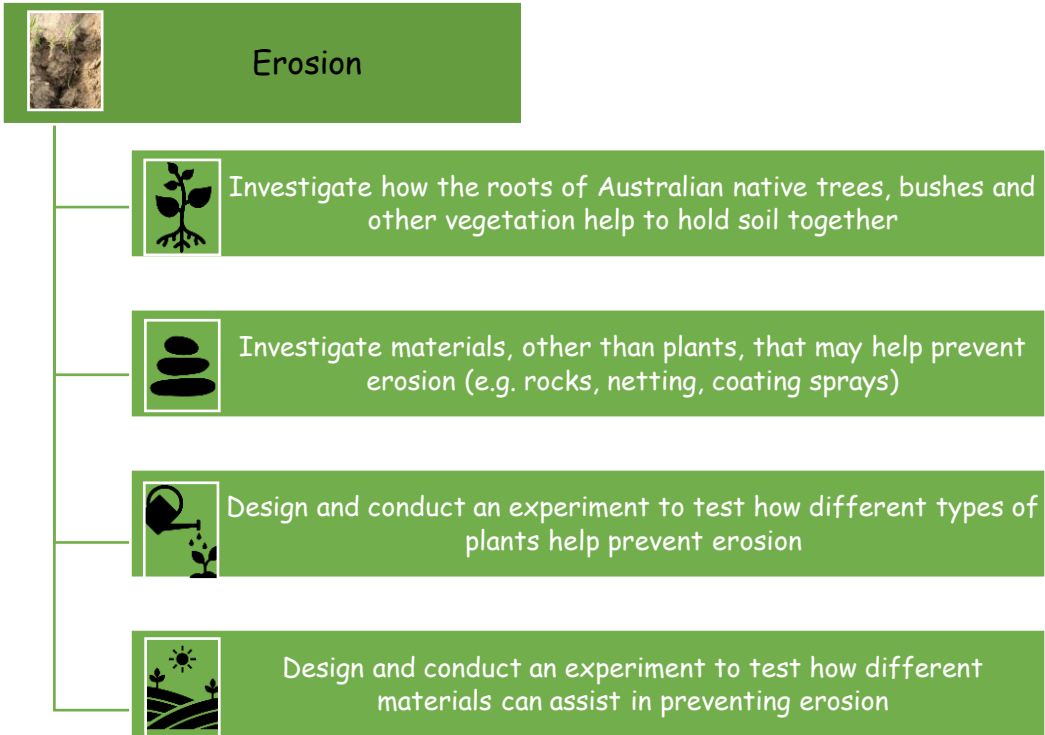
A comprehensive risk assessment **must** be done before carrying out investigations.





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1. Landscape and bushfires



Other areas within this topic to consider:

- Effect of landscape slope on erosion
- How different amounts of ash in soil affect erosion

Examples of how to set up simple erosion experiments that students can add on to can be found in these PALMS activities:

[Erosion by Wind and Water](#)

[All the Rivers Run](#)





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Water quality



Investigate what effect soil erosion after fires may have on water turbidity (cloudiness)



Consider how to collect water samples and what to test them for



Design a system for cleaning water



Design and conduct an experiment to test some different water samples

Other areas within this topic to consider:

- Natural water filtration techniques e.g. reed beds
- Effect of water quality on aquatic plants





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2. Soil and bushfires



Soil nutrients



Investigate how long after a bushfire plants start to germinate



Investigate how ash from bushfires can help some native species to germinate



Design and conduct an experiment to test how well plants grow in soil containing different amounts of ash



Design and conduct an experiment to test how well plants grow with different amounts of nutrients added to soil

Useful resources:

Simple explanations of what major nutrients are, what they do and where they come from

<https://seedsurvivor.com/just-for-kids/nutrient-world/>

<https://www.ncagr.gov/cyber/kidswrld/plant/nutrient.htm>

Tips for how to help your garden recover after bushfires and includes a section on the effect of ash on soil (may need some adult interpretation)

<https://sophiespatch.com.au/2020/01/03/bush-fire-garden-recovery/>



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Soil microorganisms and insects



Investigate the temperatures insects and soil microorganisms can tolerate



Investigate how compost may help soil microorganisms to survive



Design and conduct a survey of the different types of insects living in soil in your garden



Design and conduct an experiment to see if the amount of ash in soil affects how long it takes an apple core to rot

Useful resources:

Article on impact of bushfires on soil, mentioning effect on microorganisms (may need some adult interpretation)

<https://www.abc.net.au/gardening/impact-of-fires-on-soil/11951568>

Experiment to grow soil microbes aimed at older students but could provide some ideas for this topic <https://www.sciencelearn.org.nz/resources/975-growing-soil-microbes>





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3. Materials and bushfires



Clothing



Investigate what clothing firefighters must wear when fighting fires



Find out what materials firefighter uniforms and protective equipment are made from



Design clothing for firefighters that will protect them and keep them cool



Design and conduct a series of experiments to test how different fabrics let heat through

Useful resource:

List of Personal Protective Equipment (PPE) and clothing worn by NSW firefighters

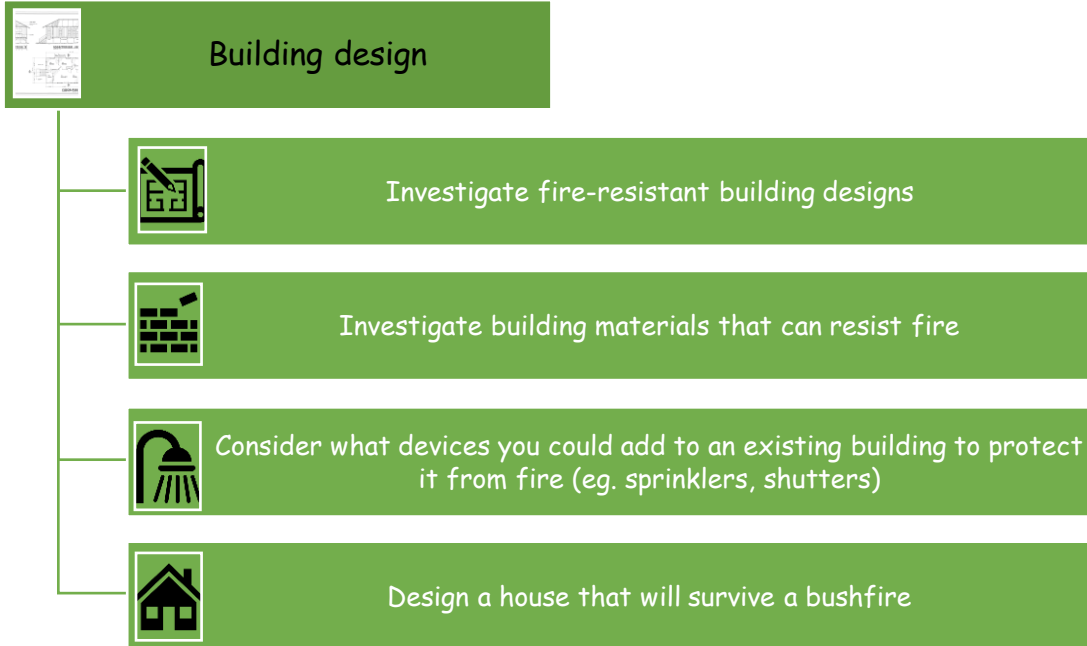
<https://www.fire.nsw.gov.au/page.php?id=164>



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Useful resources:

Guide to prepare your home for bushfires (some adult interpretation required)

https://www.dfes.wa.gov.au/safetyinformation/fire/bushfire/BushfireManualsandGuides/DFES_Bushfire-Homeowners_Survival_Manual.pdf

News article on how different materials and design can help houses to be bushfire resistant (some adult interpretation required)

<https://www.abc.net.au/news/2019-12-29/houses-need-to-be-built-to-withstand-bushfires/11809934>



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4. Living things and bushfires



Smoke and plants



Investigate which species of plants endemic to your area require bushfire smoke to germinate



Investigate which species of native plants are most fire resistant



Design a bushfire resistant garden



Design and conduct an experiment to see how well different native or endemic plant species grow when sprayed with smoke water

Useful resources:

Advice based on Kings Park research on how to use smoke to sow and grow native plants, including a list of species that respond best

<https://www.bgpa.wa.gov.au/about-us/information/research/seed-conservation/smoke-to-sow-and-grow>

Leaflet giving advice on landscaping and plant choice to minimise bushfire risk (some adult interpretation required)

<https://sophiespatch.com.au/wordpress/wp-content/uploads/2020/01/reducingfireriskingardens.pdf>



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Native animals



Investigate how native animals may be affected by bushfires



Find out more about local wildlife rehabilitation centres or carers in your area and how they help animals



Design water and feeding stations for native animals in bushfire affected areas



Design nesting boxes or artificial burrows for native animals in bushfire affected areas

Useful resources:

Factsheet on helping wildlife during bushfires (NSW context)

<https://www.wires.org.au/wildlife-info/wildlife-factsheets/bushfire-factsheet>

News article on what you should and shouldn't do for wildlife during bushfires including a link to how to make watering stations (some adult interpretation required)

<https://theconversation.com/how-you-can-help-not-harm-wild-animals-recovering-from-bushfires-131385>

Advice on helping wildlife including link to making nest boxes (WA context)

<https://www.dpaw.wa.gov.au/about-us/contact-us/wildcare-helpline?showall=&start=4>

Other areas within this topic to consider:

- Talk with local wildlife care organisations about ways students could help



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Could It Be Better?

Once students have fully examined the challenge and come up with their solutions, they should then spend some time reviewing their solution to come up with ways it may be improved. There are always restrictions on what students can achieve in a classroom setting due to time, space, budget, safety and equipment availability. Ask the students to think about their solution if they were to be given unlimited resources. The obvious limitations in this particular project are the ability to test their solution safely in a bushfire situation.

Aspects for the students to consider to try and put their solution in a real-world context:

- Availability of resources - Do you have access to enough of the materials? Is there enough of it available in Australia? On Earth?
- Will current technology be useful, or do you need something more?
- Estimate how much it would cost to put your plan in place.
- Estimate how long it would take to put your plan in place.
- Can you do all of this yourself or do you need to bring in some experts? Who might these experts be?
- Did your experiments or tests give you enough information to start manufacturing or implementing your solution tomorrow? What further experiments or tests might you need to do?





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Report Back To Base

To finish up the Landscapes, Life & Fire STEM Project, students should present their findings back to the class or perhaps even to the school or a wider audience! There are many ways this can be done such as written reports, posters, a STEM Fair, oral presentations, at a parent evening or as a short film. The mode the students use to communicate their findings may also fit into another curriculum area such as English or Digital Technologies.

It is also worth considering if the student's projects would be eligible for entry in one of the many Science and STEM competitions available. Check with your local science teachers' association or community group about competitions or consider national programs such as the CREST (Creativity in Research, Engineering, Science and Technology) Awards run by CSIRO.

Students should cover the following points in presenting their findings:

- What have we found out or discovered that we didn't know before?
- What did we design, build, program, test etc.?
- What STEM skills have we used? (problem solving, creativity, critical analysis, teamwork, independent thinking, communication, digital literacy)
- What data did we generate in our investigation and what does this show? (this may be in the form of tables or graphs and may not be relevant to every section of the project)
- How could we better investigate the challenge if we had no limit on resources or time?
- What was the most challenging aspect of the project?



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STEM Project 1 - Maps

Appendix 1: Full Project Map





STEM Project 1 - Maps


STEM Project Map 1



Landscapes,
Life
& Fire



Landscape
and
bushfires



Soil
and
bushfires



Materials
and
bushfires

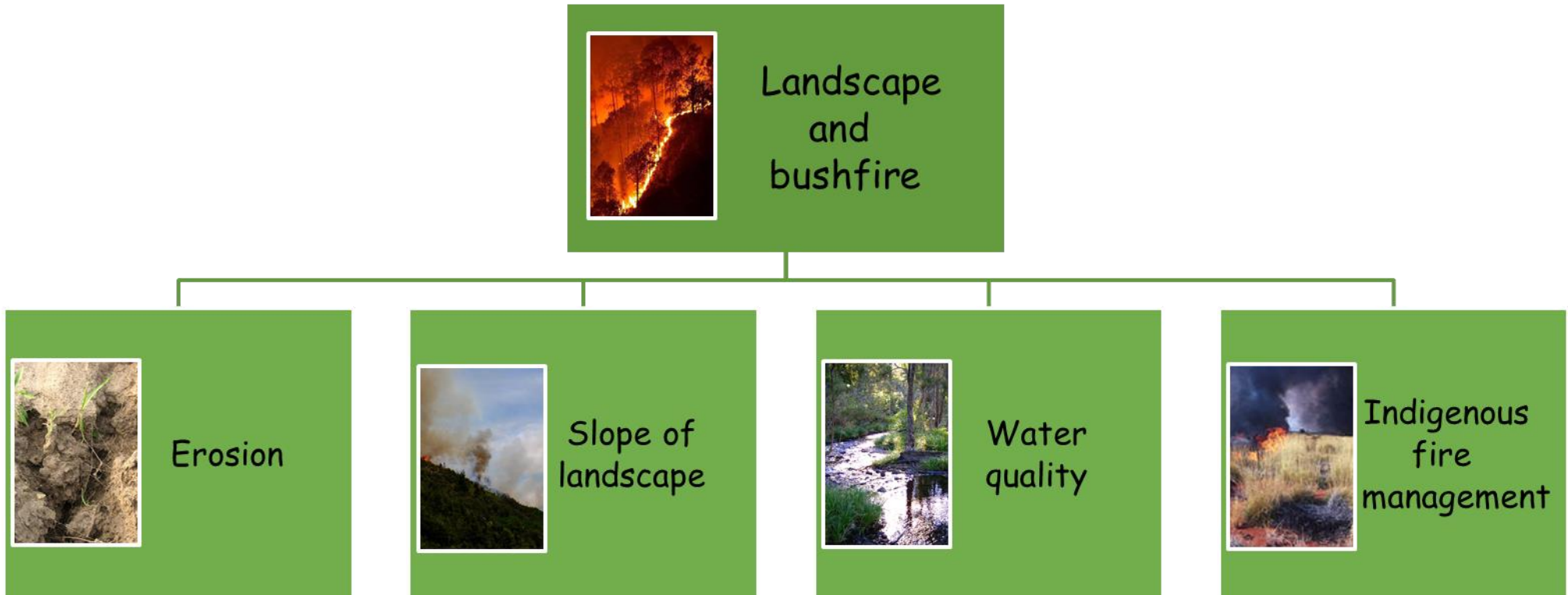


Living
things and
bushfires



STEM Project 1 - Maps

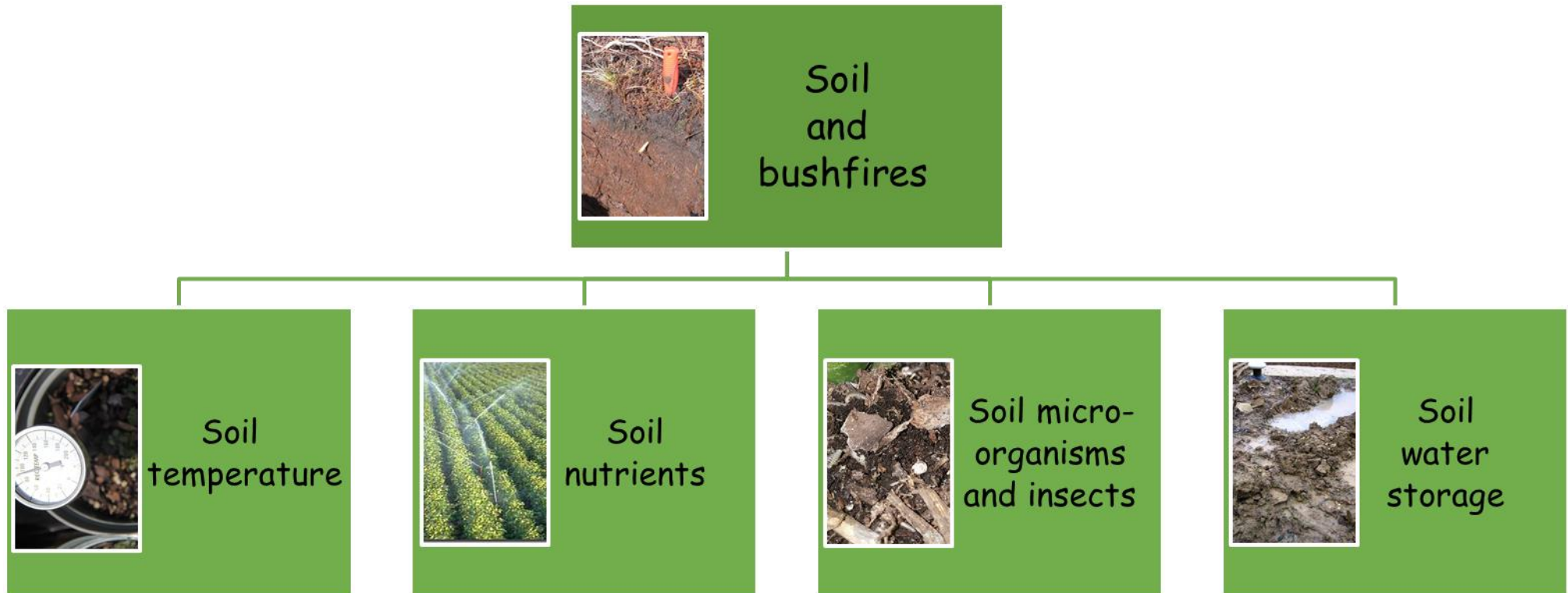
STEM Project Map 2





STEM Project 1 - Maps

STEM Project Map 3





STEM Project 1 - Maps

STEM Project Map 4



Materials
and
bushfires



Building
materials



Clothing



Vehicles



Building
design




STEM Project 1 - Maps

STEM Project Map 5



Living things
and
bushfires



Smoke
and
plants



Weeds
and
feral
animals



Air
quality



Native
animals



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Appendix 2

Landscape, Life & Fire Project Keywords

Bushfire

Forest fire

Wildfire

Erosion

Landscape

Slope

Town planning

System

Water quality

Runoff

Indigenous

Management

Soil

Temperature

(Soil) fertility

(Soil) nutrients

Microorganism

Insect

Water repellent

Materials

Building

Clothing

Vehicles

Building design

Living

Non-living

Smoke

Flora

Fauna

Germinate

Weed

Invasive species

Feral animal

Air quality

Native

Endemic

Fire fighting

Ash

Fire repellent



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Appendix 3

Year 4 Australian Curriculum links

Note: All curriculum areas may not be covered by each student depending on how the project is organised and assigned.

Science	Technology*	Engineering*	Mathematics
<p>Science Understanding</p> <p>Biological Sciences Living things have life cycles (ACSSU072) Living things depend on each other and the environment to survive (ACSSU073)</p> <p>Chemical Sciences Natural and processed materials have a range of physical properties that can influence their use (ACSSU074)</p>	<p>Technologies and Society Ways products, services and environments are designed to meet community needs, including consideration of sustainability (ACTDEK010)</p> <p>Food and fibre production Types of technologies used in food and fibre production or processing, including</p>	<p>Engineering principles and systems Forces, and the properties of materials, affect the behaviour of a product or system (ACTDEK011)</p> <p>Materials and technologies specialisations Suitability and safe practice when using materials, systems and components for a range of purposes (ACTDEK013)</p>	<p>Number and Algebra Recognise, represent and order numbers to at least tens of thousands (ACMNA072) Recognise that the place value system can be extended to tenths and hundredths. Make connections between fractions and decimal notation (ACMNA079)</p> <p>Measurement and Geometry Use scaled instruments to</p>





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<p>Earth and Space Sciences Earth's surface changes over time as a result of natural processes and human activity (ACSSU075)</p> <p>Science as a Human Endeavour Nature and development of science Science involves making predictions and describing patterns and relationships (ACSHE061) Use and influence of science Science knowledge helps people to understand the</p>	<p>how they are used to help meet consumer needs (ACTDEK012)</p> <p>Digital systems Digital systems and peripheral devices are used for different purposes and can store and transmit different types of data (ACTDIK007)</p> <p>Representation of data Data can be represented in different ways (ACTDIK008)</p> <p>Producing and implementing Select, and safely use, appropriate</p>	<p>Investigating and defining Define a sequence of steps to design a solution for a given task (WATPPS21) Identify and choose the appropriate resources from a given set (WATPPS22)</p> <p>Designing Develop and communicate design ideas and decisions using annotated drawings and appropriate technical terms (WATPPS23)</p> <p>Evaluating Use criteria to evaluate and justify simple design</p>	<p>measure and compare lengths, masses, capacities and temperatures (ACMMG084) Compare objects using familiar metric units of area and volume (ACMMG290) Compare the areas of regular and irregular shapes by informal means (ACMMG087) Compare and describe two dimensional shapes that result from combining and splitting common shapes, with and without the use of digital technologies (ACMMG088)</p>
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<p>effect of their actions (ACSHE062)</p> <p>Science Enquiry Skills</p> <p>Questioning and predicting With guidance, identify questions in familiar contexts that can be investigated scientifically and make predictions based on prior knowledge (ACSIS064)</p> <p>Planning and conducting With guidance, plan and conduct scientific investigations to find answers to questions, considering the safe use of appropriate</p>	<p>components and equipment to make solutions (WATPPS24)</p> <p>Digital implementation Use simple visual programming environments that include a sequence of steps (algorithm) involving decisions made by the user (branching) (ACTDIP011)</p>	<p>processes and solutions (WATPPS25)</p> <p>Collaborating and managing Work independently, or collaboratively when required, to plan, safely create and communicate ideas and information for solutions (WATPPS26)</p> <p>Investigating and defining Define a sequence of steps to design a solution for a given task (WATPPS21)</p>	<p>Use simple scales, legends and directions to interpret information contained in basic maps (ACMMG090)</p> <p>Statistics and Probability Describe possible everyday events and order their chances of occurring (ACMSP092) Identify everyday events where one cannot happen if the other happens (ACMSP093) Select and trial methods for data collection, including survey questions and recording sheets (ACMSP095)</p>
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<p>materials and equipment (AC SIS065)</p> <p>Consider the elements of fair tests and use formal measurements and digital technologies as appropriate, to make and record observations accurately (AC SIS066)</p> <p>Processing and analysing data and information</p> <p>Use a range of methods including tables and simple column graphs to represent data and to identify patterns and trends (AC SIS068)</p> <p>Compare results with predictions, suggesting possible</p>			
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<p>reasons for findings (AC SIS216)</p> <p>Evaluating</p> <p>Reflect on investigations, including whether a test was fair or not (AC SIS069)</p> <p>Communicating</p> <p>Represent and communicate observations, ideas and findings using formal and informal representations (AC SIS071)</p>			
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*Drawn from Design and Technologies and Digital Technologies curriculum



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Links to other curriculum areas

Humanities and Social Science (HASS)

- The importance and purpose of laws (e.g. to maintain social cohesion, to reflect society's values) ([ACHASSK092](#))
- The importance of environments to animals and people, and different views on how they can be protected ([ACHASSK088](#))
- Aboriginal and Torres Strait Islander Peoples' ways of living were adapted to available resources and their connection to country/place has influenced their views on the sustainable use of these resources, before and after colonisation ([ACHASSK089](#))
- The diversity and longevity of Australia's first peoples and the ways they are connected to country/place (e.g. land, sea, waterways, skies) and their pre-contact ways of life ([ACHASSK083](#))
- The nature of contact between Aboriginal and/or Torres Strait Islander Peoples and others (e.g. the Macassans, Europeans) and the impact that these interactions and colonisation had on the environment and people's lives (e.g. dispossession, dislocation, the loss of lives through conflict, disease, loss of food sources and medicines) ([ACHASSK086](#))
- Identify current understanding of a topic (e.g. brainstorm, kwl chart) (WAHASS26)
- Locate and collect information from a variety of sources (e.g. photographs, maps, books, interviews, internet) (WAHASS28)
- Record selected information and/or data (e.g. use graphic organisers, develop note-taking strategies) (WAHASS29)





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- Develop criteria for selecting relevant information (e.g. accuracy, reliability, usefulness) (WAHASS31)
- Identify different points of view/perspectives in information and/or data (e.g. distinguish fact from opinion, explore different stories on the same topic) (WAHASS33)
- Draw conclusions and give explanations, based on the information and/or data displayed in texts, tables, graphs and maps (e.g. show similarities and differences) (WAHASS35)
- Reflect on learning, identify new understandings and act on findings in different ways (e.g. complete a kwl chart, propose action in response to new knowledge) (WAHASS39)

English

- Understand that social interactions influence the way people engage with ideas and respond to others for example when exploring and clarifying the ideas of others, summarising their own views and reporting them to a larger group ([ACELA1488](#))
- Understand differences between the language of opinion and feeling and the language of factual reporting or recording ([ACELA1489](#))
- Identify features of online texts that enhance readability including [text](#), navigation, links, graphics and [layout](#) ([ACELA1793](#))
- Incorporate new vocabulary from a range of sources into students' own texts including vocabulary encountered in research ([ACELA1498](#))
- Use comprehension strategies to build literal and inferred meaning to expand content knowledge, integrating and linking ideas and analysing and evaluating texts ([ACELY1692](#))



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Appendix 4

References used in preparing this project

GENERAL INFORMATION

<http://learnline.cdu.edu.au/units/env207/index.html>

http://www.gtaq.com.au/Resources/Documents/Bushfires_final_txt_LR.pdf

<http://geoscience-au.maps.arcgis.com/apps/MapJournal/index.html?appid=1dacb52695204ae0802c8c7bc7a94d2f#>

<http://www.bom.gov.au/weather-services/fire-weather-centre/index.shtml>

<https://knowledge.aidr.org.au/disasters/>

<https://www.bbc.com/news/world-australia-50951043>

https://en.wikipedia.org/wiki/2019%E2%80%9320_Australian_bushfire_season

<https://blog.csiro.au/air-quality-how-were-minimising-smoke-impact/>

<https://www.bnhcrc.com.au/>

<https://www.abc.net.au/news/2020-02-19/australia-bushfires-how-heat-and-drought-created-a-tinderbox/11976134?nw=0>





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<https://www.bushfirefront.org.au/home/fire-facts/impacts-of-bushfires/>

BUSHFIRES AND SOIL

<https://www.abc.net.au/news/2019-01-22/bushfire-ravaged-soil-takes-up-to-80-years-to-recover/10736626>

<https://www.abc.net.au/radio/programs/worldtoday/scientists-warn-bushfires-could-turn-soil-toxic/11876598>

<https://www.abc.net.au/gardening/impact-of-fires-on-soil/11951568>

<https://www.soilscienceaustralia.org.au/about/2020-fire-and-soil/>

<https://www.environment.nsw.gov.au/~media/6676FDEC72B546F5B849301424B29835.ashx>

<https://ewater.org.au/bushfire/downloads/1000003.pdf>

<http://www.metts.com.au/bushfire-storms-soil.html>

<https://www.publish.csiro.au/book/7743/>

<https://www.publish.csiro.au/wf>

<http://www2.nau.edu/~gaud/bio300w/frsl.htm>





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BUSHFIRES AND WEEDS

<https://www.bgpa.wa.gov.au/about-us/information/research/ecosystem-ecology/fire-risk-management>

<https://theconversation.com/pulling-out-weeds-is-the-best-thing-you-can-do-to-help-nature-recover-from-the-fires-130296>

<https://dipwe.tas.gov.au/invasive-species/weeds/weed-publications-and-resources/weed-spread-after-fire>

<https://invasives.org.au/blog/bushfire-recovery-feral-weeds-threat/>

<https://www.bushcarebluemountains.org.au/watching-for-weeds-after-bush-fires/>

<http://hotspotsfireproject.org.au/downloads/s3cur3f0ld3r/the-interaction-between-fire-and-weeds-a-booklet-for-landholders-in-nsw.pdf>

<https://walga.asn.au/getattachment/dcb9db11-2421-49a7-a39b-9f2ebee39db8/12-PartB7-Fire-Management.pdf>

<https://invasives.org.au/blog/bushfire-recovery-feral-weeds-threat/>

https://www.naturalresources.sa.gov.au/kangarooisland/land-and-water/fire-management/Bushfires_and_weeds





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BUSHFIRES AND WATER QUALITY

<https://www.waterquality.gov.au/issues/bushfires>

<https://blog.csiro.au/the-relief-of-rain-after-bushfires/>

BUSHFIRES AND FLORA

<https://www.bgpa.wa.gov.au/about-us/information/research/seed-conservation/smoke-to-sow-and-grow>

<https://www.stateflora.sa.gov.au/the-australian-garden/why-choose-native-plants/bushfire-resistance>

<https://apsvic.org.au/fire-resistant-and-retardant-plants/>

<https://www.recreatingthecountry.com.au/blog/deciduous-trees-can-provide-crucial-bushfire-protection>

<https://sophiespatch.com.au/2020/01/03/bush-fire-garden-recovery/>

<https://www.sgaonline.org.au/we-will-rebuild-gardening-after-bushfires/>

<https://www.frontiersin.org/articles/10.3389/fpls.2019.00283/full>

<https://www.ffm.vic.gov.au/bushfire-fuel-and-risk-management/plants-and-animals>





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INDIGENOUS FIRE MANAGEMENT

<https://www.science.org.au/curious/earth-environment/bushfires-managing-landscapes>

<https://www.csiro.au/en/Education/Programs/Indigenous-STEM/Programs/Science-Pathways/Resources>

<https://australiancurriculum.edu.au/media/5653/ccp-tbi-f-6-ver5-online.pdf>

FIREFIGHTING CLOTHING & EQUIPMENT

<https://www.fire.nsw.gov.au/page.php?id=164>

<https://www.oakharbor.org/fire/page/what-does-firefighter-look>

https://en.wikipedia.org/wiki/Bunker_gear

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<https://blog.csiro.au/fire-truck-burnovers/>





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BUILDINGS & BUSHFIRES

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https://www.dfes.wa.gov.au/safetyinformation/fire/bushfire/BushfireManualsandGuides/DFES_Bushfire-Homeowners_Survival_Manual.pdf

Videos

https://youtu.be/KxG1sUxR_6c Drill of Victorian Country Fire Authority (CFA) firefighters demonstrating heat blankets and sprays on trucks

<https://youtu.be/4ONQSjkrWi8> Longer video showing testing in simulated bushfire

<https://youtu.be/74wm6I06BQA> American firefighter explaining required safety clothing

