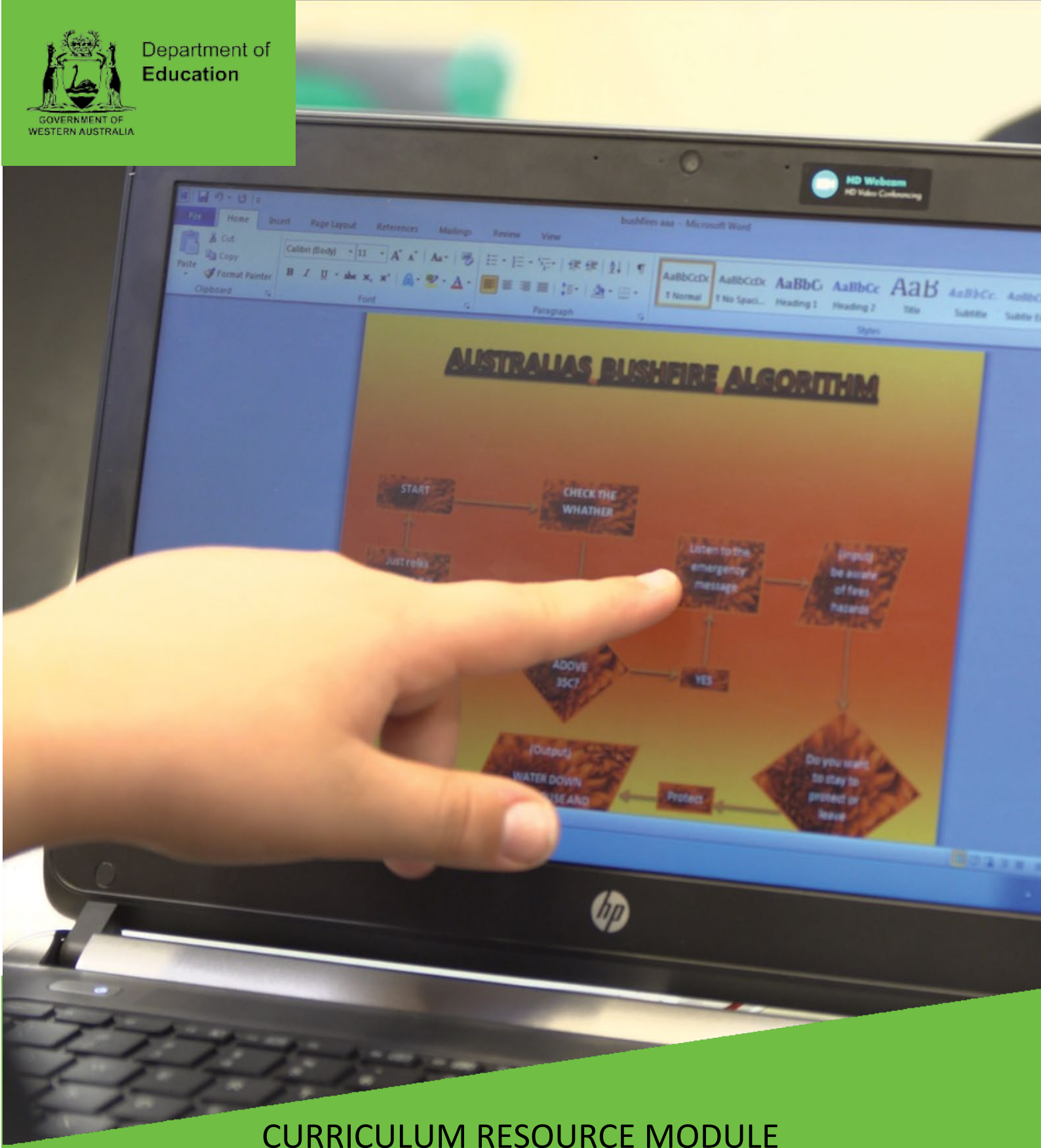
Department of Education

GOVERNMENT OF WESTERN AUSTRALIA



CURRICULUM RESOURCE MODULE

Bushfire risk warnings

YEAR 6

THE STEM LEARNING PROJECT

scitech

STAWA SCIENCE TEACHERS' ASSOCIATION OF WESTERN AUSTRALIA

Acknowledgements

The STEM Learning Project respectfully acknowledges the Traditional Custodians of the lands upon which our students and teachers live, learn and educate.

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The STEM Learning Project

The aim of the STEM Learning Project is to generate students' interest, enjoyment and engagement with STEM (Science, Technology, Engineering and Mathematics) and to encourage their ongoing participation in STEM both at school and in subsequent careers. The curriculum resources will support teachers to implement and extend the Western Australian Curriculum and develop the general capabilities across Kindergarten to Year 12.

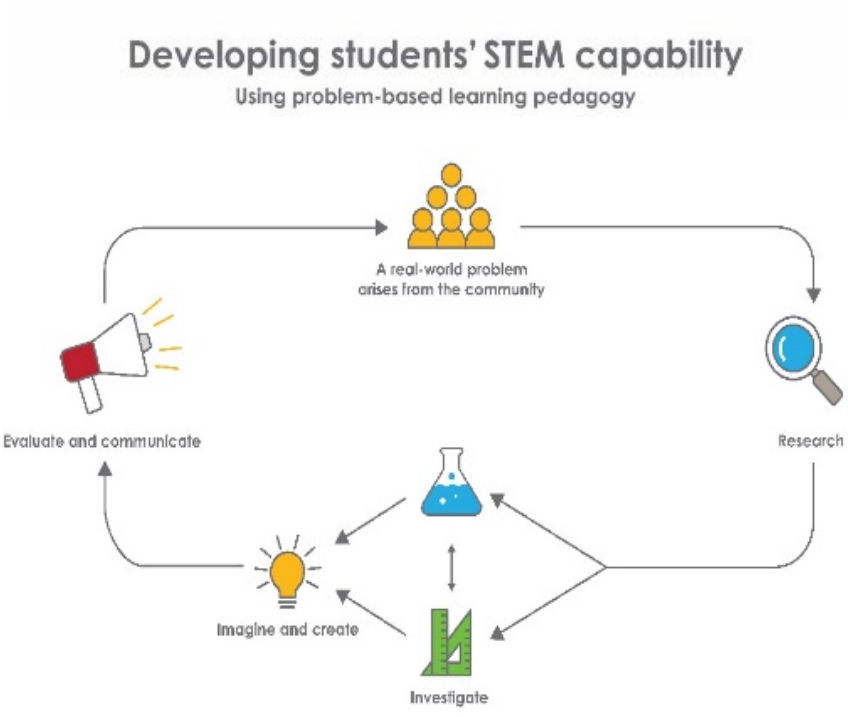
Why STEM?

A quality STEM education will develop the knowledge and intellectual skills to drive the innovation required to address global economic, social and environmental challenges.

STEM capability is the key to navigating the employment landscape changed by globalisation and digital disruption. Routine manual and cognitive jobs are in decline whilst non-routine cognitive jobs are growing strongly in Australia. Seventy-five per cent of the jobs in the emerging economy will require critical and creative thinking and problem solving, supported by skills of collaboration, teamwork and literacy in mathematics, science and technology. This is what we call STEM capability. The vision is to respond to the challenges of today and tomorrow by preparing students for a world that requires multidisciplinary STEM thinking and capability.

The approach

STEM capabilities are developed when students are challenged to solve open-ended, real-world problems that engage students in the processes of the STEM disciplines.



Year 6 – Bushfire risk warnings

Overview

Bushfires are one of the most frequently occurring natural disasters in Australia. They are responsible for damage to land, property and loss of life. Effective warning systems are extremely important for minimising the impact of bushfires.

This module connects students to this real-world problem, engaging their science understandings and inquiry skills, design process skills and mathematical computational thinking and reasoning to create an algorithm that provides information on the likelihood of a bushfire.

Timing this module so it is current with the bushfire season in the school's local area will increase its relevance and context and potentially provide engagement through relevant media coverage.

Students will collaborate, reflect, and give and receive feedback. They will also have the opportunity to present their algorithm to their peers and, where possible, a local expert.

What is the context?

Bushfires are a real and significant threat in Australia.

What is the problem?

How do you determine the risk of a bushfire occurring in order to issue an appropriate warning?

How does this module support integration of the STEM disciplines?

Science

Students will develop science understandings of the weather and other environmental factors that create the conditions under which bushfires occur (*ACSSU096: Sudden geological changes and extreme weather events can affect Earth's surface*) and develop their understanding of the impact of bushfires on living things (*ACSSU094: The growth and survival of living things are affected by physical conditions of their environment*), infrastructure and communities (ACSHE100: *Scientific knowledge is used to solve problems and inform personal and community decisions*) and share these understandings(*ACSIS012: Share observations and ideas*).

Technology

Digital Technologies are also used in representing and communicating the algorithm to an audience.

The *Design process guide* is included as a resource to provide assistance to teachers in understanding the complete design process as developed in the technologies curriculum.

Mathematics

Mathematical computational thinking (*ACMNA123: Select and apply efficient mental and written strategies and appropriate digital technologies to solve problems involving all four operations with whole numbers*) and Digital Technologies algorithmic logic (*ACTDIP019: Design, modify, follow and represent both diagrammatically, and in written text, simple algorithms (sequence of steps) involving branching (decisions) and iteration (repetition)*) are used in the development of an algorithm. Students plan the sequence of steps and decisions required to go from input values (environmental factors) to output values (warnings). Students analyse tabular displays of Bureau of Meteorology (BoM) data (*ACMSP147: Interpret and compare a range of data displays, including side-by-side column graphs for two categorical variables*), complete calculations, and engage in pre-algebraic thinking to run and test their algorithms against real-world data.

General capabilities

There are opportunities for the development of general capabilities and cross-curriculum priorities as students engage with *Bushfire risk warnings*. In this module, students:

- Develop problem solving skills as they research the problem and its context (*Activity1*); investigate parameters impacting on the problem (*Activity 2*); imagine and develop solutions (*Activity 3*); and evaluate and communicate their solutions to an audience (*Activity 4*).
- Utilise creative thinking as they generate possible design solutions; and critical thinking, numeracy skills and ethical understanding as they choose between alternative approaches to solving the problem.
- Utilise personal and social capability throughout the module as they develop socially cohesive and effective working teams; collaborate in generating solutions; adopt group roles; and reflect on their group work capabilities through self and peer evaluation.
- Utilise a range of literacies and information and communication technology (ICT) capabilities as they collate records of work completed throughout the module in a journal and represent and communicate their solutions to an audience using digital technologies in *Activity 4*.
- Communicate and, using evidence, justify their group's design to the class or a local expert.

What are the pedagogical principles of the STEM learning modules?

The STEM Learning Project modules develop STEM capabilities by challenging students to solve real-world problems set in authentic contexts. The problems engage students in the STEM disciplines and provide opportunities for developing higher order thinking and reasoning, and the general capabilities of creativity, critical thinking, communication and collaboration.

The design of the modules is based on four pedagogical principles:

- Problem-based learning

  This is an underlying part of all modules with every module based around solving an initial problem. It is supported through a four-phase instructional model: research the problem and its context; investigate the parameters impacting on the problem; design and develop solutions to the problem; and evaluate and communicate solutions to an authentic audience.

- Developing higher order thinking

  Opportunities are created for higher order thinking and reasoning through questioning and discourse that elicits students' thinking, prompts and scaffolds explanations and requires students to justify their claims. Opportunities for making reasoning visible through discourse are highlighted in the modules with the icon shown here.

- Collaborative learning

  This provides opportunities for students to develop teamwork and leadership skills, challenge each other's ideas, and co-construct explanations and solutions. Information that can support teachers with aspects of collaborative learning is included in the resource sheets.

- Reflective practice

  Recording observations, ideas and one's reflections on the learning experiences in some form of journal fosters deeper engagement and metacognitive awareness of what is being learned. Information that can support teachers with journaling is included in the resource sheets.

These pedagogical principles can be explored further in the STEM Learning Project online professional learning modules located in Connect Resources.

Activity sequence and purpose

Activity 1

RESEARCH

Fire danger

To capture students' interest and engage them with the problem, identify the causes of bushfires and discuss the significance of bushfires in their community.

Activity 2

INVESTIGATE

Design an algorithm

To investigate and design an algorithm to determine risk warnings for bushfires.

Activity 3

IMAGINE & CREATE

Test the algorithm

Test the algorithm using real world data and refine to improve its prediction accuracy.

Activity 4

EVALUATE & COMMUNICATE

Prepare and share presentation

Create a presentation outlining the algorithm. The presentation will be given to the class and, if possible, a local expert such as a member of the local fire brigade or forecaster from the BoM.

Review and reflect through peer assessment.

Background

Expected learning	Students will be able to: 1. Explain the factors that impact on bushfire risk and describe the impacts of bushfires. 2. Analyse BoM data and identify numerical values for risk variables indicating the degree of risk. 3. Design, test and explain an algorithm and its mathematical model for predicting the risk of bushfires. 4. Use digital devices to source information and construct a multimodal presentation.
Vocabulary	This module uses subject specific terminology which is shown in *Teacher resource sheet 1.5: Bushfire terminology*. The following vocabulary list contains other terms that need to be understood, either before the module commences, or developed as they are used. adaptations, curing, fuel load, habitat, humidity, ignition, lignotubers, prescribed burn, relative humidity, mean, severity, topography, variable, wind speed,
Timing	There is no prescribed duration for this module. The module is designed to be flexible enough for teachers to adapt. Activities do not equate to lessons; one activity may require more than one lesson to implement.
Safety notes	There are potential hazards inherent in these activities and with the equipment being used, and a plan to mitigate any risks will be required. Potential hazards specific to this module include but are not limited to: • Possible exposure to cyber bullying, privacy violations and uninvited solicitations when using the internet. • Teachers should consider the potential for emotional responses from students with recent fire experiences. Consider notifying parents before starting the module.
Assessment	The STEM modules have been developed to provide students with learning experiences to solve authentic real-world problems using science, technology, engineering and mathematics capabilities.

While working through the module, the following assessment opportunity will arise:

- Students will produce three pieces of work; an algorithm (one per group), a presentation (one per group) and a journal (one per student).

Appendix 1 indicates how the activities are linked to the Western Australian Curriculum

Evidence of learning from journaling, presentations and anecdotal notes from this module can contribute towards the larger body of evidence gathered throughout a teaching period and can be used to make on-balance judgements about the quality of learning demonstrated by the students in the Science, Technologies and Mathematics learning areas.

Students can further develop the general capabilities. Continuums for these are included in the *General capabilities continuums* but are not intended to be for assessment purposes.

Additional learning opportunities

Students could:

- employ a variety of resources to build a warning system in the form of an app or interactive game
- develop more advanced mathematical models for fire risk warnings
- create a weather station prototype (engineering) to measure the variables that inform their warning system
- devise bushfire mitigation strategies specific to their location
- devise a strategy for communicating bushfire warnings
- investigate fire oxygen levels and ignition temperatures as part of an additional science activity.

Inspiration resource: *stem-works.com/subjects/5-extreme-weather/activities*

Excursion and incursion

Department of Fire and Emergency Services (DFES) Education and Heritage Centre, Perth.

BoM (Bureau of Meteorology) staff participate in the Scientists in Schools program.

Activity 1: Fire danger

Activity focus 	To consider the causes and impacts of bushfires, engage students with material describing bushfire events and patterns in their region and search for information about bushfire warnings.
Background information	All fires need fuel, oxygen and a source of ignition. Fuel loads accumulate after high winter rainfall and when no recent natural or prescribed burns have taken place. Prescribed burns reduce the amount of available fuel such as branches, grass and leaf litter. Bushfires can be ignited naturally by lightning strikes or by human activity. The likelihood and severity of bushfires is strongly influenced by weather conditions and topography. The risk, severity and rate of spread of a fire increases with high temperatures, low humidity and high wind speeds. Steeply sloping ground can also increase the rate of spread of a fire. The impact of bushfires on vegetation depends on the heat of the fire. Mild burns can release nutrients from leaf litter, encouraging new plant growth. Hot burns can kill all plant life above ground. Many Australian trees have special adaptations to protect them from fire and enable them to regrow from seeds or lignotubers. Fire can destroy habitat and food sources for animals and leave soil prone to erosion. In severe fires, communities can lose livestock, pets, houses and other infrastructure. Fire is important in Aboriginal culture and fire management is one way in which Aboriginal people care for country. *Before Europeans arrived Aboriginal people were practising a form of fire management that in some respects was more successful than that which has been practised since* – Prime Minister Tony Abbott (2013). See links in *Digital resources* for further information. Bushfire danger rating systems are based on input variables which generate output variables. Key inputs include temperature, humidity and wind speed. Outputs refer to the level of warning generated by a system and include low, medium, high and extreme.

Instructional procedures	Student thinking from all activities should be recorded in a reflective journal. The journal can be either digital or physical. See *Student journal* for more support. **Content warning:** When planning for the delivery of this topic, it is important to consider the backgrounds and experiences of the students as content may cause distress for some students. It may be necessary to notify parents, alert students and provide alternative lesson content.
Expected learning	Students will be able to: 1. Explain how fuel load, temperature, humidity, ignition source and wind influence the risk of a bushfire (Science). 2. Describe the impacts of bushfires on vegetation, animals, infrastructure and communities (Science). 3. Use digital devices to source relevant information about bushfire risk (Technologies).
Equipment required	**For the class:** Interactive whiteboard or display screen to view bushfire videos. **For the students**: Digital device (optional), butcher paper.
Preparation	Preload webpage links to a common drive to ensure all students have access to the material.
Activity parts	**Part 1: Prior knowledge** To determine students' prior knowledge of bushfire events in Australia, students discuss the following questions through a think-pair-share activity, recording answers using a method of choice such as a brainstorm or concept map. 1. What is a bushfire? 2. When do bushfires occur? 3. What kinds of places are bushfires likely to occur? 4. What else do you know about bushfires? Students will add to this document as they work through the module. It can be an individual or shared document, depending on the needs of the students.

Part 2: Bushfire effects

View bushfire videos (see links in *Digital resources*).

Ask students if they have been affected or know someone who has been affected by a bushfire. Students may wish to share their experiences.

Content warning:

Consider the backgrounds and experiences of the students as content may cause distress for some students. It may be necessary to notify parents, alert students and provide alternative lesson content.

Part 3: Brainstorm

Students work in four groups to brainstorm about bushfires.

Write the following questions on four separate pieces of butcher paper and place them on tables around the room.

1. How do people know when they are in danger of a bushfire?
2. What factors cause a bushfire to be severe?
3. What is the impact of bushfires? On community? On flora and fauna?
4. What can a community do to minimise the impact of a bushfire?

Separate students into four groups and assign each group to a piece of butcher paper. Each group should allocate one student to scribe.

Encourage students to write down anything that comes to mind about the topic within a two-minute period. The scribe should number each idea as it is written down.

After two minutes, groups rotate clockwise, read what was written by the previous group and add additional ideas.

The process should continue until each group is back at their starting point.

Other cooperative learning techniques that may be suitable for this group exercise include the jigsaw and placemat set up. Further details on these techniques can be found in the *Teacher resource sheets 1.1 to 1.4: Cooperative learning*.

	Part 4: Class review As a class, discuss the group brainstorms, identifying the stand out ideas. Students work in pairs to add this information to their document from Part 1.
	Part 5: Research Working collaboratively, students use devices to further research points 1-4 from *Part 3: Brainstorm,* as well as: • factors (input variables) that influence the risk of fires, • bushfire warning terminology, which is used to inform people about the level of fire risk (output variables), • methods used to warn communities of fire risk. See links in *Digital resources.* Students add this information to their document from Part 1. If the pairs regroup into larger groups of eight, a jigsaw strategy could be used for this activity. See *Teacher resource sheet 1.2: Cooperative learning – Jigsaw*.
Resource sheets	*Teacher resource sheets 1.1 to 1.4: Cooperative learning* *Teacher resource sheet 1.5: Bushfire terminology*
Digital resources	Yarloop bushfire videos *www.youtube.com/watch?v=zIw07JuZRY0* *www.youtube.com/watch?v=X1-qTG_yfyA*
	Australia Firestorm on BBC My Country Documentary (four part series). The teacher may view this lengthy documentary before starting the module to identify the most relevant sections. *www.youtube.com/watch?v=UMmGE5RNrR4*
	Digital resources including fact sheets, videos and tools relevant to Western Australia *www.dfes.wa.gov.au/safetyinformation/warningsystems/Pages/default.aspx#4*
	Indigenous weather knowledge (BOM 2014) *www.bom.gov.au/iwk/climate_culture/Indig_seasons.shtml*
	Aboriginal fire management (Creative Spirits 2018) *www.creativespirits.info/aboriginalculture/land/aboriginal-fire-management*

	Free classroom resources for teachers including curriculum links, news reports, informational posters, interactives and statistics from Western Australia *www.dfes.wa.gov.au/schooleducation/schools/BushfirePatrol/DFES_BushfirePatrol-UpperPrimary.pdf*
	Padlet is an app which can be used to compile student learning in real time. *www.padlet.com*
Literary resources	*The Barrumbi Kids* by Leonie Norrington *Fire* by Jackie French

Activity 2: Design an algorithm

Activity focus

Students create an algorithm that provides the desired level of risk warning for a potential bushfire when weather input variables are entered.

Background information

An algorithm is a sequence of steps that is followed to solve a problem. People use algorithms every day to solve problems and complete tasks. For example, baking a cake or getting dressed.

A flowchart is a diagrammatic representation of an algorithm. A flowchart can take the form of a branching set of shapes with decision-making steps. The shapes used in a flowchart are shown in *Teacher resource sheet 2.1: Flowcharting symbols* and an example of a possible flowchart is shown in *Teacher resource sheet 2.2: Flowchart example*.

In its most developed form, an algorithm can be converted to computer code or generalised with a mathematical model.

The fire risk algorithm developed in this module may be extended to include a mathematical model allowing the risk associated with high temperature, low humidity and high wind speed to give a numerical rating of bushfire risk.

In this example, three measurements of input variables are converted to ratings:

Temperature (°C)	< 30 = 0	30 – 35 = 1	> 35 = 2
Humidity (%)	> 25 = 0	25 – 20 = 1	< 20 = 2
Wind speed (km/h)	< 40 = 0	40 – 60 = 1	> 60 = 2

Based on this model, when the ratings (0, 1 or 2) are summed, a score of six would equate to an extreme risk rating, while a score of zero would equate to a low fire risk.

Another mathematical model involves the summing of the raw measurements for temperature, relative humidity and wind speed (eg 30°, 55%, 25 km/h). However, there is an inverse relationship between humidity and fire risk (high humidity = low risk). A better model to account for this is *risk* = $t - h + w$.

	More detail on these types of mathematical models is included in *Teacher resource sheet 2.3: Mathematical modelling*. Information regarding the influence of humidity, wind and rainfall on fire danger can be found on the website of the Bureau of Meteorology. Negotiation, critical thinking and reasoning skills will be displayed by the students as they work on their designs. Problem solving in collaborative situations is a STEM capability that students need to exercise. Allowing students to negotiate amongst themselves will encourage them to develop this skill. Facilitated by the teacher, students follow the design process (see *Design process guide)* to refine and enhance their model. The steps of ideation, development and production are followed in this activity. Students are encouraged to build resilience and embrace the design cycle.
Instructional procedures	This task is designed to allow for differentiation, and algorithms may be simple or complex depending on a student's thinking. Teachers should provide the scaffolding for students to problem-solve but it is advisable not to show students the included examples of bushfire algorithms.
Expected learning	Students will be able to: 1. Identify the features and processes of decision-making algorithms (Technologies). 2. Identify variables that impact bushfire risk, and assign them numerical values (Science and Mathematics). 3. Design an algorithm that uses risk factors (input variables) to determine levels of warning (output variables) (Mathematics). 4. Compare and evaluate alternative algorithms (Technologies).
Equipment required	**For the class:** Whiteboard or interactive whiteboard.
	For the students: Coloured pencils, pens, A3 paper, calculators, devices.

Activity parts

Part 1: Outlining the task

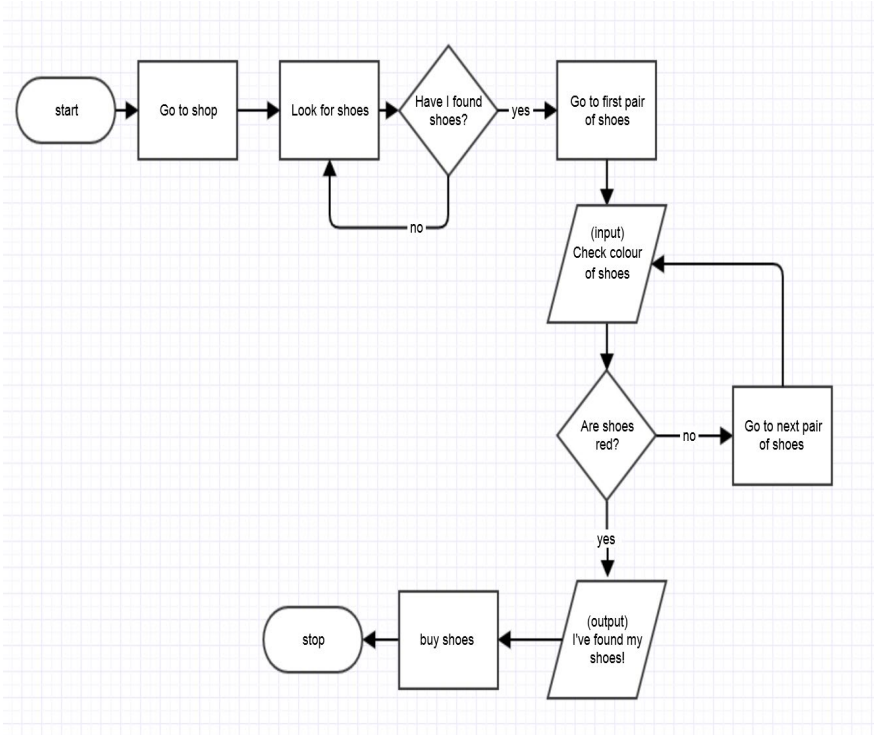
Explain to students that they will create an algorithm that predicts the risk of a bushfire. The purpose of the algorithm is to give a community warning so they can prepare for a fire and minimise its impact.

Part 2: Algorithms and flowcharts discussion

Discuss the meaning of an algorithm and flowchart. Relate this to the scenario in everyday life of buying a new pair of red shoes.

Using the example below, discuss how to alter an algorithm based on different scenarios. Discussion questions may include:

- How would you change the algorithm if you could only spend $80?
- Can you extend the algorithm to consider shoe size?



Part 3: Algorithms and flowcharts video

Watch the Khan Academy video, *What is an algorithm and why should you care?*

See *Digital resources* for the link.

Part 4: Flowchart symbols

Explain the meaning of the shapes and flowlines that construct the flowchart of an algorithm. The basic shapes are shown in *Teacher resource sheet 2.1: Flowcharting symbols*.

A full set of flowcharting symbols is available in Microsoft Word using the 'insert, shapes' function.

Part 5: Fire terminology

Review the terminology relating to weather, fire risk and fire danger ratings. In particular, focus on wind speed, temperature and humidity. Refer to *Teacher resource sheet 1.5: Bushfire terminology*.

It may be useful to note that some sources give wind speed in knots. A knot is one nautical mile per hour and is equivalent to about 1.85 km/h.

Part 6: Developing algorithms

Discuss with the class how an algorithm using weather conditions as inputs could give bushfire risk warnings as an output.

Students separate into small groups and begin to design an algorithm based on the discussion and previous learning. This algorithm could be in the form of a flowchart, a table, written instructions or a numerical model. Refer to:

Teacher resource sheet 2.1: Flowcharting symbols

Teacher resource sheet 2.2: Flowchart example

Providing students with enough time, and the opportunity to struggle, is important in the problem solving process. Scaffolding should be minimal at first to encourage student thinking. Encouragement rather than information is advised for this stage of problem solving.

Part 7: Feedback

When groups have progressed as far as they can, it may be helpful to facilitate a class discussion that supports their current thinking and leads them further.

Focus questions at this point could include:

- What form is your algorithm?

- What input variables are you using?
- Does your algorithm allow for the input of all of these variables?
- What outputs are you using?
- Does your algorithm lead to one of these outputs?
- If you are using a numerical model, how are you representing the variables?

Ask groups to share their thinking with the class and encourage other groups to provide verbal feedback.

Where appropriate, challenge students to consider how a numerical calculation could help combine the risks associated with temperature, humidity and wind speed to give an appropriate rating of fire risk. See *Teacher resource sheet 2.3: Mathematical modelling* for information that will help you support groups.

Allow time for groups to further develop their algorithms. Support here needs to vary depending on the complexity of the algorithm. Focusing on the purpose of an algorithm (a sequence of steps that is followed to solve a problem) will allow for many types of solutions.

Part 8: Journaling

Students reflect on their learning. *Student journal* notes may include:

- When they learnt something new
- What they learnt
- When they were challenged and how they overcame the challenge
- When they made changes to their approach or their design and why.

Resource sheets

Teacher resource sheet 2.1: Flowcharting symbols

Teacher resource sheet 2.2: Flowchart example

Teacher resource sheet 2.3: Mathematical modelling

Digital resources	Khan Academy, *What is an algorithm and why should you care?* *www.khanacademy.org/computing/computer-science/algorithms/intro-to-algorithms/v/what-are-algorithms*
	Algorithms: *Plugged & Unplugged* *docs.google.com/presentation/d/1K-6F3yYRf2lkwkU1C2-yLxveV9Zt8RtyrVBfEzB0qS8/edit#slide=id.g13ec2dcc77_1_67*
	Algorithm definition and pictorial example *www.tynker.com/blog/articles/ideas-and-tips/how-to-explain-algorithms-to-kids/*
	Legend of symbols used in an algorithm *1.bp.blogspot.com/_-n5ew-cmW7o/TU6u0Mt768I/AAAAAAAAAIE/9PB0Vy0BeJU/s1600/flowchart-symbols.gif*
	Bushfire weather *www.bom.gov.au/weather-services/bushfire/about-bushfire-weather.shtml*

Activity 3: Test the algorithm

Activity focus

Use real-world data to determine whether the algorithm developed in *Activity 2* gives an appropriate fire risk warning. Then refine and modify the algorithm to improve the accuracy of outputs.

Background information

An example showing input variables for different days is shown below.

	Yarloop fire	Summer day	Winter day
Mean maximum temperature (°C)	40+	30.6	16.8
Mean wind speed (km/h)	60	13.4	10.4
Mean relative humidity (%)	20	54	82

Instructional procedures

Real-world data can be found via the DFES or BoM websites. For ease of use, an extract from this data has been included in the *Teacher resource sheet 3.1: BoM data sets*. These are complex and may need simplifying or scaffolding.

It is also possible to obtain data from a school weather station (which could be set up) or via the BoM Twitter feed.

A digital option for flowcharting is Gliffy *www.gliffy.com*

Guide students to follow the steps of the design process (see *Design process guide*) to refine and enhance their model.

The steps of ideation, development and production are followed in this activity. Students are encouraged to build resilience and embrace the design cycle.

Negotiation, critical thinking and reasoning skills will be required by the students as they work on their designs. Problem solving in collaborative situations is a STEM capability that students need to exercise. Allowing students to negotiate amongst themselves will encourage them to develop this skill.

	Additional learning experience Analyse rainfall and evaporation (these are included in the provided data sets). Other factors such as lightning activity, curing (how dry the fuel is) and fuel load could also be investigated.
Expected learning	Students will be able to: 1. Analyse BoM data to identify values for risk factors on days when bushfires occurred and in seasons with no fires (Science). 2. Substitute risk factor values into their algorithm to test the outputs generated, and evaluate the effectiveness of their model (Mathematics). 3. Revise their algorithm based on feedback from testing (Technologies).
Equipment required	**For the class:** Students will need access to real world data. These may be accessed (in order of complexity) through the *Teacher resource sheet 2.3: Mathematical modelling*, *Teacher resource sheet 3.1: BoM Data sets*, or BoM observations.
	For the students: Paper, coloured pencils, textas, calculators. Access to a computer or device (optional).
Preparation	Arrange access to real-world data. This data could be accessed through devices or printed as handouts.
Activity parts	**Part 1: Fire history** Students identify the dates and locations of at least two bushfires in Australia. The Yarloop fires may be a good starting point for students.
	Part 2: Low risk days Students identify the dates and locations of two low fire risk days, for example, the middle of winter. Discuss with students their reasoning behind choosing these days.

Part 3: Weather data

Use the BoM link or data provided in the *Teacher resource sheet 3.1: BoM data sets* to find the weather readings for the low risk days and the days when fires occurred. Data for a summer's day without a bushfire may also be useful to use for testing the algorithms. Examples of suitable data are given in the *Background information*.

Part 4: Testing data

Students input the weather values from *Part 3* into their algorithms and calculate the outputs for the different weather conditions.

Part 5: Evaluating algorithms

Students should consider:

- Is your algorithm giving appropriate warnings?
- Do the warning levels provide increases as expected?
- What parts of your algorithm could you change to improve the validity of the outputs?

As part of the design process, students retest and refine their algorithm until appropriate warnings are provided.

Students test and evaluate each other's algorithms.

Part 6: Journaling

Students make notes in their journals about creating and redesigning their algorithm, recording:

- When they learnt something new
- What they learnt
- When they were challenged and how they overcame their challenge
- When they changed their design and why.

Digital resources

Free classroom resources from DFES for teachers
www.dfes.wa.gov.au/schooleducation/schools/BushfirePatrol/DFES_BushfirePatrol-UpperPrimary.pdf

Real-world data and information. BoM observations (all information for any given day is provided)
www.bom.gov.au/climate/data/index.shtml

Activity 4: Prepare and share presentation

Activity focus

Students will compile their journal notes to make a group multimedia presentation about the development of their algorithm. Students will then give an oral presentation to the class or a local expert. Finally, students will reflect on the effectiveness of their algorithm with peer feedback.

Instructional procedures

The presentations provide a rich opportunity for assessing the students' understanding of the science and technology principles and processes, as well as literacies associated with speaking and listening. Including a visitor with an interest in the topic to the audience will increase students' engagement and learning from the task.

Preparing the presentations

Students will need support and scaffolding to prepare for their presentation. To scaffold cooperative group work, each member of the group could have a role and responsibility. For example, one could be the Content Director, one the Media Director and a third the Presentation Director. All students contribute to all aspects of the presentation, with one student overall responsibility for managing that phase of the task. See *Teacher resource sheet 1.1: Cooperative learning – Roles* for more information.

Using Information and communication technology (ICT)

Digital options for presentations include creating a comic strip, *eBook*, poster in *Pages*, *Keynote* or *PowerPoint* or *iMovie* (or similar). Photographs taken throughout the design process should be used in digital presentations.

The presentation will be shared through a platform such as *Seesaw*, *Class Dojo* or *Connect,* added to a class blog or shared on an interactive whiteboard. Students may require explicit instruction in using these apps.

If digital technology is not accessible, students could share their work using a traditional poster, recount or book.

	Content warning: When planning for the delivery of this topic, it is important to consider the backgrounds and experiences of students as content may cause distress for some students. If necessary notify parents, alert students and provide alternative content.
Expected learning	Students will be able to: 1. Use digital technology to create a multimodal presentation, communicating information about bushfire risk and their algorithm (Technologies). 2. Explain how fuel load, temperature, humidity, wind and ignition source influence the risk of a bushfire (Science). 3. Explain their algorithm design, mathematical model and its reliability in predicting bushfire risk (Mathematics and Technologies).
Equipment required	**For the class:** Interactive whiteboard or whiteboard. Multimedia specific to students' presentation requirements.
	For the students: Digital devices loaded with appropriate apps for multimedia presentations. *Student activity sheet 4.1: Peer evaluation*
Preparation	Ensure the technology and media are available. Invite a local community expert, such as a firefighter, State Emergency Service volunteer or weather forecaster to view the final student presentations.
Activity parts	**Part 1: Introduction** Explain to students that they will create a multimedia presentation to describe their algorithm, justify its design and effectiveness and highlight options for further enhancements.
	Part 2: Choosing media and creating presentations In groups, students use a chosen form of digital media to communicate their design process and final solution. See *Digital resources* for suggestions.

	Part 3: Delivering presentations Students share their digital presentations with the class. The class should discuss how each algorithm differs. If possible, a local expert could give feedback on the algorithms and presentations, and discuss the importance of warning systems from an industry or community perspective.
	Part 4: Feedback Students should provide peer feedback on group work skills using the *Student activity sheet 4.1: Peer evaluation*. If possible, multiple students should test and review each algorithm design, leaving notes for the group. A 3-2-1 strategy would work well; students identify 3 things they discovered, 2 things they found interesting and 1 question they still have for the group. Feedback could be recorded on a printed copy of the algorithm or on a separate page and photocopied for each group member to paste into their learning journals.
	Part 5: Journaling Students reflect on feedback and their learning experience in their journals.
Resource sheets	*Student activity sheet 1.0: Journal checklist* *Student activity sheet 4.1: Peer evaluation* *Student activity sheet 4.2: Self-evaluation*
Digital resources	iMovie *www.apple.com/au/imovie/*
	eBook *www.ebooks.com/*
	Scratch *www.scratch.mit.edu* *splash.abc.net.au/home#!/digibook/2427023/introduction-to-scratch*

Appendix 1A: Links to the Western Australian Curriculum

The *Bushfire risk warnings* module provides opportunities for developing students' knowledge and understandings in science, technologies and mathematics. The table below shows how this module aligns to the content of the Western Australian Curriculum and can be used by teachers for planning and monitoring.

BUSHFIRE RISK WARNINGS Links to the Western Australian Curriculum	ACTIVITY			
	1	**2**	**3**	**4**
SCIENCE				
SCIENCE UNDERSTANDING				
Earth and space sciences: Sudden geological changes and extreme weather events can affect Earth's surface (ACSSU096)	●			●
Biological sciences: The growth and survival of living things are affected by physical conditions of their environment (ACSSU094)	●			
SCIENCE AS A HUMAN ENDEAVOUR				
Use and influence of science: Scientific knowledge is used to solve problems and inform personal and community decisions (ACSHE100)	●			●
Communicating: Share observations and ideas (ACSIS012)				●
DIGITAL TECHNOLOGIES				
PROCESS AND PRODUCTION SKILLS				
Digital implementation: Design, modify, follow and represent both diagrammatically, and in written text, simple algorithms (sequence of steps) involving branching (decisions) and iteration (repetition) (ACTDIP019)		●	●	
MATHEMATICS				
NUMBER AND ALGEBRA				
Number and place value: Select and apply efficient mental and written strategies and appropriate digital technologies to solve problems involving all four operations with whole numbers (ACMNA123)		●	●	●
STATISTICS AND PROBABILITY				
Data representation and interpretation: Interpret and compare a range of data displays, including side-by-side column graphs for two categorical variables (ACMSP147)			●	●

Further information about assessment and reporting in the Western Australian Curriculum can be found at: *https://k10outline.scsa.wa.edu.au/home*

Appendix 1B: Mathematics proficiency strands

Key ideas

In Mathematics, the key ideas are the proficiency strands of understanding, fluency, problem-solving and reasoning. The proficiency strands describe the actions in which students can engage when learning and using the content. While not all proficiency strands apply to every content description, they indicate the breadth of mathematical actions that teachers can emphasise.

Understanding

Students build a robust knowledge of adaptable and transferable mathematical concepts. They make connections between related concepts and progressively apply the familiar to develop new ideas. They develop an understanding of the relationship between the 'why' and the 'how' of mathematics. Students build understanding when they connect related ideas, when they represent concepts in different ways, when they identify commonalities and differences between aspects of content, when they describe their thinking mathematically and when they interpret mathematical information.

Fluency

Students develop skills in choosing appropriate procedures; carrying out procedures flexibly, accurately, efficiently and appropriately; and recalling factual knowledge and concepts readily. Students are fluent when they calculate answers efficiently, when they recognise robust ways of answering questions, when they choose appropriate methods and approximations, when they recall definitions and regularly use facts, and when they can manipulate expressions and equations to find solutions.

Problem-solving

Students develop the ability to make choices, interpret, formulate, model and investigate problem situations, and communicate solutions effectively. Students formulate and solve problems when they use mathematics to represent unfamiliar or meaningful situations, when they design investigations and plan their approaches, when they apply their existing strategies to seek solutions, and when they verify that their answers are reasonable.

Reasoning

Students develop an increasingly sophisticated capacity for logical thought and actions, such as analysing, proving, evaluating, explaining, inferring, justifying and generalising. Students are reasoning mathematically when they explain their thinking, when they deduce and justify strategies used and conclusions reached, when they adapt the known to the unknown, when they transfer learning from one context to another, when they prove that something is true or false, and when they compare and contrast related ideas and explain their choices.

Source: www.australiancurriculum.edu.au/f-10-curriculum/mathematics/key-ideas/?searchTerm=key+ideas#dimension-content

Appendix 2: General capabilities continuums

The general capabilities continuums shown here are designed to enable teachers to understand the progression students should make with reference to each of the elements. There is no intention for these to be used for assessment.

Information and communication technology (ICT) capability learning continuum

Sub-element	Typically by the end of Year 4	Typically by the end of Year 6	Typically by the end of Year 8
Create with ICT **Generate ideas, plans and processes**	use ICT to generate ideas and plan solutions	use ICT effectively to record ideas, represent thinking and plan solutions	use appropriate ICT to collaboratively generate ideas and develop plans
Create with ICT **Generate solutions to challenges and learning area tasks**	create and modify simple digital solutions, creative outputs or data representation/ transformation for particular purposes	independently or collaboratively create and modify digital solutions, creative outputs or data representation/ transformation for particular audiences and purposes	design and modify simple digital solutions, or multimodal creative outputs or data transformation for particular audiences and purposes following recognised conventions
Communicating with ICT **Collaborate, share and exchange**	use appropriate ICT tools safely to share and exchange information with appropriate known audiences	select and use appropriate ICT tools safely to share and exchange information and to safely collaborate with others	select and use appropriate ICT tools safely to lead groups in sharing and exchanging information, and taking part in online projects or active collaborations with appropriate global audiences

Critical and creative thinking learning continuum

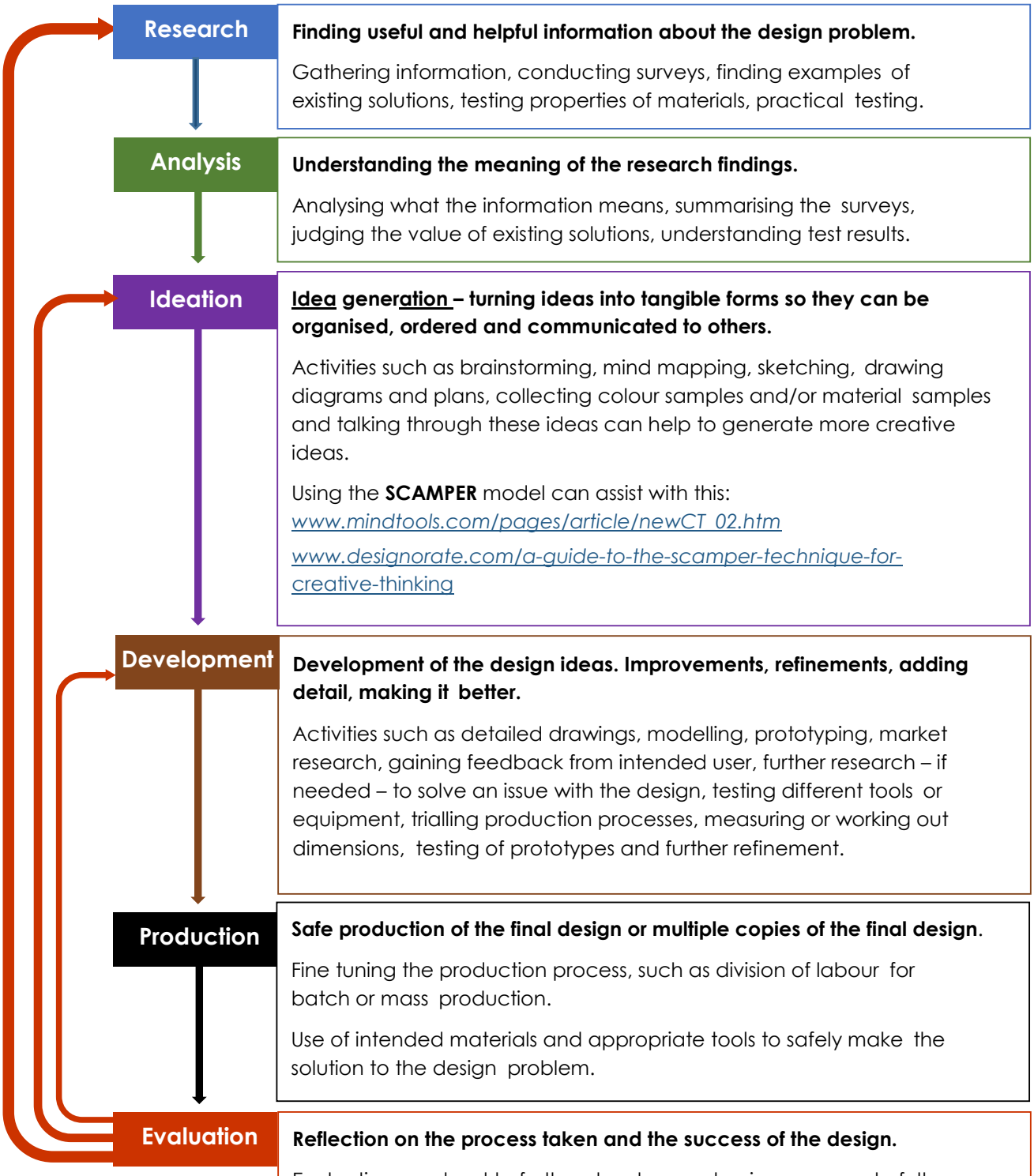
Sub-element	Typically by the end of Year 4	Typically by the end of Year 6	Typically by the end of Year 8
Inquiring – identifying, exploring and organising information and ideas **Organise and process information**	collect, compare and categorise facts and opinions found in a widening range of sources	analyse, condense and combine relevant information from multiple sources	critically analyse information and evidence according to criteria such as validity and relevance
Generating ideas, possibilities and actions **Imagine possibilities and connect ideas**	expand on known ideas to create new and imaginative combinations	combine ideas in a variety of ways and from a range of sources to create new possibilities	draw parallels between known and new ideas to create new ways of achieving goals
Generating ideas, possibilities and actions **Seek solutions and put ideas into action**	experiment with a range of options when seeking solutions and putting ideas into action	assess and test options to identify the most effective solution and to put ideas into action	predict possibilities, and identify and test consequences when seeking solutions and putting ideas into action
Reflecting on thinking and processes **Transfer knowledge into new contexts**	transfer and apply information in one setting to enrich another	apply knowledge gained from one context to another unrelated context and identify new meaning	justify reasons for decisions when transferring information to similar and different contexts

Personal and social capability learning continuum

Sub-element	Typically by the end of Year 4	Typically by the end of Year 6	Typically by the end of Year 8
Social management **Work collaboratively**	describe characteristics of cooperative behaviour and identify evidence of these in group activities	contribute to groups and teams, suggesting improvements in methods used for group investigations and projects	assess the extent to which individual roles and responsibilities enhance group cohesion and the achievement of personal and group objectives
Social management **Negotiate and resolve conflict**	identify a range of conflict resolution strategies to negotiate positive outcomes to problems	identify causes and effects of conflict, and practise different strategies to diffuse or resolve conflict situations	assess the appropriateness of various conflict resolution strategies in a range of social and work-related situations
Social management **Develop leadership skills**	discuss the concept of leadership and identify situations where it is appropriate to adopt this role	initiate or help to organise group activities that address a common need	plan school and community projects, apply effective problem-solving and team-building strategies, and make the most of available resources to achieve goals

Access to this information is via the link here:
k10outline.scsa.wa.edu.au/home/p-10-curriculum/general-capabilities-over/general-capabilities-overview/general-capabilities-in-the-australian-curriculum

Appendix 3: Design process guide



Appendix 4: Student journal

When students reflect on learning and analyse their ideas and feelings, they self-evaluate, thereby improving their metacognitive skills.

These modules encourage students to self-reflect and record the stages of their learning in a journal. This journal may take the form of a written journal, a portfolio or a digital portfolio.

Using digital portfolios can help develop students' Information and Communication Technology (ICT) capability.

Reflective practice and recording can be supported in classrooms by creating opportunities for students to think about and record their learning through notes, drawings or pictures. Teachers should encourage students to revisit earlier journal entries to help them observe the progress of their thoughts and understanding.

Journals are a useful tool that gives teachers additional insight into how students value their own learning and progress, as well as demonstrating their individual achievements.

The following links provide background information and useful apps for journaling.

Reflective journal (University of Technology Sydney) *www.uts.edu.au/sites/default/files/reflective_journal.pdf*
Reflective writing (University of New South Wales Sydney)) *student.unsw.edu.au/reflective-writing*
Balancing the two faces of ePortfolios (Helen Barrett, 2009) *electronicportfolios.org/balance/Balancing.jpg*
Digital portfolios for students (Cool tools for school) *cooltoolsforschool.wordpress.com/digital-student-portfolios*
Kidblog – digital portfolios and blogging kidblog.org/home
Evernote (a digital portfolio app) *evernote.com*
Weebly for education (a drag and drop website builder) *education.weebly.com*
Connect – the Department of Education's integrated, online environment *connect.det.wa.edu.au*

Appendix 5: Student activity sheet 1.0: Journal checklist

As an ongoing part of this module, you have been keeping a journal of your work.

Before submitting your journal to your teacher please ensure you have included the following information.

- Tick each box once complete and included.
- Write N/A for items that were not required in this module.

Your name and group member's names or photographs.	
An explanation of the problem you are solving.	
Your notes from *Activity 1*	
Your notes from *Activity 2*	
Your notes from *Activity 3*	
Your notes from *Activity 4*	
Student activity sheet 4.1: Peer-evaluation	
Student activity sheet 4.2: Self-evaluation	

Student activity sheet 1.0: Journal checklist	

Appendix 6: Teacher resource sheet 1.1: Cooperative learning – Roles

Cooperative learning frameworks create opportunities for groups of students to work together, generally to a single purpose.

As well as having the potential to increase learning for all students involved, using these frameworks can help students develop personal and social capability.

When students are working in groups, positive interdependence can be fostered by assigning roles to group members.

These roles could include:

- working roles such as Reader, Writer, Summariser, Time-keeper.
- social roles such as Encourager, Observer, Noise monitor, Energiser.

Teachers using the *Primary Connections* roles of Director, Manager and Speaker for their science teaching may find it effective to also use these roles for STEM learning.

Further to this, specific roles can be delineated for specific activities that the group is completing.

It can help students if some background to the purpose of group roles is made clear to them before they start, but at no time should the roles get in the way of the learning. Teachers should decide when or where roles are appropriate to given tasks.

Appendix 7: Teacher resource sheet 1.2: Cooperative learning – Jigsaw

This resource sheet provides a brief outline of a collaborative learning strategy known as 'jigsaw'.

Cooperative learning frameworks create opportunities for groups of students to work together, generally for a single purpose.

As well as having the potential to increase learning for all students involved, using these frameworks can help students develop personal and social capability.

The jigsaw strategy typically has each member of the group becoming an 'expert' on one or two aspects of a topic or question being investigated. Students start in their cooperative groups, then break away to form 'expert' groups to investigate and learn about a specific aspect of a topic. After developing a sound level of understanding, the students return to their cooperative groups and teach each other what they have learnt.

Within each expert group, issues such as how to teach the information to their group members are considered.

<table>
<tr><td>Step 1</td><td>Cooperative groups
(of four students)</td><td colspan="2">1 2 3 4</td><td colspan="2">1 2 3 4</td></tr>
<tr><td>Step 2</td><td>Expert groups
(size equal to the number of groups)</td><td>1 1</td><td>2 2</td><td>3 3</td><td>4 4</td></tr>
<tr><td>Step 3</td><td>Cooperative groups
(of four students)</td><td colspan="2">1 2 3 4</td><td colspan="2">1 2 3 4</td></tr>
</table>

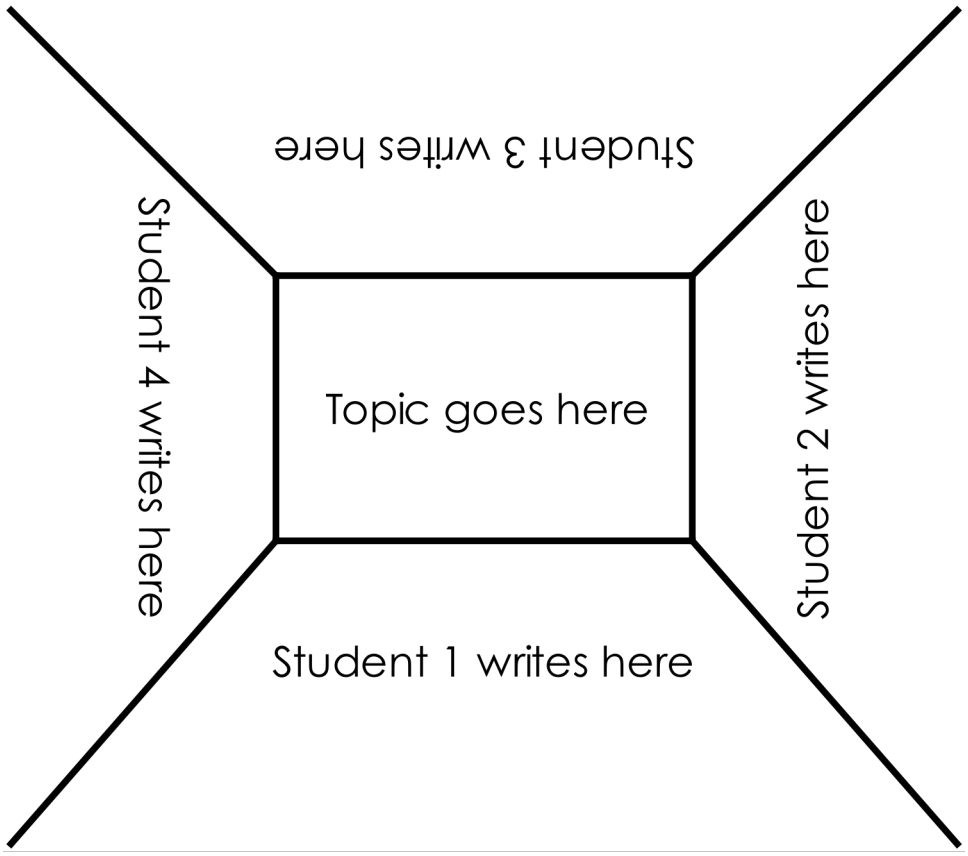
Appendix 8: Teacher resource sheet 1.3: Cooperative learning – Placemat

This resource sheet provides a brief outline of a cooperative learning strategy known as 'placemat'.

Cooperative learning frameworks create opportunities for groups of students to work together, generally for a single purpose.

As well as having the potential to increase learning for all students involved, using these frameworks can help students develop personal and social capability.

The placemat strategy involves students working collaboratively to record prior knowledge about a common topic and brainstorm ideas. It also allows teachers to readily see the contribution of each student. The diagram below shows a typical placemat template.



Appendix 9: Teacher resource sheet 1.4: Cooperative learning – Think, Pair, Share

This resource sheet provides a brief outline of a cooperative learning strategy known as 'think – pair – share'.

Cooperative learning frameworks create opportunities for groups of students to work together, generally to a single purpose.

As well as having the potential to increase learning for all students involved, using these frameworks can help students develop personal and social capability.

In the 'think' stage, each student thinks silently about a question asked by the teacher.

In the 'pair' stage, students discuss their thoughts and answers to the question in pairs.

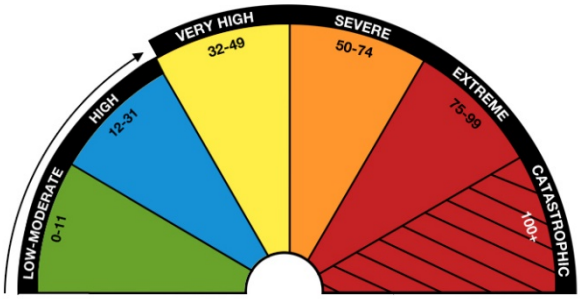
In the 'share' stage, the students share their answer, their partners answer or what they decided together. This sharing may be with other pairs or with the whole class. It is important also to let students 'pass'. This is a key element of making the strategy safe for students.

Think – pair – share increases student participation and provides an environment for higher levels of thinking and questioning.

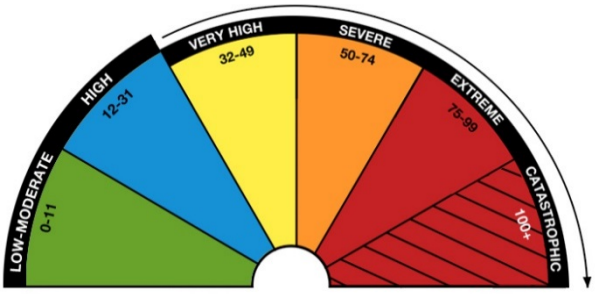
Appendix 10: Teacher resource sheet 1.5: Bushfire terminology

Acknowledgement: Department of Fire and Emergency Services
www.dfes.wa.gov.au

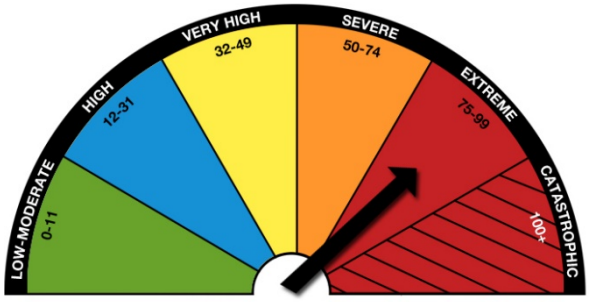
Fire Danger Rating	
Red + lines	**= catastrophic** bushfire risk
Red	**= extreme** bushfire risk
Orange	**= severe** bushfire risk
Yellow	**= very high** bushfire risk
Blue	**= high** bushfire risk
Green	**= low** bushfire risk



A **Low-Moderate** and **High** Bushfire Danger Rating may possibly indicate an unsafe fire time.



Increasing hot temperatures, dryness and wind bring a much greater bushfire risk. Campfires are banned when the Fire Danger Rating is **Very High** and above.



This day has an **extreme fire danger rating** and has an extreme bushfire risk.

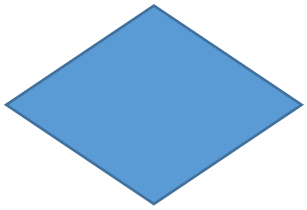
Acknowledgement: Department of Fire and Emergency Services
www.dfes.wa.gov.au

Alert Level	Bushfire Warning - EMERGENCY WARNING
EMERGENCY WARNING for western Prepareville	**Bushfire risk:** You are danger. There is a threat to lives and homes.
	What to do: • You need to take immediate action. • Close all doors and windows, and turn off evaporative air conditioners; but keep water running through the system if possible, so the pads remain wet and don't catch on fire. • If the way is clear, leave now for a safer place. • If you cannot leave, you need to get ready to shelter in your home and actively defend it. • If you are not at home, it is too dangerous now to return.
Alert Level	**Bushfire Warning - WATCH AND ACT**
WATCH AND ACT for southern Prepareville	**Bushfire risk:** A bushfire is nearby and heading in your direction.
	What to do: • Put your bushfire survival plan into action. Do not wait for further warnings before you act. • There is ember attack ahead of the fire, so close all doors and windows, and turn off evaporative air conditioners but keep water running through the system if possible. • Leave now with your family for a safer place and take your emergency kit with you.
Alert Level	**Bushfire Warning - ADVICE**
ADVICE for Makeaplan	**Bushfire risk:** A bushfire has started. There is no immediate danger.
	What to do: • Stay alert and monitor your surroundings. • Watch for signs of a bushfire, especially smoke and flames. • Read through your bushfire survival plan.

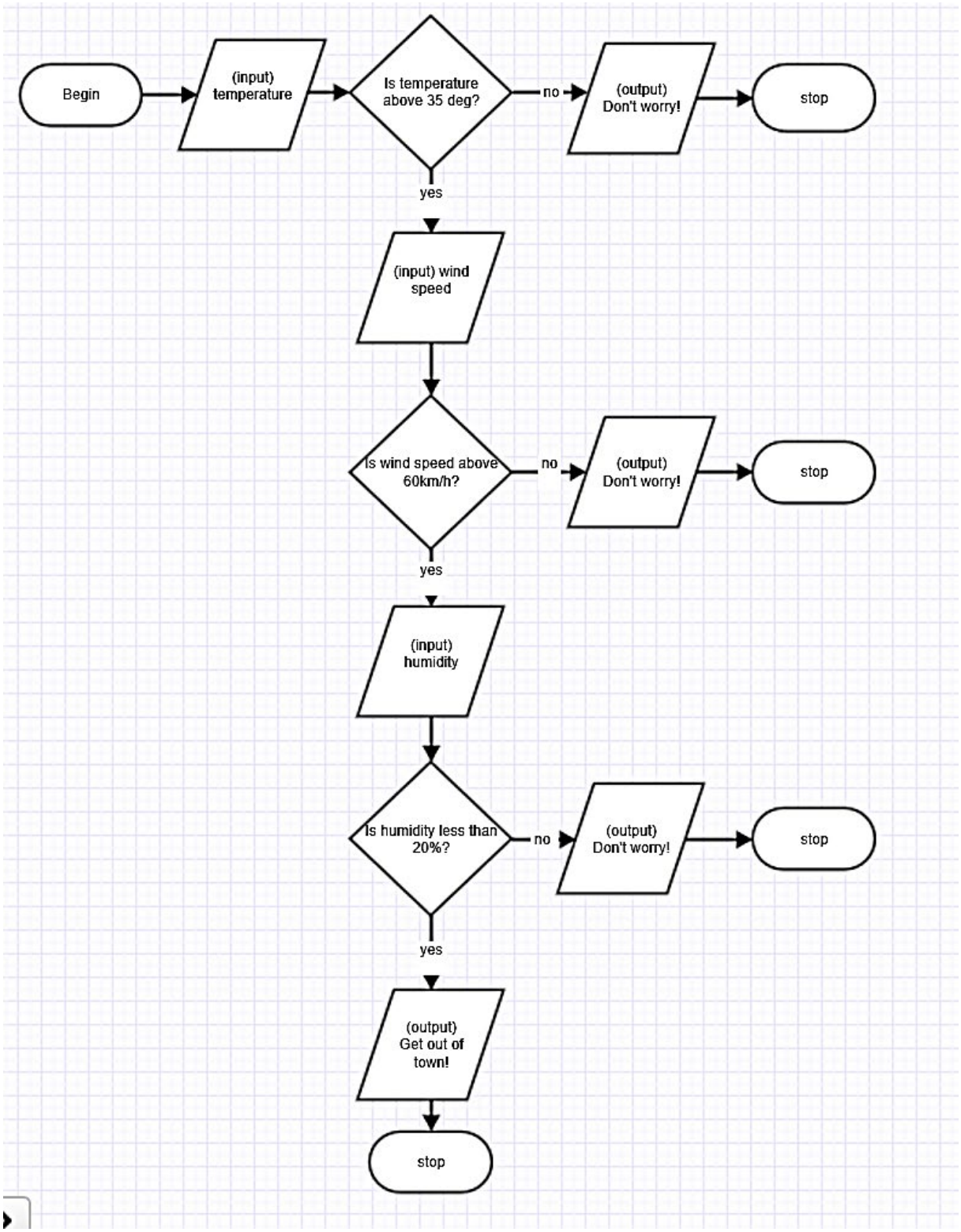
Acknowledgement: Department of Fire and Emergency Services
www.dfes.wa.gov.au

Appendix 11: Teacher resource sheet 2.1: Flowcharting symbols

A flowchart is a diagrammatic representation of an algorithm. It can take the form of a branching set of shapes with decision-making steps. The shapes used in a flowchart are shown here with explanations of their purpose.

	**Terminator** This symbol is used to represent the start and end of a flowchart.
	**Process** This symbol is used to represent one or more instructions or things to do.
	**Data** This symbol is used to represent the input or output of any information.
	**Decision** This symbol is used to represent a point in the flowchart where a decision is made and from which two or more paths could be followed.
	**Flowline** This symbol is used to show the direction of the process or data flow.

Appendix 12: Teacher resource sheet 2.2: Flowchart example



Appendix 13: Teacher resource sheet 2.3: Mathematical modelling

This resource sheet provides a number of possible fire prediction models. In all examples *t* = temperature in °C, *h* = % humidity, *w* = wind speed in km/h). The following values have been used to test the individual models.

	Yarloop fire	Summer day	Winter day
Mean maximum temperature (°C)	40+	30.6	16.8
Mean relative humidity (%)	20	54	82
Mean wind speed (km/h)	60	13.4	10.4

Possible models	**Example/testing using data above**	**Comments**
Model 1 Risk = t + w + h	Yarloop fire: *Risk* = 40 + 60 + 20 = 120 Summer day: *Risk* = 30.6 + 13.4 + 54 = 98.0 Winter day: *Risk* = 16.8 + 10.4 + 82 = 109.2	• This is the simplest model. However, it is usually an error to add quantities that have different units. • Students may or may not be aware of the need for added quantities to have the same units and examples using everyday items may help them to see that these totals do not have meaning eg. 5 oranges + 1 metre ruler = 6 ? • Therefore, students should not be adding temperature, humidity and wind speed as the total does not have any real meaning. • This model assumes all variables influence the risk in the same way (ie they all increase the risk). In reality, there is an inverse relationship between humidity and fire risk (as humidity increases the fire risk decreases). The higher risk ratings calculated in the testing, for a winter day compared with a summer day, emphasises the fault in this model. • For this model to be appropriate 1 degree Celsius would have to have the equivalent effect on fire risk as 1% of humidity and 1 kmh-1 of wind speed.

Possible models	Example/testing using data above	Comments
Model 2 Risk = t + w - h	Yarloop fire: Risk = 40 + 60 – 20 = 80 Summer day: Risk = 30.6 + 13.4 – 54 = -10.0 Winter day: *Risk* = 16.8 – 82 + 10.0 = – 54.8	• This is another simple model. However, it is usually an error to add or subtract quantities that have different units. • Students may or may not be aware of the need for added and subtracted quantities to have the same units and examples using everyday items may help them to see that these totals do not have meaning eg. 5 oranges + 1 metre ruler – 4 pillows = 2 ? • Therefore, students should not be adding and/or subtracting temperature, humidity and wind speed as the total does not have any real meaning. • This model is an improvement on Model 1 as it takes into consideration the inverse relationship between humidity and fire risk. The risk ratings calculated in the testing appears to rank the three days correctly.
Model 3 Risk = t x w x h	Yarloop fire: *Risk* = 40 x 60 x 20 = 48 000 Summer day: *Risk* = 30.6 x 13.4 x 54 = 22,142.16 Winter day: *Risk* = 16.8 x 10.4 x 82 = 14,327.04	• This is another simple model and it is possible to multiply and divide values with different units. • The units for the total are non-standard as a combination of degrees Celsius, kilometres per hour and percentage of water vapour. • This model assumes all variables influence the risk in the same way (ie they all increase the risk). In reality, there is an inverse relationship between humidity and fire risk (ie as humidity increases the fire risk decreases). The higher risk ratings calculated in the testing, for a winter day compared with a summer day, emphasises the fault in this model. • For this model to be appropriate 1 degree Celsius would have to have the equivalent effect on fire risk as 1 kmh-1 of wind speed etc.

Possible models	Example/testing using data above	Comments
Model 4 Risk = t x w ÷ h	Yarloop fire: *Risk* = 40 x 60 ÷ 20 = 120 Summer day: *Risk* = 30.6 x 13.4 ÷ 54 = 7.59 Winter day: *Risk* = 16.8 x 10.4 ÷ 82 = 2.13	• It is possible to multiply and divide values with different units. • The units for the total are non-standard as a combination of degrees Celsius, kilometres per hour and percentage of water vapour. • This model is an improvement on Model 3 as it takes into consideration the inverse relationship between humidity and fire risk. The risk ratings calculated in the testing appears to rank the three days correctly.
Model 5 *Risk = 2t – h + 1.5w*	Yarloop fire: Risk = (2 × 40) – 20 + (1.5 × 60) = 150 Summer day: Risk = (2 × 30.6) – 54 + (1.5 × 13.4) = 27.3 Winter day: Risk = (2 ×16.8) – 82 + (1.5 ×10) = – 32.8	• Another consideration in building a numerical model is that the scales differ. • The scales are: o °C, which could have values from about 15 to 45 o %, which could be from 0 to 100 o km/h, which could have values from 0 to about 60 • As the scales differ and each variable has a different importance in affecting fire risk, a weighted model may be better. • For example the variables could be weighted 2, -1 and 1.5 according to estimated importance

<table>
<tr><th>Possible models</th><th>Example/testing using data above</th><th>Comments</th></tr>
<tr><td>Model 6

Ordinal Scale

Risk = 2t + h + 1.5w</td><td>Using the table values would result in:

Yarloop fire:
Risk = (2 × 4) + 4 + (1.5 × 4) = 18

Summer day:
Risk = (2 × 3) + 2 + (1.5 × 1) = 9.5

Winter day:
Risk = (2 × 1) + 1 + (1.5 x 1) = 3.5</td><td>• An ordinal scale could be used to emphasise the relative effect of extremes and can take into consideration the relative importance of, for example, extreme temperatures compared to high or moderate temperatures. For example,
<table>
<tr><th>Ordinal scale of fire risk</th><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td>Mean maximum temperature (°C)</td><td>< 30</td><td>30 – 35</td><td>36 - 38</td><td>> 38</td></tr>
<tr><td>Mean relative humidity (%)</td><td>> 80</td><td>80 – 50</td><td>49 - 40</td><td>< 40</td></tr>
<tr><td>Mean wind speed (km/h)</td><td>< 20</td><td>20 - 40</td><td>41 – 60</td><td>> 60</td></tr>
</table>
• An ordinal scale also removes the requirement for a combined unit of measurement. The unit of measurement could be ‘fire risk’.
• Possible overall risk rating scores for warning levels can then be applied.
<table>
<tr><td>Warning levels</td><td>Overall risk rating</td></tr>
<tr><td>Extreme</td><td>>10</td></tr>
<tr><td>High</td><td>8 - 10</td></tr>
<tr><td>Moderate</td><td>5 - 7</td></tr>
<tr><td>Low</td><td><5</td></tr>
</table></td></tr>
</table>

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Appendix 14: Teacher resource sheet 3.1: BoM data sets

The complexity of climate data is illustrated in these tables. However, it may be necessary to reduce data to a more simplified and concise format for students.

2016 Murray Road Bushfire (Western Australia)

Dates: 6 – 23 January 2016 Fatalities: 2 Houses burnt: 181 Area burnt: 69,915 ha

Climate data from BoM for Dwellingup (nearest weather station) for surrounding dates:

January

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9 am						3 pm					
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours	km/h		local	°C	%	8th	km/h		hPa	°C	%	8th	km/h		hPa
1	Fr	13.8	31.4	0						19.9	49		ESE	28	1017.2	30.0	24				1012.9
2	Sa	16.9	35.3	0			ESE	46	00:07	23.8	46		E	20	1012.7	34.6	24		ESE	13	1009.2
3	Su	17.7	35.1	0			ESE	48	06:12	24.5	52		ESE	26	1013.4	34.1	27		ESE	13	1010.9
4	Mo	19.0	34.3	0			ESE	39	00:05	22.9	56		ESE	17	1011.8	33.2	29		WNW	19	1009.6
5	Tu	17.1	32.6	0			NW	37	17:55	25.1	50		ESE	9	1011.9	30.8	39		W	15	1009.8
6	We	18.8	38.1	0			ESE	56	21:46	25.3	50		E	20	1015.2	35.0	18		NE	13	1012.6
7	Th	20.5	40.1	0			ESE	54	00:20	28.5	33		E	24	1017.0	38.5	13		NNE	13	1012.8

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9 am						3 pm					
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours	km/h		local	°C	%	8th	km/h		hPa	°C	%	8th	km/h		hPa
8	Fr	20.5	30.8	0						27.1	33		ESE	13	1013.9	26.3	56		ENE	28	1012.4
9	Sa	15.7	34.7	5.0			NW	43	16:42	26.9	41		ENE	6	1013.2	34.4	27		NW	17	1009.3
10	Su	17.6	25.9	0			WNW	35	13:08	20.5	69		W	13	1012.7	24.4	49		WNW	17	1011.7
11	Mo	15.1	26.6	0			NW	37	14:51	22.7	58		NNW	7	1012.1	25.1	50		NW	19	1011.0
12	Tu	17.0	24.1	1.4			SSE	44	22:18	19.6	80		WSW	13	1013.6	22.7	52		WSW	17	1014.1
13	We	11.6	28.5	0			ESE	59	08:49	17.7	48		ESE	28	1023.6	26.8	21		ESE	17	1021.2
14	Th	13.0	31.5	0			ESE	54	00:01	20.0	43		E	28	1024.8	30.6	17		E	22	1020.2
15	Fr	15.0	34.6	0			SW	39	18:12	25.3	32		E	17	1020.3	33.5	11		ENE	6	1016.2
16	Sa	18.6	36.4	0			WNW	46	14:27	29.3	29		NE	17	1014.6	34.0	21		WNW	22	1011.4
17	Su	16.9	32.0	0			SSE	52	19:26	26.1	46		NW	6	1010.7	30.5	30		WSW	15	1007.0
18	Mo	17.1	23.0	0			N	39	10:02	19.9	73		N	17	1004.7	21.0	60		NW	17	1003.2
19	Tu	14.2	24.7	0.6			NE	33	18:08	18.1	63		NNW	9	1005.2	17.7	73		WNW	4	1004.7
20	We	13.0	24.0	17.0			S	37	21:45	17.9	83		SSE	9	1008.0	22.3	57		SSE	11	1006.9
21	Th	13.9	23.3	0.2			SSE	35	09:05	18.0	78		SSE	17	1014.4	21.5	57		SE	13	1014.2
22	Fr	11.5	28.9	0			E	35	07:50	17.7	63		ESE	19	1018.6	27.3	28		E	9	1015.3
23	Sa	16.1	33.8	0						23.0	53		ESE	15	1016.3	27.0	40		N	30	1013.6

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9 am						3 pm					
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours	km/h		local	°C	%	8th	km/h		hPa	°C	%	8th	km/h		hPa
24	Su	17.4	34.6	2.0			SE	46	21:55	23.3	64		ESE	17	1016.2	33.0	26		ENE	9	1012.8
25	Mo	19.1	31.1	0			ESE	43	04:54	22.5	64		E	20	1012.0	29.5	47		NE	7	1009.0
26	Tu	18.5	32.7	0			SE	46	21:09	22.8	66		E	17	1013.6	30.1	35		SSW	13	1011.0
27	We	17.3	31.6	0						21.2	59		ESE	24	1017.1	29.8	27		ESE	19	1015.0
28	Th	14.2	31.7	0			ESE	57	07:40	19.9	53		ESE	28	1018.2	30.9	19		E	22	1014.9
29	Fr	15.6	34.7	0			E	57	06:44	22.0	52		E	28	1014.9	33.6	21		NE	13	1010.7
30	Sa	17.2	21.2	2.2			E	43	00:16	18.5	78		S	15	1009.1	18.6	86		ENE	17	1005.5
31	Su	17.4	21.0	14.2			SW	54	13:14	19.8	81		WSW	7	1001.5	16.8	68		S	24	1003.0
Statistics for January 2016																					
Mean		16.4	30.6							22.3	56			17	1013.8	28.5	37			15	1011.4
Lowest		11.5	21.0	0						17.7	29		#	6	1001.5	16.8	11		WNW	4	1003.0
Highest		20.5	40.1	17.0			ESE	59		29.3	83		#	28	1024.8	38.5	86		N	30	1021.2
Total				42.6																	

***Climate data from BoM for Dwellingup in* June**

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9 am						3 pm					
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours	km/h		local	°C	%	8th	km/h		hPa	°C	%	8th	km/h		hPa
1	We	3.5	18.7	0			E	28	11:39	8.4	93		SE	13	1024.3	18.2	45		ESE	13	1021.3
2	Th	4.5	19.1	0						9.7	87		ESE	15	1022.0	18.4	39		ENE	13	1017.4
3	Fr	8.1	21.3	0			W	46	23:10	14.4	65		NE	13	1013.5	19.9	56		NNW	17	1010.6
4	Sa	10.7	15.3	9.6			WSW	46	03:47	11.0	83		SSW	15	1015.6	14.4	50		SW	13	1015.8
5	Su	2.4	15.1	0.2			ENE	22	10:48	5.4	93		SE	11	1017.6	14.6	55		ENE	9	1014.3
6	Mo	1.5	15.4	0			SW	54	20:22	9.3	94		NE	11	1011.0	12.8	85		N	15	1006.5
7	Tu	7.9	12.5	12.4			SSW	52	14:51	8.7	82		SSW	15	1010.4	10.5	65		SSW	28	1012.9
8	We	4.7	12.9	0			S	43	10:52	8.1	69		SSW	19	1024.8	12.1	54		SSW	15	1024.7
9	Th	7.6	13.2	0			NNW	30	09:40	10.1	72		NNW	13	1027.3	11.5	84		N	13	1025.5
10	Fr	9.5	17.0	6.0			N	30	04:23	13.1	94		NW	6	1026.3	15.8	65		NW	11	1025.7
11	Sa	7.5	17.2	0.4			NNE	39	12:14	10.8	81		NE	17	1026.5	16.1	52		NNE	17	1022.7
12	Su	9.8	20.1	0			N	50	14:20	13.5	56		NNE	17	1019.2	17.8	46		N	24	1013.5
13	Mo	6.6	16.3	26.8			SSE	37	21:20	10.6	95		NW	9	1015.7	15.9	68		WSW	9	1016.0

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9 am					3 pm					
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours	km/h		local	°C	%	8th	km/h		hPa	°C	%	8th	km/h		hPa
14	Tu	10.5	17.0	0.2			SSE	37	09:43	12.7	83		SE	19	1023.5	15.5	68		SSE	19	1021.6
15	We	9.9	16.1	0.2			SSE	26	01:35	12.1	86		SE	13	1022.4	15.5	66		ESE	6	1021.0
16	Th	7.1	17.5	0.2			SSE	24	18:18	10.4	93		SSE	9	1022.3	15.3	72		SSE	11	1020.0
17	Fr	7.6	15.5	0			ESE	37	09:46	8.8	89		ESE	13	1023.9	13.6	62		E	15	1021.7
18	Sa	4.5	16.8	0.2			NNE	35	14:20	9.1	88		NE	13	1022.0	16.6	52		N	17	1017.1
19	Su	6.9	17.8	0						11.6	73		N	15	1011.1	15.3	91		NW	19	1008.0
20	Mo	11.0	15.2	19.2			SW	39	22:04	12.9	95		WNW	6	1009.9	14.6	75		WNW	17	1008.3
21	Tu	4.3	14.3	0.4			S	33	01:23	8.3	93		Calm		1016.8	13.1	56		SSW	7	1016.0
22	We	6.5	15.9	0.4			SW	41	16:16	10.4	94		W	2	1017.3	15.3	56		W	19	1015.9
23	Th	6.5	14.7	3.0			SSW	28	02:33	8.9	91		SSE	11	1021.4	13.3	58		SSE	9	1020.4
24	Fr	4.5	14.3	0			NNE	30	10:28	8.8	79		NNE	9	1020.5	13.7	59		NNW	11	1017.3
25	Sa	8.7	15.1	6.2			NNW	35	02:09	10.1	94		SSW	15	1019.5	14.0	44		SSW	11	1020.5
26	Su	0.6	15.2	0.4			N	33	12:05	5.0	94		N	7	1025.4	14.0	58		NNW	13	1022.7
27	Mo	5.0	15.9	0			NNE	39	12:09	10.7	56		N	15	1020.4	15.1	43		NNW	20	1015.9

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9 am					3 pm					
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours	km/h		local	°C	%	8th	km/h		hPa	°C	%	8th	km/h		hPa
28	Tu	4.2	15.2	4.4			W	48	17:09	13.0	92		NNW	19	1012.4	14.7	91		NNW	13	1010.8
29	We	9.0	16.1	33.4						12.6	92		W	11	1017.7	15.0	62		WSW	15	1019.4
30	Th	1.7	16.3	0.4			SSW	19	12:12	5.2	94		Calm		1027.1	15.8	55		W	6	1024.8
Statistics for June 2016																					
Mean		6.4	16.1							10.1	85			11	1019.6	14.9	61			14	1017.6
Lowest		0.6	12.5	0						5.0	56		Calm		1009.9	10.5	39		#	6	1006.5
Highest		11.0	21.3	33.4			SW	54		14.4	95		#	19	1027.3	19.9	91		SSW	28	1025.7
Total				124.0																	

2015–16 Great Ocean Road Bushfire (Victoria)

Dates: 25 December – 5 January 2016 Fatalities: none Houses burnt: 116 Area burnt: 2,200 ha

Climate data from BoM for Aireys Inlet (nearest weather station) for surrounding dates: **December 2015**

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9 am						3 pm					
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours	km/h		local	°C	%	8th	km/h		hPa	°C	%	8th	km/h		hPa
1	Tu	11.0	21.2	0.8			WSW	65	14:16	14.6	64		NW	15		17.8	38		WNW	28	
2	We	6.8	17.9	0			SSW	56	15:08	12.5	54		WSW	13		15.7	53		SSW	31	
3	Th	10.7	20.6	0			S	24	14:36	13.7	70		WNW	7		17.8	63		S	15	
4	Fr	11.9	20.8	0			S	26	15:43	15.6	77		ENE	9		19.5	68		E	9	
5	Sa	13.2	21.5	0			SSW	30	12:42	15.7	85		SW	15		20.3	66		SSW	17	
6	Su	14.3	19.7	0			SW	30	21:16	16.5	92		S	9		18.6	82		SE	7	
7	Mo	16.1	24.7	0			ESE	30	06:22	16.8	91		E	7		18.9	78		SE	4	
8	Tu	16.2	33.7	0			NW	91	06:32	20.1	80		NNW	31		24.0	48		SSW	28	
9	We	15.5	24.5	0						18.5	60		WNW	28		23.8	41		WSW	20	
10	Th	9.9	21.7				SSW	28	15:14	17.1	56		ENE	7		19.4	51		SSE	13	

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9 am						3 pm					
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours	km/h		local	°C	%	8th	km/h		hPa	°C	%	8th	km/h		hPa
11	Fr	12.3	20.5	0			WSW	76	14:24	14.8	62		W	26		14.8	55		SW	39	
12	Sa	8.4	18.2	0			SW	41	07:23	13.5	51		SSW	19		15.3	54		SSW	20	
13	Su	8.6	19.9	0			E	28	10:27	15.9	61		NE	11		18.3	57		S	13	
14	Mo	11.3	20.8	0			S	26	16:57	16.9	74		SSW	11		18.1	61		SSE	13	
15	Tu	11.7	22.5	0			S	22	13:52	16.2	80		ESE	6		20.9	63		S	15	
16	We	16.1	23.0	0			SSW	26	16:22	16.8	94		SE	7		20.9	73		S	11	
17	Th	16.1	29.3	0			SW	33	12:39	20.8	76		E	9		25.0	64		SW	13	
18	Fr	17.1	23.7	0			SSW	35	14:07	18.8	87		SW	15		18.7	83		SSW	20	
19	Sa	14.9	43.0	0			NW	76	13:42	23.0	68		E	7		38.5	15		WNW	13	
20	Su	22.5	33.6	0.2			WNW	72	11:22	30.4	33		WSW	20		17.7	86		W	26	
21	Mo	13.3	20.2	1.8			SW	57	03:42	15.2	71		SW	22		19.0	47		SSW	26	
22	Tu	12.6	21.7	0			SW	35	18:53	15.8	56		SE	9		20.5	51		SSE	15	
23	We	14.3	22.6	0			SSE	30	14:37	18.9	71		S	11		21.0	69		S	19	
24	Th	15.4	26.6	0			E	26	17:24	19.4	77		SE	6		23.5	60		ESE	9	

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9 am						3 pm					
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours	km/h		local	°C	%	8th	km/h		hPa	°C	%	8th	km/h		hPa
25	Fr	19.4	37.2	0			N	63	07:28	26.5	35		N	33		36.1	17		NNW	22	
26	Sa	11.3	18.9	16.4			SW	78	01:52	11.8	88		WSW	15		16.3	71		SW	37	
27	Su	9.8	20.2	3.4			SSW	41	15:10	13.6	67		SW	17		19.1	50		SSW	22	
28	Mo	12.7	20.3	0			SSW	26	18:48	16.7	55		S	11		19.6	53		S	15	
29	Tu	11.7	21.7	0			S	24	14:55	17.2	69		SSE	6		20.1	57		S	13	
30	We	11.6	29.3	0			E	19	11:25	17.9	74		ENE	4		22.7	61		SE	6	
31	Th	17.8	39.9	0			WNW	48	13:14	29.0	22		NW	19		36.3	19		SSE	15	
Statistics for December 2015																					
Mean		13.4	24.5							17.7	67			13		21.2	56			17	
Lowest		6.8	17.9	0						11.8	22		ENE	4		14.8	15		SE	4	
Highest		22.5	43.0	16.4			NW	91		30.4	94		N	33		38.5	86		SW	39	
Total				22.6																	

January 2016

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9 am						3 pm					
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours	km/h		local	°C	%	8th	km/h		hPa	°C	%	8th	km/h		hPa
1	Fr	18.0	23.2	0			SSW	57	15:06	20.2	66		SSW	17		21.6	69		SSW	22	
2	Sa	15.0	22.2	0			SSW	63	01:37	17.1	94		S	24		20.2	75		SSE	22	
3	Su	16.8	21.1	0			ESE	52	17:19	17.4	73		ESE	17		19.9	66		SE	22	
4	Mo	16.7	21.8	0			ESE	46	21:39	18.1	78		E	17		21.1	60		ESE	22	
5	Tu	16.3	23.8	0			E	43	00:15	17.7	73		ESE	13		22.2	63		SSE	17	
6	We	17.3	21.8	0			S	37	21:52	17.9	87		SE	15		19.9	73		SSE	15	
7	Th	15.4	21.7	0			SW	52	20:08	17.2	69		SSW	20		19.8	53		SSW	28	
8	Fr	14.4	21.9				SSW	39	01:43	16.3	63		SW	19		20.7	53		S	19	
9	Sa	12.7	22.6	0			SSW	33	17:14	16.2	75		WSW	9		21.2	60		SSW	17	
10	Su	12.9	27.5	0			NNE	24	21:47	16.4	74		N	7		19.9	64		ESE	9	
11	Mo	16.4	34.7	0			SSW	44	16:43	27.5	32		NNW	11		22.6	66		SW	11	
12	Tu	16.0	23.1	0.2			ESE	22	11:29	17.5	75		SE	7		21.1	59		ESE	9	
13	We	15.4	36.3	0			NW	54	16:18	23.0	67		NE	11		31.1	39		SE	11	

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9 am					3 pm					
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours	km/h		local	°C	%	8th	km/h		hPa	°C	%	8th	km/h		hPa
14	Th	15.5	19.2	0.4			SSW	72	15:57	15.8	63		SW	30		17.4	52		SSW	39	
15	Fr	12.0	21.0	0.2			SSW	56	02:09	15.0	54		S	20		19.4	39		S	19	
16	Sa	14.1	22.1	0			S	28	12:56	17.6	58		SSE	9		20.9	51		S	15	
17	Su	14.9	27.1	0			S	22	23:04	19.0	69		ESE	6		25.3	54		SE	7	
18	Mo	17.7	35.9	0			NW	57	10:32	27.0	25		NW	31		25.6	51		SW	19	
19	Tu	13.4	24.1	0			SSW	24	16:07	19.0	65		ENE	4		21.2	66		S	11	
20	We	15.2	22.6	1.8			SSE	19	15:32	17.4	84		Calm			21.7	75		S	9	
21	Th	16.6	19.6	0			S	24	17:27	17.5	91		Calm			18.4	78		SSE	6	
22	Fr	15.0	18.6	2.0			WSW	35	06:04	16.0	94		NW	6		17.7	94		SE	4	
23	Sa	15.4	22.1	6.0			SSW	48	13:17	17.4	81		WSW	13		19.9	68		SSW	24	
24	Su	14.8	23.6	0			S	35	19:21	17.1	80		WSW	13		20.6	67		SSW	19	
25	Mo	16.1	21.8	0			SSW	43	16:52	17.3	64		S	19		19.7	57		SW	26	
26	Tu	16.6	23.0	0			ESE	39	21:53	18.9	80		SE	13		22.5	66		SE	19	
27	We	18.0	24.8	0			ESE	43	03:20	18.8	87		E	9		20.6	91		ENE	9	

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9 am					3 pm					
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours	km/h		local	°C	%	8th	km/h		hPa	°C	%	8th	km/h		hPa
28	Th	17.9	23.1	3.0			NW	37	04:22	21.4	69		WNW	11		20.7	73		E	11	
29	Fr	13.3	22.0	0			SSW	33	12:42	15.2	71		W	7		17.8	71		SSE	17	
30	Sa	11.8	22.5	0			ESE	30	21:02	16.8	81		SSE	6		21.2	63		SSE	13	
31	Su	16.1	23.6	12.2			ENE	33	15:18	16.9	93		ENE	13		21.9	62		E	17	
Statistics for January 2016																					
Mean		15.4	23.8							18.3	72			12		21.1	63			16	
Lowest		11.8	18.6	0						15.0	25		Calm			17.4	39		SE	4	
Highest		18.0	36.3	12.2			SSW	72		27.5	94		NW	31		31.1	94		SSW	39	
Total				25.8																	

Climate data from BoM for Aireys Inlet: **June 2016**

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9 am						3 pm					
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours	km/h		local	°C	%	8th	km/h		hPa	°C	%	8th	km/h		hPa
1	We	7.2	15.3	0.2			NNW	13	06:30	8.9	92		NNW	6		13.2	68		E	7	
2	Th	8.8	14.4	0			ESE	22	23:49	11.2	89		S	2		12.9	79		SSE	6	
3	Fr	11.0	14.5	0			E	35	08:02	13.4	74		E	20		13.9	82		ESE	9	
4	Sa	11.4	14.5	5.0			E	26	01:41	13.1	92		ENE	13		13.9	90		SSW	7	
5	Su	12.6	16.0	1.2			NW	22	13:16	12.8	95		WNW	9		14.1	79		NW	13	
6	Mo	7.4	14.8	0			NW	30	23:50	9.9	84		NW	17		13.7	70		N	9	
7	Tu	8.9	15.7	0			NW	52	07:18	10.7	90		NW	24		14.6	79		W	15	
8	We	10.4	14.5	0.4			NW	48	13:43	10.7	86		NW	13		13.1	76		NNW	19	
9	Th	10.4	15.6	6.6			NW	57	10:51	11.4	83		NW	26		13.5	82		W	17	
10	Fr	7.6	15.1	0.4			NW	63	09:23	9.1	89		NW	24		14.4	66		NW	24	
11	Sa	7.4	12.7	5.2			WSW	56	12:11	9.0	81		WSW	26		10.4	62		SW	33	
12	Su	7.0	13.0	0.2			NW	35	22:47	8.0	79		NW	22		11.9	64		NNW	9	
13	Mo	6.8	13.0	0			NNW	37	12:48	7.9	69		NW	19		12.5	60		NNW	19	

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9 am					3 pm					
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours	km/h		local	°C	%	8th	km/h		hPa	°C	%	8th	km/h		hPa
14	Tu	5.5	13.8	0			NNW	59	07:59	8.5	72		NW	13		12.8	67		WNW	11	
15	We	7.8	15.7	0			NW	41	06:30	9.7	80		NW	22		14.9	63		NW	13	
16	Th	6.5	13.3	0			NNW	48	21:11	8.3	74		NNE	11		9.6	84		N	11	
17	Fr	8.2	12.8	4.4			SSW	41	22:21	12.3	92		WNW	9		12.5	94		WNW	13	
18	Sa	10.1	12.5	7.2			SSW	35	01:07	10.6	69		S	15		11.8	66		SSW	13	
19	Su	9.4	13.9	0			SE	30	23:27	9.6	91		NNE	4		12.4	79		SSE	9	
20	Mo	9.5	13.8	0.6			SSW	43	14:09	12.8	86		S	22		13.3	74		SSW	28	
21	Tu	9.3	13.7	0			NNW	57	11:42	9.9	83		NNW	13		11.0	90		NNW	20	
22	We	8.8	13.8	2.0			W	61	12:43	9.1	85		WNW	24		13.2	69		W	24	
23	Th	9.1	13.4	1.4			NNW	96	11:50	10.4	84		NNW	44		10.6	88		NNW	48	
24	Fr	3.5	7.9	2.8			SW	72	13:54	4.7	89		WNW	26		7.3	70		W	26	
25	Sa	3.0	13.5	4.4			SW	41	02:18	7.7	73		W	13		11.6	71		WNW	7	
26	Su	4.6	11.2	0			NNW	59	12:40	6.0	79		N	6		10.4	63		NNW	17	
27	Mo	5.8	12.1	0			NW	61	03:56	7.2	86		NW	33		11.1	71		WNW	17	

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9 am						3 pm					
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours	km/h		local	°C	%	8th	km/h		hPa	°C	%	8th	km/h		hPa
28	Tu	7.2	15.1	0			NW	57	03:46	9.2	81		NW	26		13.5	76		NW	17	
29	We	8.9	15.3	0			N	50	15:05	9.6	82		NW	24		13.4	56		N	26	
30	Th	7.7	10.7	4.0			WNW	67	15:07	7.8	95		N	35		9.2	91		NNW	33	
Statistics for June 2016																					
	Mean	8.1	13.7							9.7	83			18		12.4	74			17	
	Lowest	3.0	7.9	0						4.7	69		S	2		7.3	56		SSE	6	
	Highest	12.6	16.0	7.2			NNW	96		13.4	95		NNW	44		14.9	94		NNW	48	
	Total			46.0																	

2015 Pinery Bushfire (South Australia)

Dates: 25 November – 2 December 2015 Fatalities: 2 Area burnt: 85,000 ha

Climate data from BoM for Rosedale (nearest weather station) for surrounding dates: **November 2015**

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9 am						3 pm					
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours	km/h		local	°C	%	8th	km/h		hPa	°C	%	8th	km/h		hPa
1	Su	12.5	25.4	0	8.8					16.5	94	8	N	2							
2	Mo	12.4	23.2	0.2	6.2					17.1	87	8	Calm								
3	Tu	12.8	28.7	0	4.8					19.0	59	8	E	11							
4	We	17.4	25.0	5.6	6.6					21.5	86	2	E	2							
5	Th	14.5	19.8	20.0	3.8					16.6	94	8	W	4							
6	Fr	13.9	21.5	0.4	2.2					15.5	94	8	WSW	2							
7	Sa	8.5	31.2	0	3.2					15.5	84	4	NE	2							
8	Su	14.5	36.0	0	6.8					24.5	57	4	NE	6							
9	Mo	21.0	37.0	0	7.6					31.1	49	7	NNW	2							
10	Tu	19.0	27.0	0	9.6					21.0	73	8	E	2							

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9 am					3 pm				
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours	km/h		local	°C	%	8th	km/h		hPa	°C	%	8th	km/h		hPa
11	We	14.2	26.5	0	5.0					16.7	79	7	E	7							
12	Th	14.0	25.8	3.2	4.0					20.0	77	1	Calm								
13	Fr	6.6	22.5	0	9.6					15.0	75	6	SSW	4							
14	Sa	6.0	23.5	0	7.0					14.5	78	2	SSE	2							
15	Su	6.5	25.4	0	4.0					14.0	78	2	W	2							
16	Mo	7.5	31.0	0	7.2					24.0	39	0	ENE	11							
17	Tu	11.8	36.2	0	7.8					28.0	22	2	NW	2							
18	We	16.2	40.4	0	11.2					34.0	14	6	N	11							
19	Th	19.2	40.0	0	12.2					31.2	37	2	SE	2							
20	Fr	16.0	22.8	0	11.4					20.5	65	8	SW	6							
21	Sa	7.4	23.3	0	6.2					16.8	55	5	SE	4							
22	Su	4.5	21.9	0	7.4					14.5	68	1	WNW	2							
23	Mo	9.8	23.2	0	5.6					16.6	65	8	SW	4							
24	Tu	6.4	31.0	0	6.8					18.0	67	0	E	7							

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9 am						3 pm					
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours	km/h		local	°C	%	8th	km/h		hPa	°C	%	8th	km/h		hPa
25	We	13.2	36.5	0	10.0					31.0	31	6	NNW	11							
26	Th	11.4	18.9	0	7.6					14.6	57	7	SW	4							
27	Fr	3.2	21.7	0	8.2					15.0	54	2	S	4							
28	Sa	5.0	24.2	0	6.0					16.5	60	1	E	2							
29	Su	10.5	29.6	0	6.2					18.0	66	3	ENE	2							
30	Mo	17.5	35.8	0	8.0					29.5	45	2	N	15							
Statistics for November 2015																					
Mean		11.8	27.8		7.0					20.2	63	4		4							
Lowest		3.2	18.9	0	2.2					14.0	14	0	Calm								
Highest		21.0	40.4	20.0	12.2					34.0	94	8	N	15							
Total				29.4	211.0																

December 2015:

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9 am						3 pm					
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours	km/h		local	°C	%	8th	km/h		hPa	°C	%	8th	km/h		hPa
1	Tu	12.4	20.5	0	10.2					19.2	61	2	W	19							
2	We	2.2	21.2	0	4.0					14.6	56	4	Calm								
3	Th	9.4	29.2	0	8.4					18.0		0	E	11							
4	Fr	12.1	35.5	0	7.8					27.5		6	NNE	4							
5	Sa	21.5	40.3	0	10.4					30.7		1	NE	6							
6	Su	23.5	43.0	0	13.2					35.3		7	NNW	6							
7	Mo	30.0	38.2	0	15.6					34.3		8	NE	13							
8	Tu	15.4	27.0	2.6	9.8					23.5	65	0	NW	4							
9	We	15.2	25.7	0	9.4					20.4	63	6	WSW	7							
10	Th	10.9	27.0	0	7.2					18.5	63	4	E	2							
11	Fr	13.4	22.8	0	9.0					17.8	58	6	W	11							
12	Sa	4.0	25.7	0	6.2					15.2	49	1	ESE	6							
13	Su	9.8	34.1	0	7.0					22.2	35	8	NE	4							

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9 am						3 pm					
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours	km/h		local	°C	%	8th	km/h		hPa	°C	%	8th	km/h		hPa
14	Mo	15.8	37.2	0	9.2					29.5	25	2	E	7							
15	Tu	19.0	35.5	1.6	10.0					23.5	60	8	E	4							
16	We	20.8	40.8	0	7.6					32.5	37	3	NE	11							
17	Th	24.2	42.3	0	13.0					35.8	18	0	NNE	7							
18	Fr	18.2	42.7	0	12.2					33.5	28	0	SE	4							
19	Sa	26.0	42.8	0	14.4					38.2	29	8	N	6							
20	Su	20.5	24.4	1.2	9.0					20.5	100	8	W	6							
21	Mo	11.0	25.2	1.2	5.0					16.8	75	8	E	7							
22	Tu	10.4	31.7	0	6.0					20.2	62	0	E	11							
23	We	10.8	34.3	0	8.4					24.9	49	1	E	7							
24	Th	18.0	38.6	0	11.2					29.2	53	0	ENE	11							
25	Fr	23.5	38.4	0	12.0					32.5	52	6	N	6							
26	Sa	14.0	23.8	0	10.0					17.5	66	3	SSW	6							
27	Su	5.5	26.5	0	8.0					15.0	68	0	ENE	9							

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9 am					3 pm				
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours	km/h		local	°C	%	8th	km/h		hPa	°C	%	8th	km/h		hPa
28	Mo	14.5	30.9	0	11.2					19.2	63	0	E	9							
29	Tu	14.0	35.2	0	8.0					26.1	60	0	E	4							
30	We	21.3	38.1	0	12.0					29.0	55	8	NE	4							
31	Th	21.0	39.5	0	8.2					32.5	47	3	Calm								
Statistics for December 2015																					
Mean		15.8	32.8		9.5					25.0	53	3		6							
Lowest		2.2	20.5	0	4.0					14.6	18	0	Calm								
Highest		30.0	43.0	2.6	15.6					38.2	100	8	W	19							
Total				6.6	293.6																

***Climate data from BoM for Rosedale (nearest weather station) for* June 2016**

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9 am						3 pm					
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours	km/h		local	°C	%	8th	km/h		hPa	°C	%	8th	km/h		hPa
1	We	9.4	19.5	1.4	0.4					12.2	92	7	E	2							
2	Th	10.4	18.0	0	1.8					13.0	77	7	Calm								
3	Fr	3.9	17.5	0	1.2					9.0	92	6	Calm								
4	Sa	3.0	16.0	0	1.7					8.3	96	4	Calm								
5	Su	7.5	15.2	0	0.9					11.5	82	8	NW	2							
6	Mo	9.6	16.1	5.0	1.8					12.6	91	7	W	22							
7	Tu	8.4	15.7	1.6	1.2					12.1	94	8	W	4							
8	We	9.5	17.5	3.0	0.6					12.0	88	8	ENE	4							
9	Th	10.9	15.0	5.6	2.6					13.2	97	8	W	7							
10	Fr	10.0	15.2	5.0	1.6					12.1	89	8	NW	2							
11	Sa	4.5	15.2	5.6	1.2					6.7	97	8	S	2							
12	Su	5.2	13.8	0.2	0.6					7.5	86	7	NE	2							
13	Mo	1.0	14.5	0	1.4					5.5	84	4	E	2							

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9 am					3 pm				
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours	km/h		local	°C	%	8th	km/h		hPa	°C	%	8th	km/h		hPa
14	Tu	5.5	20.5	0	1.6					11.5	82	1	Calm								
15	We	7.5	18.7	0	0.8					11.7	80	2	E	2							
16	Th	11.7	15.2	1.4	2.2					14.4	87	8	N	4							
17	Fr	12.2	15.8	7.0	1.8					13.2	100	8	W	2							
18	Sa	9.5	14.7	4.2	0.8					11.0	78	8	SE	2							
19	Su	8.5	13.5	0.2	2.0					10.5	87	2	Calm								
20	Mo	3.7	14.0	0.2	1.2					8.0	100	8	Calm								
21	Tu	6.6	13.8	7.6	1.4					10.5	94	8	NW	4							
22	We	8.5	15.4	4.2	1.0					11.0	90	8	NW	4							
23	Th	10.0	13.2	0.4	1.0					11.5	82	5	NW	7							
24	Fr	6.0	12.7	23.0	4.0					8.0	87	3	W	4							
25	Sa	3.0	13.8	0.2	1.0					6.5	93	8	SE	2							
26	Su	6.0	13.5	0	1.0					9.2	84	8	NE	2							
27	Mo	5.5	14.5	0.8	0.8					10.0	96	8	Calm								

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9 am					3 pm				
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours	km/h		local	°C	%	8th	km/h		hPa	°C	%	8th	km/h		hPa
28	Tu	4.5	15.5	0.2	1.4					8.3	86	2	NNW	2							
29	We	2.0	12.7	0	1.6					6.0	93	8	Calm								
30	Th	5.5	13.7	0.8	1.0					10.9	89	2	WNW	15							
Statistics for June 2016																					
Mean		7.0	15.3		1.4					10.3	89	6		3							
Lowest		1.0	12.7	0	0.4					5.5	77	1	Calm								
Highest		12.2	20.5	23.0	4.0					14.4	100	8	W	22							
Total				77.6	41.6																

Acknowledgement: Bureau of Meteorology

Appendix 15: Student activity sheet 4.1: Peer evaluation

	Always	Usually	Sometimes	Rarely
Remains focused on tasks presented				
Completes set tasks to best of their ability				
Works independently without disrupting others				
Uses time well				
Cooperates effectively within the group				
Contributes to group discussions				
Shows respect and consideration for others				
Uses appropriate conflict resolution skills				
Actively seeks and uses feedback				

Comments:

_____

_____

_____

Appendix 16: Student activity sheet 4.2: Self-evaluation

Algorithm Reflection

Photograph or drawing

What did you make?	How did you feel about your algorithm?
	
What did you like about your algorithm?	**What could you have done better?**
	

What would you do differently?


Notes