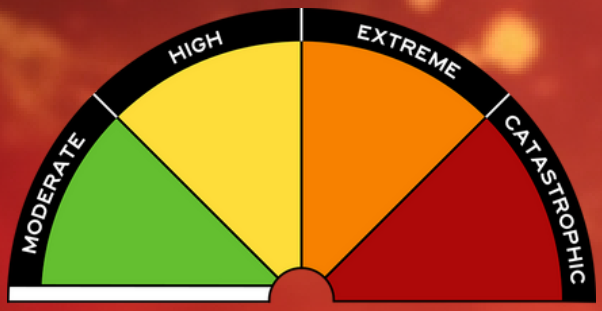
NSW GOVERNMENT | Office of the Chief Scientist & Engineer

Student Name:



Fire-Ed Up

ISTEM - SCENARIO 2
STUDENT RESOURCE FOLIO

Class:

Teacher:

Design situation

In 2022 Australia introduced a new fire danger rating system providing clearer and more accurate information to communities at risk of bush fire. The Australian Fire Danger Rating System brings together the latest science and knowledge of fire behaviour, is supported by extensive community research, and is the most significant change to the fire danger rating system in more than 50 years.

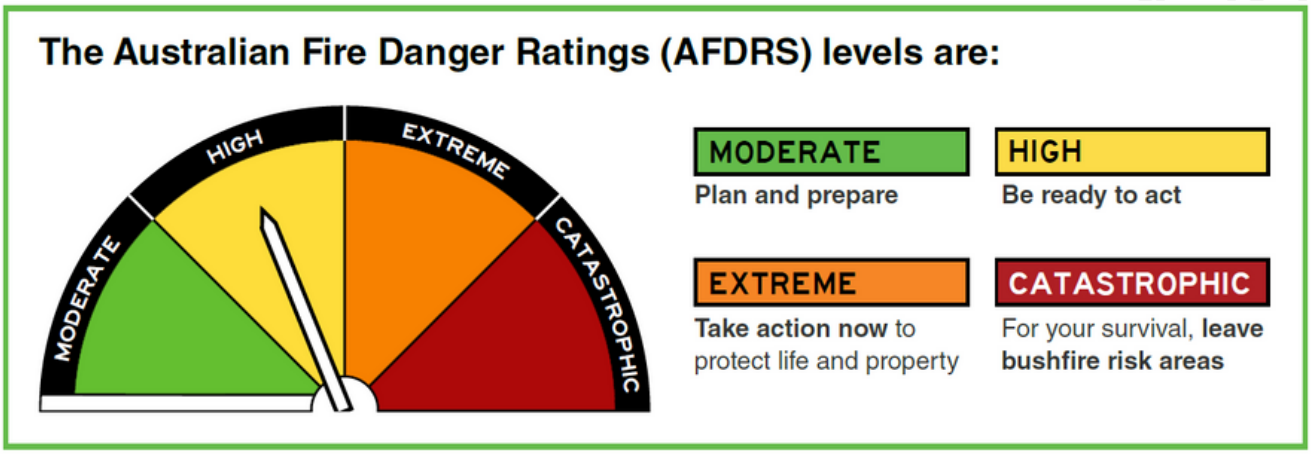
Under the previous system, fire danger ratings were based on only bush and grass based vegetation. The new system uses eight different types of vegetation, which have been mapped across the entire country.

The display of daily ratings has been simplified, four levels of fire danger rating are now used, with simple actions for the community to take at each level.

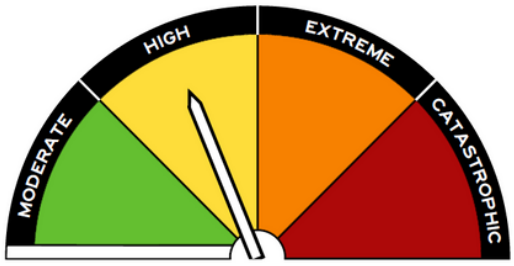
- Moderate (Green) – Plan and prepare
- High (Yellow) – Be ready to act
- Extreme (Orange) – Take action now to protect life and property
- Catastrophic (Red) – For your survival, leave bush fire risk areas

Fire danger ratings are used to communicate the consequences of a fire, if one was to start. On days when there is minimal risk, 'No rating' is used.

The previous fire danger rating system was found to be approximately 40% accurate whilst the new reporting system is now more than 60% accurate, but there is room for improvement.



Design brief



Utilising STEM technologies and local environmental insights to enhance your community's bush fire danger rating system.
Get ready to be tech heroes for your town!

Digital technologies

Gear up to use Raspberry Pi microcomputers to recreate and improve how we predict bushfires with the Australian fire danger rating system. You'll:
1. **Tweak the Code:** Modify existing code to get better at predicting fires using local data.
2. **Tech Exploration**: Discover how satellites and drones can help in bushfire safety.

You'll become mini tech experts, using cool gadgets to make a difference in keeping our community safe from fires!

Deliverables

1. Design folio

Students are to complete a design folio that captures your journey through the iSTEM engineering design process in developing digital solutions related to making the Australian fire danger rating system more accurate. Students have two options:

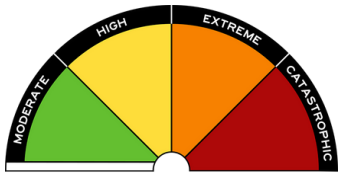
- **Custom folio:** Create your own, focusing on sketches, milestones, and decision-making.
- **Guided template:** Use the worksheets provided in this document for a more structured

2. Pitch Video: Students will create a 5-minute video to pitch your Bushfire STEM solutions. Include your team, the bushfire scenario you are addressing, and your innovative solution. Highlight how you have used STEM in your solution, its benefits, challenges faced, and future plans for the project. Your video should be clear, captivating, and show your enthusiasm for the project.

2. Prototype

Students are to produce a digital design solution prototype that can be used to improve the accuracy of the Australian fire danger rating system. This could include modifying the Raspberry Pi based Fire-Ed Up kit or may involve the development of new or different technologies.

Fire-EdUp



Background - Australian fire danger rating system (AFDRS)

Hey team! Let's chat about something super important - the Australian Fire Danger Rating System (AFDRS). Imagine it's like a warning system that tells us how risky it could be if a bushfire starts. It's a big deal because it helps everyone know what to do to stay safe.

The AFDRS is a big project where all the states in Australia work together to make a better system to forecast, or predict, fire dangers. They want to make sure that the way we estimate how dangerous a fire could be is really precise and that everyone understands the warnings clearly. It's all about keeping people safe, helping the government and businesses make smart choices, and trying to make bushfires less costly and less scary.

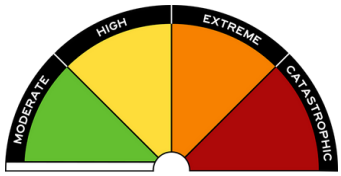
What are fire behaviour models and fuel types?

Now, what about fire behaviour models and fuel types? Well, think of fire behaviour models as special math recipes that help us guess how a fire would move in different kinds of plants and trees. And by "fuel," we don't mean petrol; we mean stuff that a fire can burn, like grass, leaves, and branches. Different plants burn in their own ways, so we need different models or recipes for each type.

The AFDRS uses eight of these models/recipes to match them to 22 different fuel types. This way, they can cover all sorts of areas, from a forest to a grassy field. Knowing this helps the fire experts plan better and keep us all safe from bushfires. Cool, right?

Video: Unpacking the fire danger rating system - Dr David Clarke, Fire behaviour Analyst NSW Rural Fire Service

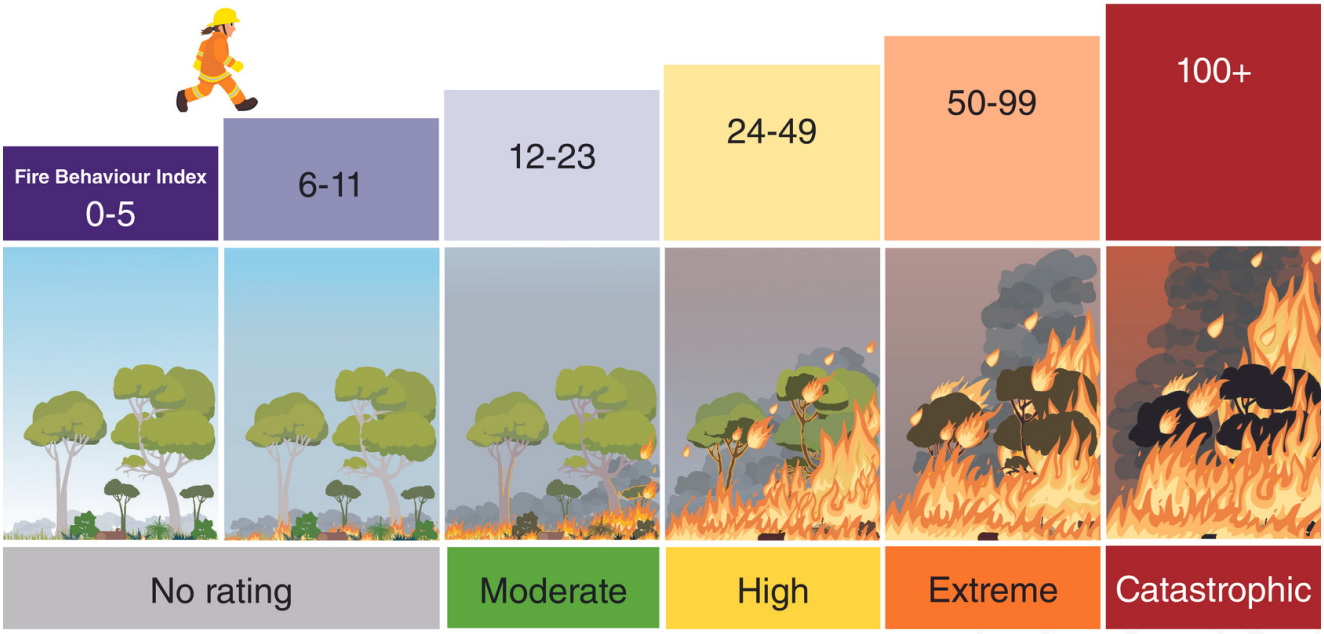
Fire-EdUp



What is the Fire Behaviour Index (FBI)?

Think of the Fire Behaviour Index (FBI) like a thermometer for fire danger. It's a set of numbers that helps people all over Australia figure out how dangerous a fire could be. Instead of just saying "it's hot" or "it's cold," the FBI gives a specific number from 0 to 100, or even higher, to show exactly how risky the fire is. The higher the number, the more dangerous the fire could be.

The FBI is broken down into different levels or steps, kind of like the levels of a video game. Each level shows us how the fire might behave. For example, one level might tell us how fast the fire could spread, how hard it might be to put out, or how much it could affect people and their houses. This helps firefighters and other experts make really important decisions when they're dealing with bushfires.



The Fire Behaviour Index (FBI) is like a special tool that helps firefighters deal with fires and make good choices. Here's what it helps with:

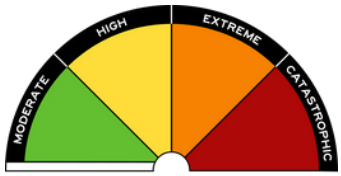
- **Figuring Out Fire Moves:** It tells us what a fire might do next and what the weather's like.
- **Planning Safe Burns:** Sometimes, people start small, safe fires on purpose to stop bigger, dangerous fires. The FBI helps them decide when to do this.
- **Fighting Fires Smarter:** It gives ideas on the best ways to put out fires and keep them from spreading.
- **Knowing the Danger:** It helps estimate how much a fire could injure people, or damage houses, and places like schools.

The FBI is like a detective that looks at all the different things about a fire, like:

- **How Strong a Fire is:** This is about how much energy the fire has.
- **How Tall the Flames are:** Bigger flames can mean a bigger fire.
- **How Quick the Fire Spreads:** This tells us how fast the fire moves across the land.
- **Where Sparks Might Fly:** Sometimes, fires can create sparks that start new fires far away.

So, the FBI doesn't just tell us one thing about a fire; it's like a combo move in a game that gives us a super-clear idea of what a fire might do.

Fire-EdUp



Fire Behaviour Index (Grassland)			Indicative Fire Behaviour and Fire Weather
MAX FLAME HEIGHT <1 m	0-5	RATE OF SPREAD 0-30 m/hr	**NO RATING** Fire difficult to ignite and sustain. Fires generally unlikely to spread and likely to self-extinguish.
<1.5 m	6-11	<1.3 km/hr	**NO RATING** Fire easily sustained. Typically wind driven fires that can spread quickly.
1.5-2.5 m	12-23	0.5-6 km/hr	**MODERATE** Typically wind driven and rapidly spreading fires with the potential to gain size quickly.
2-3 m	24-49	2.5-10 km/hr	**HIGH** Wind driven, rapidly spreading fires with potential for development into large fire area/size and with the potential for short distance spotting and long flame lengths.
2.5-3.5m	50-99	5-16 km/hr	**EXTREME** Extremely rapid fire growth and increasing likelihood of large final fire area/size. Possibility for fire behaviour to become erratic and plume driven. Strong convective column formation. Wind speed and direction likely to be erratic at times.
>3m	100+	>8 km/ hr can be expected, possibly >16 km/hr	**CATASTROPHIC** Extremely rapid fire growth and increasing likelihood of large final fire area/size. Possibility for fire behaviour to become erratic and plume driven. Strong convective column formation. Wind speed and direction likely to be erratic at times.

Source: https://www.dfes.wa.gov.au/hazard-information/bushfire/prepare

Video: Why we needed to update the fire danger rating system - Dr Meaghan Jenkins AFDRS Manager - NSW Rural Fire Service

PDF : Fire Spread Models Guide - CSIRO

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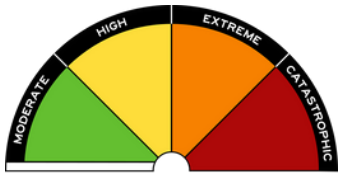


Vegetation types

Hey there! Let's talk about the different types of plants and places that can affect how bushfires behave. Imagine you're a detective figuring out how fires move in different areas:

Dry Eucalypt Forests: These are places with lots of eucalyptus trees and dry leaves and bark on the ground. They can make fires really strong, especially when it's dry.
Wet Eucalypt Forests: These forests are a bit damper because the plants hold more water. So, they don't catch fire as easily, but if they do, watch out! There's a lot of stuff underneath that can burn.

Grasslands: Imagine a big open field with lots of grass. This can be like a sea of green in winter or golden in summer. If a fire starts here, it can race across the field super fast.

Grassy Woodlands: These areas are like a mix of a park and a field, with grass and some trees scattered around. The fire might move differently here, depending on how many trees there are.

Spinifex Grasslands: In really dry, sandy places, you'll find spinifex grass that grows in little clumps with space in between. Fires here have their own unique way of spreading.

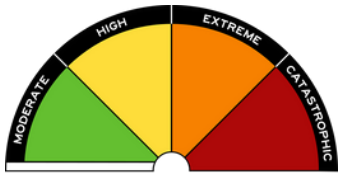
Shrublands: These are full of bushy plants that are not too tall, and you can find them near the beach or in dry places inland. Some of these bushes can be quite quick to catch fire.

Mallee-Heaths: Only in Australia, these areas have hardy, shrubby plants that have learned to live with not much water. When they burn, they can burn hot and fast.

Button Grass: Even though this grass grows in wetter spots, it can still burn and carry a fire.

Pine Plantations: Think of these as tree farms, where all the pine trees are in neat rows. The way people take care of these trees can make a big difference in how a fire might spread.

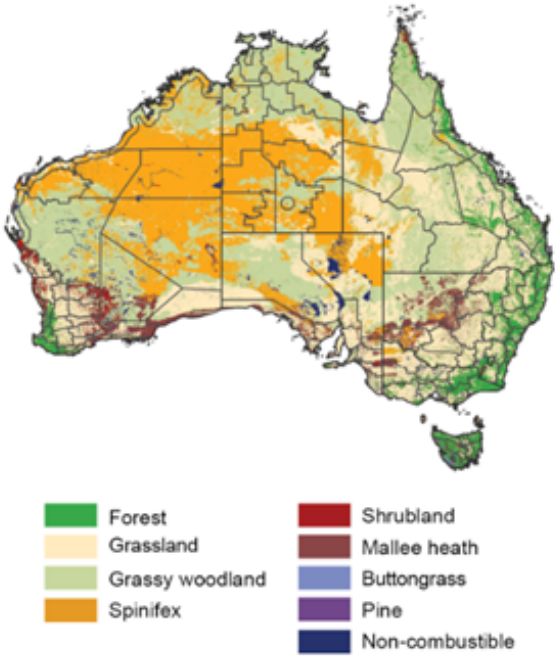
Fire-EdUp



Vegetation types used to develop fire behaviour models

Hey, did you know that by looking at the plants and trees (Vegetation) in different places, the Australian Fire Danger Rating System (AFDRS) can tell us all sorts of things about how fires might act, how fast they could spread, and how risky they might be all over the country? Pretty smart, right?

Check out this map with different types of plants and trees (vegetation types). For each kind, scientists have come up with a super cool math formula that helps guess how fires would behave there. And guess what? The old system only used two types of plants for their models, but now we have a lot more, which helps make the predictions way better!



Where do I find the the current Fire Danger Ratings for my district?

Want to check out how risky fires might be in our area? The Australian Bureau of Meteorology (kind of like our weather wizards) puts up the latest info on fire danger ratings and the fire behaviour index for every district. You can find all this on their website. Just look for our district, and you'll see how careful we need to be about fires right now.

Activities:

1. Determine the district for which you currently live.

_____

2. What is the current Fire Danger Rating for your district?

_____

3. What is the current Fire Behaviour Index for your district?

District	Thursday	Friday	Saturday	Sunday
Far North Coast	Moderate 12	Moderate 12	Moderate 12	Moderate 14
North Coast	No Rating 10	No Rating 10	Moderate 12	Moderate 13
Greater Hunter	Moderate 20	Moderate 16	Moderate 20	High 37
Greater Sydney Region	No Rating 10	Moderate 12	Moderate 16	Moderate 21
Illawarra/Shoalhaven	Moderate 12	Moderate 13	Moderate 18	High 25
Far South Coast	Moderate 12	Moderate 17	Moderate 19	Moderate 18
Monaro Alpine	Moderate 12	Moderate 13	Moderate 18	High 24
The Australian Capital Territory	No Rating 9	No Rating 11	Moderate 14	Moderate 18
Southern Ranges	Moderate 14	Moderate 16	High 26	High 34
Central Ranges	Moderate 19	Moderate 17	Moderate 21	High 30
New England	Moderate 14	Moderate 16	Moderate 15	Moderate 17
Northern Slopes	Moderate 23	Moderate 21	Moderate 21	High 26
North Western	High 27	High 26	High 29	High 34
Upper Central West Plains	High 27	Moderate 22	High 27	High 35
Lower Central West Plains	Moderate 21	Moderate 17	High 26	High 38
Southern Slopes	No Rating 11	Moderate 12	Moderate 17	High 26
Eastern Riverina	No Rating 9	No Rating 11	Moderate 15	Moderate 20
Southern Riverina	Moderate 18	Moderate 16	High 32	High 28
Northern Riverina	Moderate 19	Moderate 16	High 34	High 34
South Western	Moderate 12	No Rating 11	High 46	High 40
Far Western	Moderate 15	Moderate 16	Moderate 17	Moderate 22

Code

Fire Danger Ratings (Fire Behaviour Index - FBI)	No Rating (< 12)	Moderate (12-23)	High (24-49)	Extreme (50-99)	Catastrophic (>= 100)

4. Based on the current Fire Danger Rating and Fire Behaviour Index what type of action should you be taking?

_____

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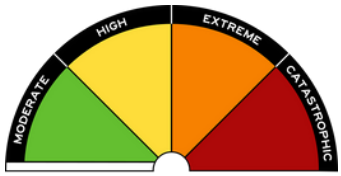

Testing your knowledge

Understanding the Australian Fire Danger Rating System (AFDRS)

1. What is the purpose of the Australian Fire Danger Rating System (AFDRS)?
2. List two improvements the AFDRS aims to provide over the previous system
3. Why is it important to have different fire behaviour models for different vegetation types?

Understanding Fire Behaviour Models and Fuel Types

1. What are fire behaviour models?
2. How do fire behaviour models help in predicting fire spread and danger?
3. Explain why a grassland fire might behave differently from a forest fire.

Differences Between Old and New Fire Danger Rating Systems

1. What was a major limitation of the previous fire danger rating system based on?
2. How many fire behaviour models does the new AFDRS use, and why is this significant?

Understanding the Fire Behaviour Index (FBI)

1. What is the Fire Behaviour Index (FBI)?
2. How does the FBI differ from the Fire Danger Rating categories?
3. Name two fire behaviour characteristics that the FBI helps to predict.

Comparing Australian Fire Danger Rating System (AFDRS) and Fire Behaviour Index (FBI)

1. How is the AFDRS mainly communicated to the public, and for what purpose?
2. In contrast, what is the primary use of the FBI?
3. Why would a firefighter use the FBI instead of just the AFDRS?

Application Questions

1. If you were to design a warning system for your community, which aspects of the AFDRS and FBI would you consider most important?
2. How would you explain the AFDRS and FBI to someone in your community who is not familiar with them?

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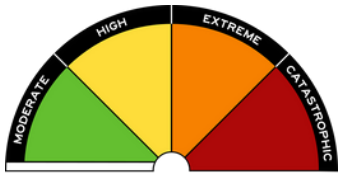


Field Measurements: Becoming a Fire Researcher

Welcome to the "Field Measurements" section of our Fire-Ed Up unit! Just like the real fire authorities in Australia, we're going to become field researchers for a day. Our mission is to gather important data from the great outdoors to help us understand the risk of bushfires in our area.

What Do Fire Authorities Do?
Across the country, fire experts are constantly collecting a variety of field measurements. Why? These measurements are crucial in assessing the Fire Behaviour Index (FBI) and the Australian Fire Danger Rating System (AFDRS). By understanding these, we can better predict and prepare for bushfires.

Your Mission as a Field Researcher
You're about to step into the shoes of these experts. With a keen eye and precise instruments, you'll collect data that's vital for predicting a simulated local FBI and AFDR. Here's what we need to know:

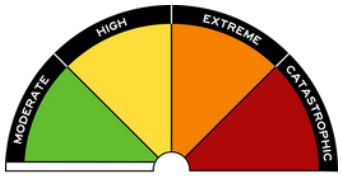
- **Temperature:** How hot is it outside? Fire loves heat, so this is a big one.
- **Wind Speed:** Strong winds can whip a small flame into a raging fire.
- **Humidity:** Dry air means plants dry out, and dried out plants burn faster.
- **Fuel Load:** This is all about how much stuff could burn in an area.
- **Fuel Moisture Content:** Wetter fuel doesn't burn as easily, so we need to know how dry it is.
- **Land Slope:** Fire climbs uphill quickly, so the steepness of the land matters.
- **Vegetation Type:** Different plant types burn in different ways. Knowing what's around is key.

You might be gathering this data at our school, a nearby field, or another interesting environment. Keep your eyes open and your instruments ready!

Using Your Data
Once we've collected our measurements, we're not just going to sit on them. We'll use this data later in our program to simulate what the FBI and AFDR might be for our local area. It's like creating a mini fire forecast station right in our classroom!

Remember, every piece of data counts. By acting like a field researcher, you're not only learning about the environment but also contributing to our understanding of bushfire risks. So, grab your gear, and let's get out there and measure!

Fire-EdUp



Anemometer (Kestrel 3000) - Wind speed, temperature & humidity

Using the Kestrel 3000 Anemometer for Bushfire Prevention Studies

Hello Future Fire Safety Experts!

Today, we're going to be like weather detectives. We'll use a gadget called the Kestrel 3000 to gather clues about the weather in our schoolyard. This isn't just any game of detective, though. The clues we find will help us understand if a bushfire might start and spread in our area. Let's get started!

1. Start Your Investigation:

- Press the power button on your Kestrel 3000 until the screen lights up. This means it's ready to go!

2. Catch the Wind:

- Look for the little orange fan, called an impeller, on your device. It catches the wind to tell us how fast it's blowing.
- Hold your Kestrel 3000 high where it can feel the wind, but make sure you're not blocking it with your body.
- The faster the wind, the higher the chance of a bushfire spreading. Check the screen to see the speed.

3. Feel the Air:

- The Kestrel 3000 can sense how much water is in the air, called humidity. Dry air can mean higher fire danger.
- Just let the Kestrel hang out in the air, but don't touch the sensor because your hands have moisture that could trick it.

4. Check the Temperature:

- The Kestrel also tells us how hot or cold it is outside. Since fires like it hot, this number is super important.
- For the best "temperature tale," keep the Kestrel out in the open for about 20 minutes, away from direct sun or your warm hands.

5. Switching the Story:

- To see different numbers like wind, heat, or humidity, press the mode button. The screen will show you which clue you're looking at.

Anemometer (Kestrel 3000) - Wind speed, temperature & humidity

6. Conclude Your Detective Work:

- After you've gathered all your clues, press and hold the power button to turn off the Kestrel 3000.

7. Record your data:

- Use the data table on page 12 to record your measurements.

We will be taking these numbers back to the classroom and feeding them into our computer program. It's going to use your detective work to calculate a simulated Fire Danger Rating and Fire Behaviour Index. This could help us predict and prevent bushfires. Pretty cool, right?

Remember to take care of the Kestrel 3000 - it's a vital tool for our bushfire prevention mission. And once we're done, we'll have a better idea of how safe our school and community are from the risk of bushfires.

For a step-by-step visual guide on how to use your Kestrel 3000, check out this handy video: **How to use a Kestrel 3000** https://www.youtube.com/watch?v=FipQ149mS9E. Watch it to see exactly how to be a weather detective!

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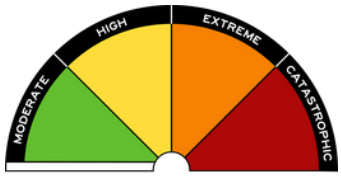

🔥 Fire-Ed Up! - Weather Detective Activity 🔍

Hey Future Weather Detectives,
Your mission, should you choose to accept it, is to uncover the secrets of the weather and how it might affect bushfires in our area. Are you ready to get started?

What You'll Need:

- Your sharp detective mind
- Access to the internet
- A gadget called an anemometer (Kestrel 3000)
- Graph paper for charting your discoveries

Your Detective Tasks:

1. **Weather Watch:**
   - Visit the BOM website and look up the latest weather scoop for your area. Use the BOM interactive map to select your nearest location.
   - Jot down the temperature, humidity, and wind speed every hour **on the table provided on the next page.**
2. **Gadget Time:**
   - Grab the Kestrel 3000 and take your own weather readings.
   - Record your findings in the table next to the BOM's numbers. Tables on the next page.
3. **Super Sleuthing:**
   - Put on your detective hat and figure out why your numbers might be different from the BOM's. Could it be buildings, trees, or maybe the time of day?
4. **Graphing Genius:**
   - Create a cool graph with your data. Make sure your graph has a title and labelled axes. Are you seeing any patterns?

Reflect:
Once you've completed your graph, think about what your data tells us. Could the weather conditions you observed lead to a bushfire? What does the difference between your readings and the BOM's tell us about local weather conditions?

Don't forget to share your findings with the class. You're now part of the elite team helping our community stay safe from bushfires!

Good luck, detectives! 🕵️‍♂️🕵️‍♀️

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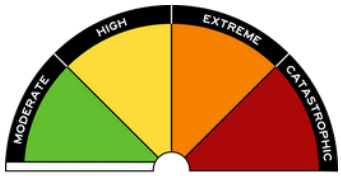


🔥 Fire-Ed Up! - Weather Detective Activity Data Sheet 🔍

Temperature (Deg C)

Time	BOM Temp	Your Temp	Difference
9 am			
10 am			
11 am			
12 pm			
1 pm			
2 pm			

Relative Humidity (%)

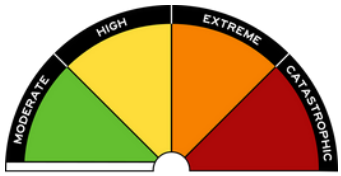
Time	BOM RH	Your RH	Difference
9 am			
10 am			
11 am			
12 pm			
1 pm			
2 pm			

Wind Speed (km/h)

Time	BOM Temp	Your Temp	Difference
9 am			
10 am			
11 am			
12 pm			
1 pm			
2 pm			

Graphing Genius:
Create a graph with your data. Make sure your graph has a title and labelled axes. Are you seeing any patterns?

Fire-EdUp



🔥 Fire-Ed Up! - Weather Detective Activity Data Sheet 🔍

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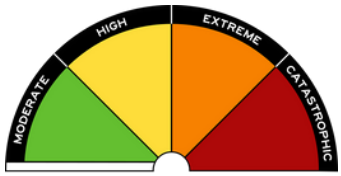


🔥 Fire-Ed Up! - The Moisture Detective Mission 🔍

Welcome, Junior Fire Scientists!

Your mission is to become a Moisture Detective and uncover the secrets of the forest floor. Let's find out how dry or damp the leaves and grass around our school are – it's super important for understanding bushfire risks!

What You'll Need:

- Your keen observation skills
- A safe area with leaves and grass (No leaf burning, that's for teachers only!)
- A notebook to jot down your findings

Learning About Fuel Moisture Content (FMC)

Fuel Moisture Content (FMC) means how wet or dry the leaves and grass are, and it's super important for figuring out bushfire risks.

Your Detective Tasks:

1. **Touch and Feel:**
   - Pick up some leaves from the ground and give them a good squish. Do they crumble like dry cereal or feel a bit damp?
2. **Listen for the Crunch:**
   - Walk on the leaves or grass. Do they sound super crunchy? That's a sign they're dry.

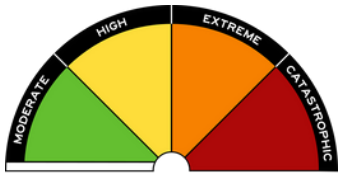
Complete the table below with your observations Junior Fire Scientists!

Task	What you found
Touch and feel.	
Listen for crunch.	

Further Experimentation

1. **The grassland Curing Mission:**
   - Observe the grass and make an observation about the % cured.
2. **Leaf Angle Test:**
   - This one's for the teacher! They'll do a special test by lighting a leaf to see how it burns. This test tells us about the moisture in the leaves. (Remember, no trying this yourself!)

Fire-EdUp



Fire-Ed Up! - The Grassland Curing Mission

What is Grass Curing?
Grass curing is all about how dry the grass is, which can affect how fast a bushfire spreads. As grass dries, it changes colour and texture. Let's learn how to read these signs!

Your Mission Objectives:

- **Observation Skills:**
  - Take a close look at the grass around our school or nearby field.
  - Use the guide below to identify the curing stage of the grass.
- **Colour Code Detective:**
  - Notice the colour of the grass and seed heads. Does it look green, yellow, or straw-coloured?
- **Seed Head Spy:**
  - Check out the seed heads of the grass. Are they developing, maturing, or have they dropped their seeds?
- **Landscape Lookout:**
  - Observe the overall landscape. Is it mostly green, half green and yellow, or mostly straw-coloured?

Complete your observations in the table below, use the table on grass curing - key attributes to assist.

Task	What you found
Grass colour	
Seed head status	
Landscape view	

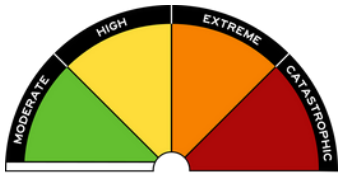


Table: Grass curing - key attributes

	% CURED OR % DEAD	GRASS COLOUR	SEED HEAD DEVELOPMENT	LANDSCAPE FEATURES
GREEN PHASE	0	Green	From beginning of grass growth to commencement of seed head development	Landscape is entirely green, no seed heads visible
	10	Green	Seed heads formed and flowering	Landscape is entirely green with green seed heads visible
	20	Green – Yellow	Seed heads maturing and seeds beginning to drop	Seed heads change colour; first easily visible appearance of dead material in landscape
	30	Green – Yellow	Most seed heads mature and seed dropping	Yellowing becoming apparent in leaves
YELLOW PHASE	40	Yellow – Green	Most seed heads mature and seed dropping	Green, with yellowing a significant part of landscape
	50	Yellow – Green	Up to ½ of all stems have dropped their seed	Landscape half green and half yellow
	60	Yellow – Green	Over ½ of all stems have dropped their seed	Yellow, with green a significant part of landscape
DRY PHASE	70	Yellow – Straw. Lower third of stalk may be green.	Most seed heads have dropped their seed	Minor amount of green or greenish-yellow visible in landscape
	80	Yellow – Straw	Almost all seed heads have dropped their seed	Non-significant amount of green or greenish-yellow visible in landscape
	90	Straw. Odd individual stalk may be green	Essentially all seed has dropped	Very little green showing anywhere, some green in wetter areas such as roadside and river valleys
	100	Bleached. All stalks fully cured	All seed heads have dropped their seed	No green anywhere in landscape

Source: CFA Grassland Curing Guide

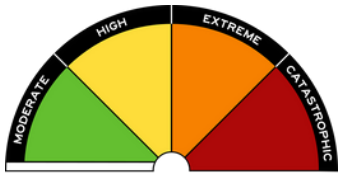
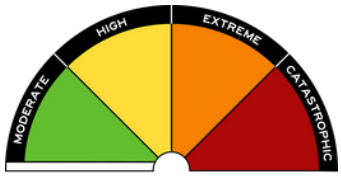


Table: Expected fire behaviour characteristics at different stages of curing under normal south-eastern Australia summer conditions.

	% CURED	WILL IT IGNITE?	FLAME HEIGHTS	SPREAD NOTES	SUPPRESSION DIFFICULTY
GREEN PHASE	0	No	N/A	Fire fails to spread	N/A
	10				
	20				
	30				
YELLOW PHASE	40	Maybe, especially if substantial thatch is present	Low, typically lower than the fuel height	Fire front will be fragmented. Fuel consumption will be patchy. Fire will be carried by thatch underneath current season's growth. Smoky.	Low
	50				
	60	Yes	Medium	Fragmented fire front with faster spread rates in areas of dry fuels. Patchy fuel consumption. Smoky.	Moderate
DRY PHASE	70	Yes	Medium	Fire spread will be moderate. Patchy areas of green will slow spread. Smoky.	High
	80	Yes	High	Fire spread will be fast. Under strong winds, fire will be difficult to suppress.	High
	90	Yes	High	Fire spread will be very fast under strong winds.	Very high
	100	Yes	High	Fire spread will be very fast under strong winds.	Very high

Source: CFA Grassland Curing Guide

Fire-EdUp



Fire-Ed Up! - The Leaf Test Mission

For Teachers: Demonstration Guide
Welcome to a fascinating demonstration that will engage your students in understanding Fuel Moisture Content (FMC) through the Leaf Test. This activity is not only educational but also vital in illustrating how moisture in leaves can influence fire behaviour.

Purpose of the Demonstration:

- To show how the moisture content in leaves affects their combustibility.
- To help students understand how different levels of FMC impact fire risk.

Safety First:

- Only teachers should perform the leaf burning test.
- Ensure all safety protocols are followed, including having fire extinguishers and water nearby.

Materials Needed:

- A variety of leaves from different locations and depths.
- A safe, controlled environment for burning leaves.
- Matches or a lighter.
- A fireproof surface or container.

Demonstration Steps:

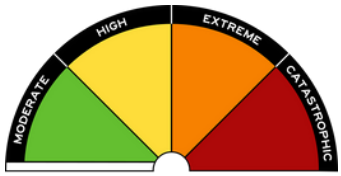
- **Leaf Collection:** Collect several leaf samples from different areas and depths around the school grounds.
- **Explain the Test:** Briefly explain to students how the angle of the leaf during burning can indicate its moisture content.

Performing the Test:

- Ignite a leaf and observe how it burns at different angles:
- **Record Observations:** For each leaf, note the angle at which it maintains combustion and the corresponding Fuel Moisture Content (FMC) percentage from the figure on the next page.

Leaf sample	Description of angle	Description (E.g. Wet, Dry)	Fuel moisture content %
Sample 1			
Sample 2			
Sample 3			

Fire-EdUp



Fire-Ed Up! - The Leaf Test Mission

Classroom discussion

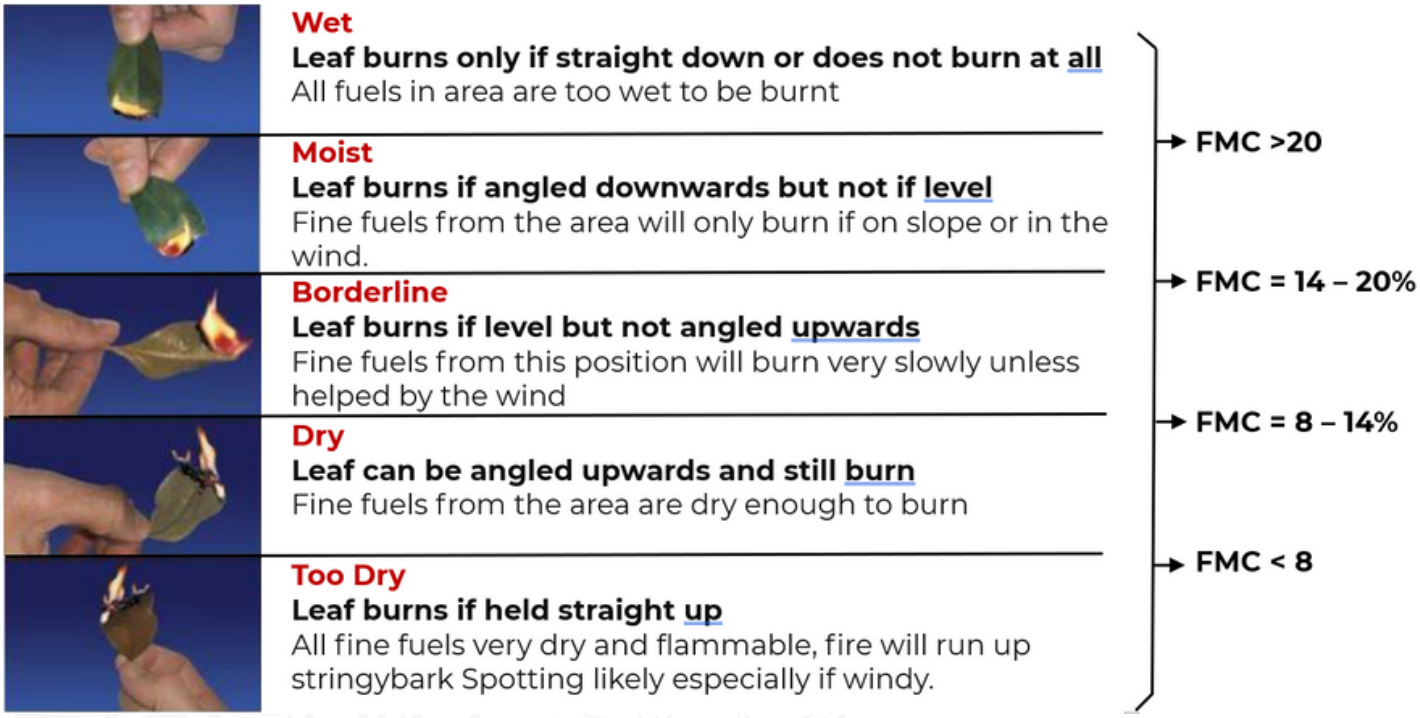
- Discuss the results and what they indicate about the potential fire behavior.
- Talk about how this knowledge is vital for hazard reduction and bushfire preparedness.

Think About It:

- How can understanding FMC help in predicting and managing bushfires?
- Why is it important to test leaves from various locations and depths?

Fuel Moisture Content Guide

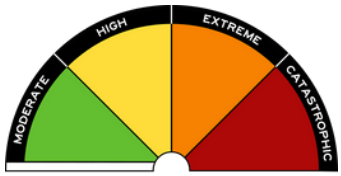
Source: NSW Rural Fire Service Firefighter's pocket book



Mission Complete!

Congratulations on completing the leaf test mission!

Fire-EdUp



Fire-Ed Up! - Slope Sleuth Mission

Welcome, Junior Fire Scientists!
Gear up for an exciting mission to discover how the slope of the land affects bushfires. You'll be using a tool called a clinometer to measure the slope.

What You'll Need:

- **A Clinometer:** Your tool to measure the slope.
- **A Partner:** Teamwork makes the slope work!
- **A Notebook:** To record your awesome findings.

Learning About Slope and Fire Behaviour:
The angle of the land (slope) can make a huge difference in how fast a bushfire spreads. For every 10 degrees uphill, a fire's spread rate doubles. Downhill, every 10 degrees decreases the spread rate by half.

How to use a Clinometer?
Our friends at Rumbalara Environmental Education Centre have produced this helpful video to explain how they are used to determine slope.

Your Mission Objectives:

1. **Partner Up:**
   - Find your slope buddy. You'll work together to find the slope level.
2. **Slope Detective:**
   - Use your clinometer to measure the slope where you're standing. Is it going uphill, downhill, or flat?
   - **Record the slope.** Remember, if it's negative, you're looking downhill.

Long-Distance Lookout:

- For a better average slope reading, try to pick a far point up or down the hill to balance out the land's ups and downs.

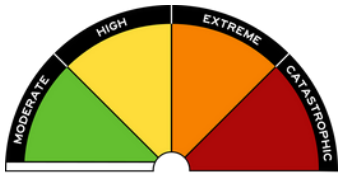
Task	Slope in Degrees	Notes
Partner at eye level		
Long distance lookout		

Think About It:

- Why is knowing the slope important in predicting how a bushfire will behave?
- How can understanding slope help in planning for bushfire safety?

Mission Debrief:
Share your findings with the class. Discuss how different slopes around our school might affect bushfire risks.

Fire-EdUp



🔥 Fire-Ed Up! - Fuel Load Finder Mission 🌿

Welcome, Junior Fire Scientists!
Prepare for an exciting mission where you'll learn to measure the amount of fuel (like leaves and scrub) that could feed a bushfire. You'll use the Knee-Waist-Shoulder Method - a cool way to estimate fuel load.

What You'll Need:

- **Your Observant Eyes:** To inspect and estimate fuel.
- **A 2-Metre Radius Area:** Choose a typical spot in a forest or bushland.
- **A Notebook:** To jot down your awesome calculations.

Learning About Fuel Load:
Fuel load is all the stuff on the ground and in the bushes that can burn in a fire. The more fuel, the bigger a fire can get.

Your Mission Objectives:

1. **Ground Litter Gauge:**
   - Look at the litter (like leaves) on the ground.
   - Estimate how much of the ground is covered in litter (in %).
   - Guess how deep the litter is in centimetres.
   - Use the formula: Every 10% cover x 2cm depth = 1 tonne per hectare.
   - Example: If 90% is covered and it's 4cm deep, that's 36 tonnes per hectare!
2. **Scrub Survey:**
   - Look at the scrub (bushes and small plants).
   - Divide the scrub into layers, each 0.5 meters high.
   - Estimate how much of each layer is covered in scrub (in %).
   - For each layer, every 20% cover = 1 tonne per hectare.
3. **Total Calculation:**
   - Add up the ground litter and all three scrub layers to find the total fine fuels.

Layer	% cover	Depth or layer	Calculated load (T/ha)
Ground litter			
Lower scrub (0-0.5m)			
Middle scrub (0.5-1m)			
Upper scrub (1-1.5m)			
Total fine fuels			

Fire-EdUp

Scrub survey guide
Source: NSW Rural Fire Service Firefighter's pocket book

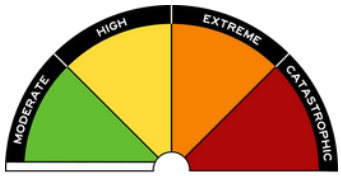
Total fine fuels - Example calculation

Layer	% cover	Depth or layer	Calculated load (T/ha)
Ground litter	70%	3 cm	10.5 t/ha
Lower scrub (0-0.5m)	100%	Lower	5 t/ha
Middle scrub (0.5-1m)	100%	Middle	5 t/ha
Upper scrub (1-1.5m)	20%	Upper	1 t/ha
Total fine fuels			**21.5 t/ha**

Think About It:

- Why is knowing the fuel load important in predicting bushfires?
- How can this knowledge help in planning for bushfire safety?
- Once you've finished, share your findings with the class. Discuss how different fuel loads might affect bushfire risks in our area.

Fire-EdUp



Fire-Ed Up! - Data Sheet Summary

***Brining it all together!**

It's time to put all the stuff we've learned into action. We're going to use all the data we collected to create our own Fire Behaviour Index (FBI) using a super special gadget. This gadget uses a Raspberry Pi Pico microcomputer and some neat input and output devices.

Here's What We'll Do:

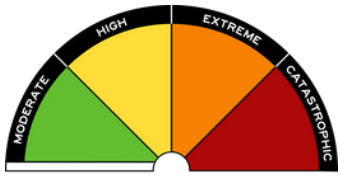
1. Gather Your Data: Think about all the fieldwork and observations we did – like checking out the fuel load, measuring the slope, and using tools like the Kestrel and Clinometer.

2. Fill Out the Table: Put all your findings in the table below. This info will be the brain food for our digital FBI device.

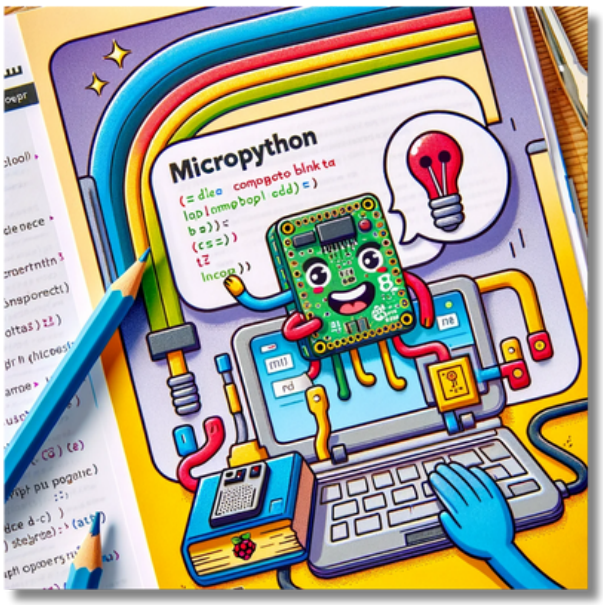
3. Create the FBI: Our gadget will take your data and turn it into a Fire Behaviour Index. It's like making a mini weather and fire forecast station!

Observation	Collected data	Suffix
Vegetation model		E.g. Grassland
Temperature		Degrees Celsius
Relative humidity		%
Wind speed		Km/h
Slope		Degrees
Fuel load		Tonnes per hectare
Fuel moisture content		%

Fire-EdUp



Welcome to MicroPython!



What is MicroPython?

- MicroPython is a lean and efficient version of the Python programming language that's designed to run on microcontrollers like the Raspberry Pi Pico. It's Python, but for small devices!

Why MicroPython?

- **Easy to Learn:** If you know Python, you already know MicroPython! And if you don't, it's a great place to start.
- **Interactive:** You can write commands and see results instantly, making learning fun and fast.
- **Powerful:** Despite being small, it lets you control hardware and create cool projects.

Getting Started with MicroPython

1. **Connect Your Microcontroller:** Plug your Raspberry Pi Pico or another device into your computer.
2. **Install MicroPython:** Load the MicroPython software onto your microcontroller. For the Fire-Ed Up program we are going to use the computer program Thonny. Thonny is a free and open-source integrated development environment for Python that is designed for beginners. It was created by Aivar Annamaa, an Estonian programmer. Thonny comes with MicroPython built in, so just one simple installer is needed and your ready to learning programming. https://thonny.org/
3. **Start Coding:** Write your first lines of code and see them work in real-time.

What Can You Do with MicroPython?

- **Blink an LED:** Learn the basics of electronic control by turning an LED on and off.
- **Read Sensors:** Measure light, temperature, or even your heartbeat.
- **Control Motors**: Make things move with your code, like a robot or a remote-controlled car.
- **Build Games:** Create simple games that you can play with friends.

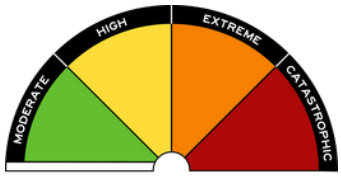
Tools You'll Need

- A microcontroller that supports MicroPython (like the Raspberry Pi Pico)
- A USB cable to connect your microcontroller to a computer
- A text editor or an integrated development environment (IDE) to write your code. For example thonny

Fire-Ed Up

In the Fire-Ed Up program students will learn a little about the MicroPython programming language as they modify code using Thonny to make our Bushfire Danger Rating simulator to be more accurate.

Fire-EdUp



In order to be able to use the Fire-Ed Up microcomputer kits and complete the activities we must first learn about some basic computer concepts. Students will need to learn about, variables, constants and algorithms.

Introduction to Variables

What are Variables?

- Variables are like storage boxes in programming. They hold information that can change, just like how the contents of a backpack can change every day.

Why Use Variables?

- We use variables to store data that we want to keep track of and change throughout our program.

Example:

- Think of a game score. As you play the game, your score changes. We can store your score in a variable to keep track of it.

Creating Variables

How to Create a Variable?

- To create a variable, we give it a name and then assign a value to it.

Example:

- score = 0 (This means we have created a variable named score and set it to 0.)

Changing Variables

How do Variables Change?

- Variables can be updated. This means the value they hold can be changed throughout the program.

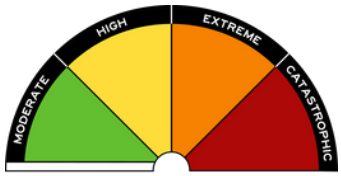
Example:

- If you earn 10 points in a game, we can update the score variable: score = score + 10

Fire -Ed Up

In the Fire-Ed Up program students will work with a number of variables that are required to get the Fire Danger Rating simulation device to work. Variables will include: **Fuel Load, Fuel Moisture, Temperature, humidity and windspeed.**

Fire-EdUp



Understanding Constants in Programming

What are Constants?

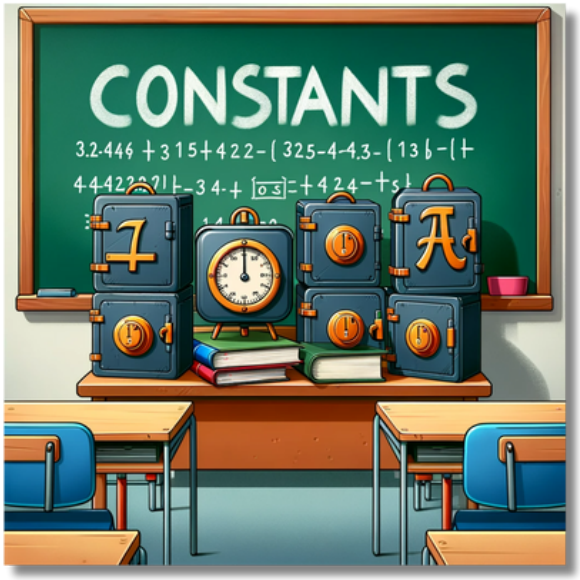
- Constants are like the name tags on the storage boxes. They hold information that does not change, just like how your name doesn't change.

Why Use Constants?

- Constants are used to store data that we know will not change throughout our program.

Example:

- The number of days in a week is always 7. We can store this in a constant.



Creating Constants

How to Create a Constant?

- To create a constant, we give it a name and assign a value, just like variables, but this value will never change throughout the program.

Example:

- DAYS_IN_A_WEEK = 7

Comparing Variable and Constants

Understand the difference?

- Variables are changeable. Constants are not.

Example:

- **'playerName'** could be a variable because different players can have different names.
- **'MAX_PLAYERS'** could be a constant because the maximum number of players might not change.

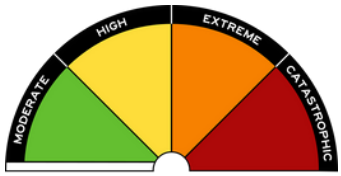
For each of the following, decide if it should be a variable or a constant and explain why.

- The number of apples in a basket as apples are taken out or put in.
- The color of a red traffic light.
- The number of pages in a book that you've read.

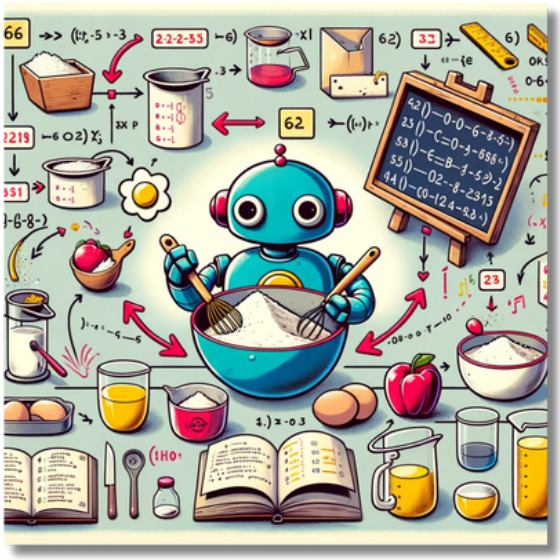
Fire -Ed Up

In the Fire-Ed Up program students will work with a number two constants these include:
Vegetation Model and Slope

Fire-EdUp



Understanding Algorithms



What is an Algorithm?
An algorithm is a set of instructions or steps that are followed to complete a specific task. Think of it like a recipe in a cookbook, which tells you step by step how to cook a dish.

Where do we see Algorithms?
Algorithms are everywhere! They are in the games you play, the phone you use, and even in the traffic lights that control the flow of cars.

How do Algorithms Work?
Algorithms take inputs (like ingredients for a recipe), perform a series of steps, and then produce an output (the finished dish).
They must be clear and precise; otherwise, the task might not be completed correctly.

Why are Algorithms Important?
They help solve problems efficiently and consistently.
They are the foundation of computer programs and technology.

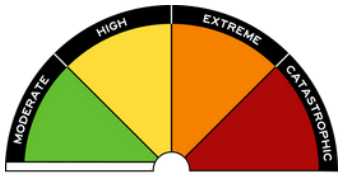
Characteristics of a Good Algorithm
1. **Clear and Unambiguous:** Each step is clear and leads to only one meaning.
2. **Well-Ordered:** Steps are in a logical order from start to finish.
3. **Effective:** The algorithm should solve the problem it was designed to solve.
4. **Finite:** The algorithm should have an end. It can't go on forever.

Examples of Simple Algorithms
A to-do list is an algorithm for organising your day.
Instructions for assembling a toy are an algorithm.

Algorithms in Mathematics
Algorithms help you solve math problems, like addition or multiplication, by giving you a step-by-step process to follow.

Fire behaviour models (Algorithms)
Fire behaviour models are mathematical models **or algorithms**, usually tailored to specific vegetation types, that describe the way fire moves and spreads through those vegetation types.

Fire-EdUp



Algorithms

Below is an example of a simple Algorithm for making Vegemite on Toast.

1. **Start**: Begin the program.
2. **Get Ingredients:** Bread, Vegemite, butter (optional).
3. **Check Bread:** Is the bread fresh? If not, get a new loaf.
4. **Plug in Toaster:** Prepare the toaster for use.
5. **Insert Bread:** Place slices of bread into the toaster.
6. **Set Toaster:** Choose the desired toastiness level.
7. **Wait:** Allow bread to toast.
8. **Is Toast Done?:** Check if the toast is done.
   - If yes, proceed to the next step.
   - If no, continue toasting.
9. **Remove Toast:** Carefully take the toast out.
10. **Butter Toast (Optional):** Spread butter on the toast while it's warm.
11. **Spread Vegemite:** Apply Vegemite to the toast.
12. **Serve:** Place the toast on a plate.
13. **End:** The process is complete.

Fire-Ed Up Algorithm

Imagine you have a magic math formula that uses the numbers and information you gathered from your earlier experiments. This special formula is like a recipe that, when followed, gives you a special number. This number is called an integer, which is just a fancy way of saying a whole number, like 1, 2, 3, and so on, all the way up to 200. It doesn't have any pieces or parts like a fraction does.

When you put in all your information, which are some things that can change (these are called variables) and some things that always stay the same (these are called constants), the formula does its magic. It gives you a number that helps us understand the risk of a fire in your area. This number is like a score that can show up on a computer screen and tell us if the risk of a fire is Moderate, High, Extreme or Catastrophic, similar to the way Australia figures out the danger of fires.

The magic math formula is the algorithm that we are going to use for the Fire_Ed Up kits.

FBI = Vegetation Model X Slope X Fuel Load(Fuel Moisture + Temperature + Humidity + Wind Speed)

FBI = Fire Behaviour Index

Note: Our simulated FBI uses a simplified model as is not the same as the official FBI.