Bushfires and Science in Disaster Resilience Education

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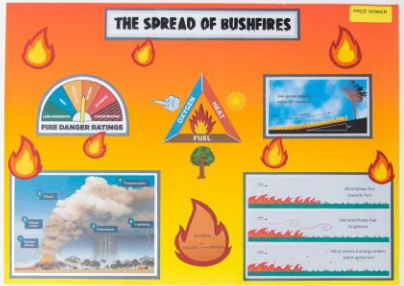
Introduction

- Who are the CFS?
- Our roles within the organisation
- Our involvement in education
- Our goals in education and for today's session



Introduction to Disaster Resilience Education

- What is Disaster Resilience Education (DRE) ?
- Why learn it?
- Frameworks
- Benefits of DRE

Australian Institute for Disaster Resilience

Bushfires and STEM

- We approach our understanding of bushfires through Science
- It's not just about the chemistry of combustion, there are physical, biological and psychological concepts that contribute to public safety
- Crosses with Geography and Environmental studies
- Consider cross curricular/integrated project based learning approaches that use big un-Googleable questions

Basic Bushfire Behaviour

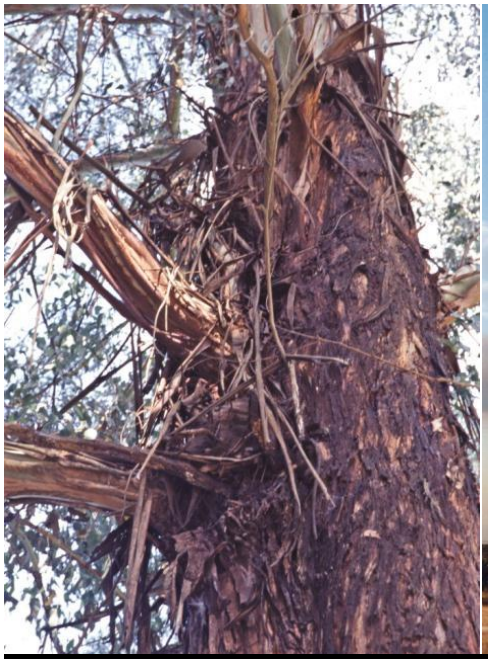
- There are a range of factors that affect how bushfires behave
- Fire services use science to inform what they do
- This include how warning messages are constructed and communicated
- As we go through this part identify links to the curriculum you teach
- Consider the range of research methods and inquiry skills that could be used in the classroom.

First, the easy links

- Fire is combustion
- Fire is hot
- Fire changes the landscape
- Organisms have adaptations to live with fire
- Weather influences fire

You can be creative and go deeper when you recognise more of the ways science is expressed in bushfires

3 factors that affect bushfire behaviour



Fuel

Weather

Hills & valleys

Fuel

- More fuel = hotter fire
- Drier fuel = hotter and faster
- Small fuel = hotter and faster
- Oil content = hotter and faster
- More salt content = less hot
- Lots of bark = lots of embers

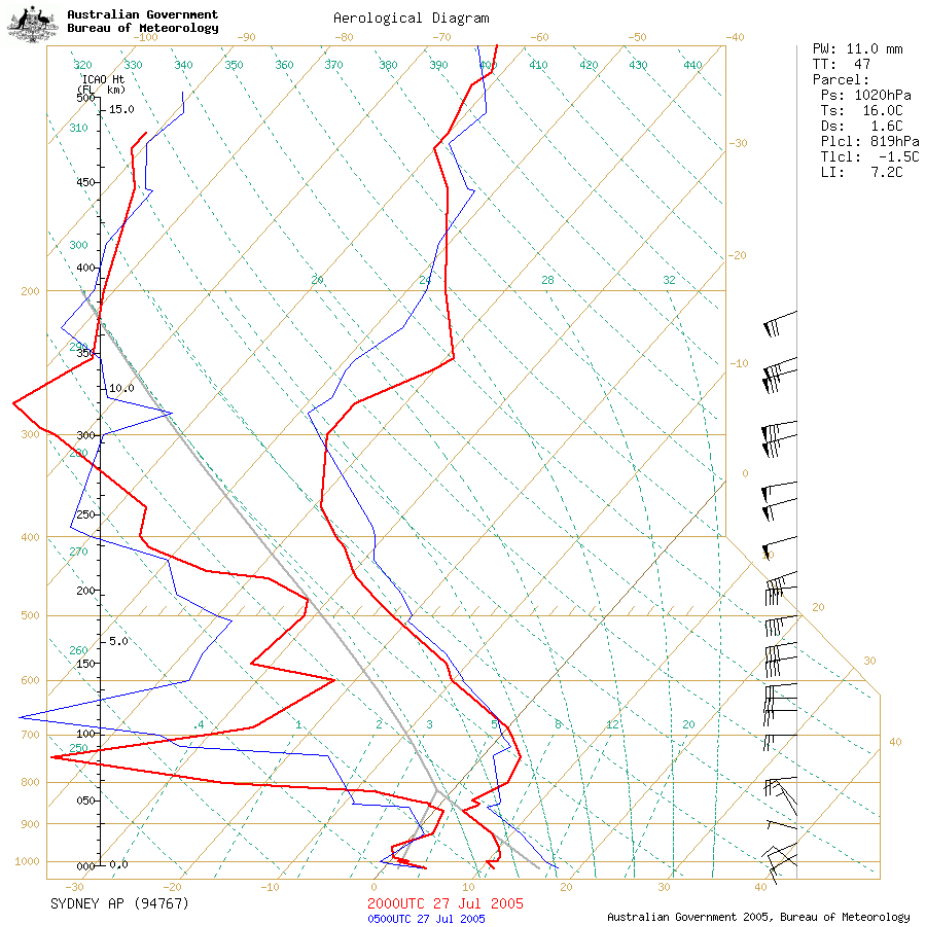
Weather factors affecting bushfire behaviour

Temperature

Relative humidity

Wind speed and direction

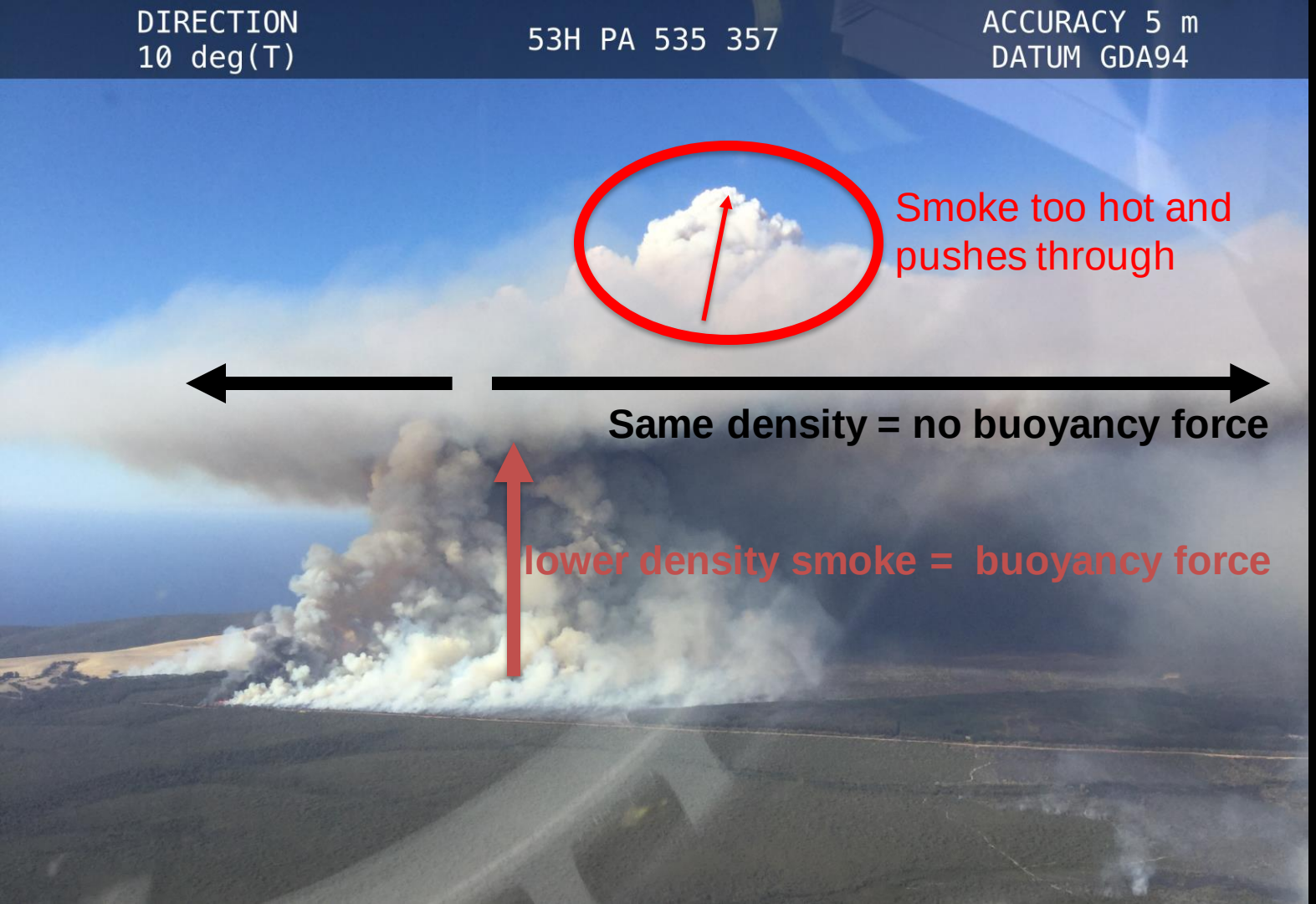
Atmospheric Stability

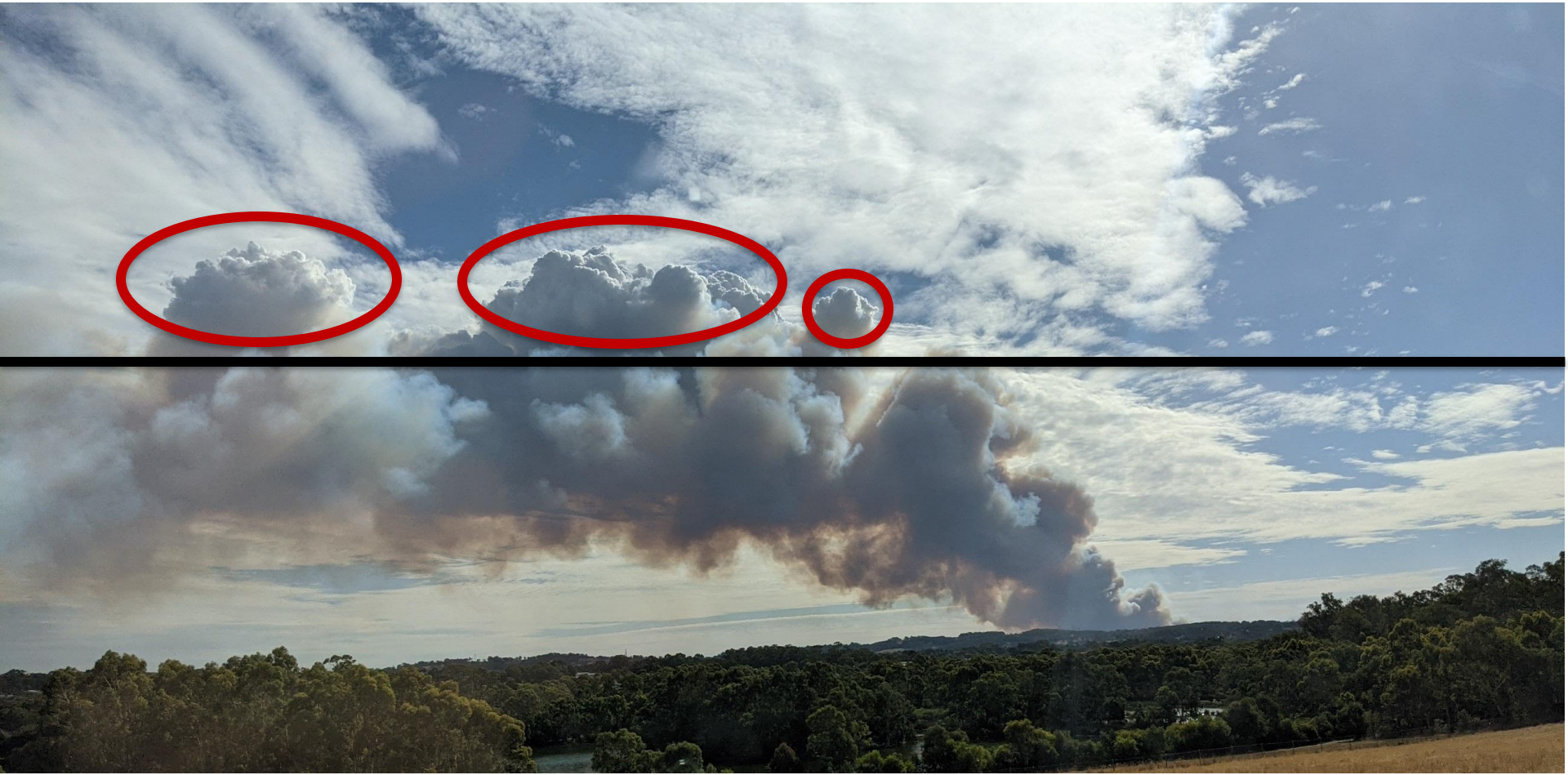


Aerological Diagram: The air temperature and dryness with altitude.

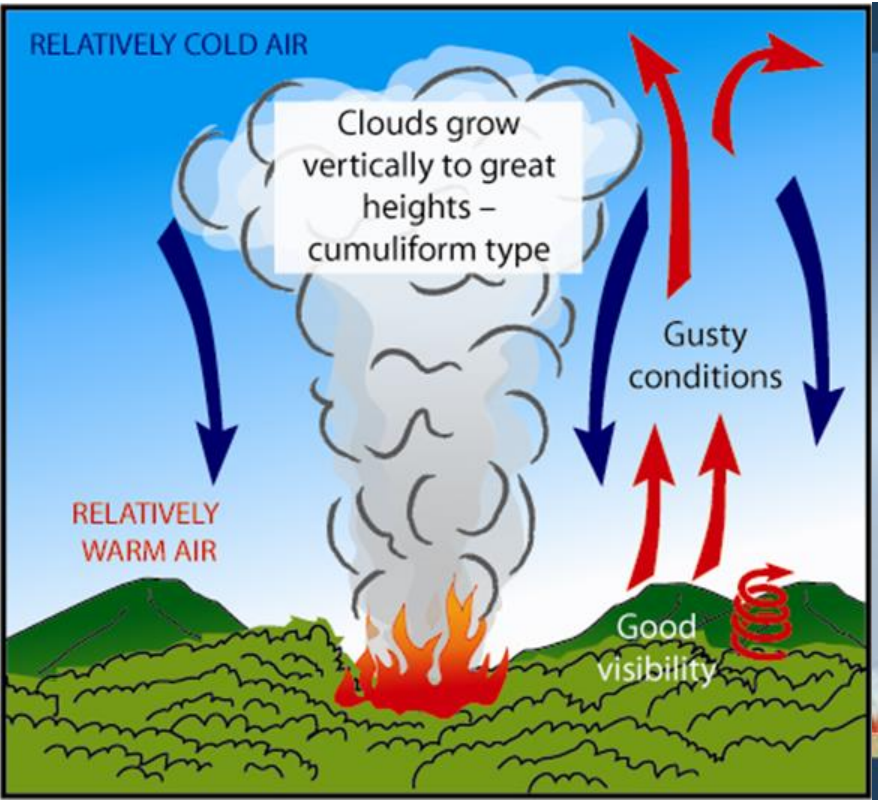
Continuous Haines Index: Measure of atmospheric stability from 0 - 13

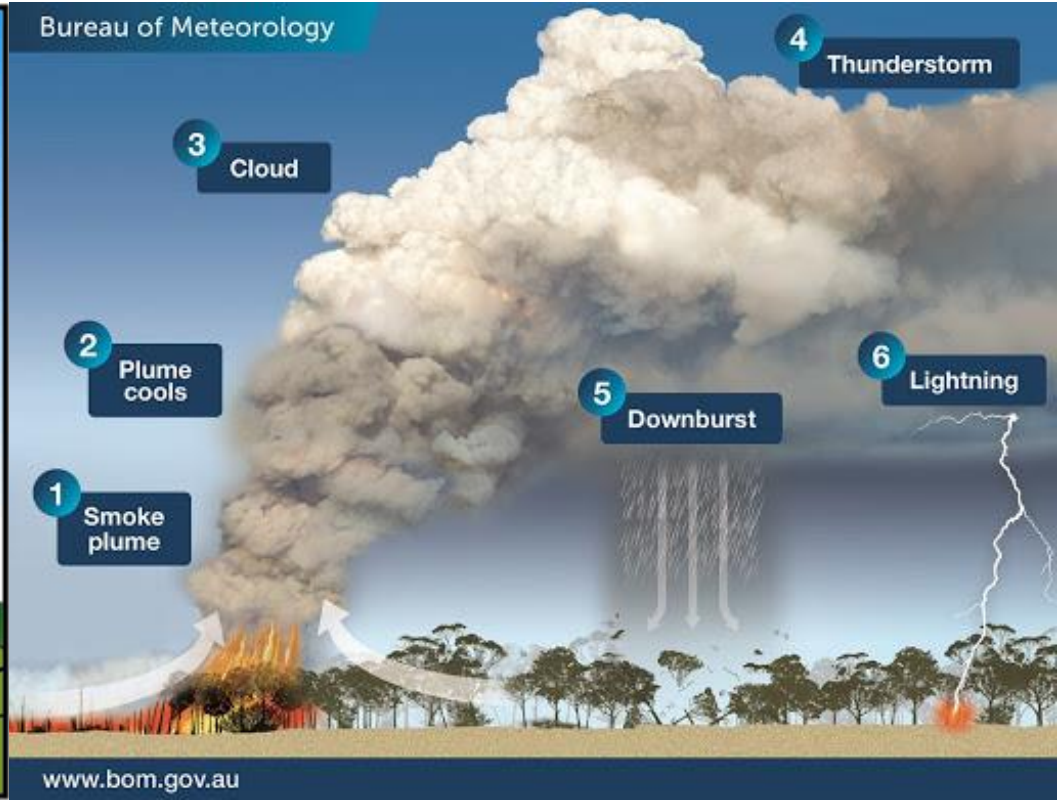
Stability = resistance to upwards motion


DIRECTION
10 deg(T)
53H PA 535 357
ACCURACY 5 m
DATUM GDA94
Smoke too hot and
pushes through
Same density = no buoyancy force
lower density smoke = buoyancy force



Who cares?


RELATIVELY COLD AIR
Clouds grow vertically to great heights – cumuliform type
Gusty conditions
RELATIVELY WARM AIR
Good visibility


Bureau of Meteorology
1 Smoke plume
2 Plume cools
3 Cloud
4 Thunderstorm
5 Downburst
6 Lightning
www.bom.gov.au

Links to curriculum?

Science Understanding:

3 Heat can be produced in many ways and can move from one object to another ACSSU049 – Maybe, smoke rises into the atmosphere and then stops rising

4 Forces can be exerted by one object on another through direct contact or from a distance ACSSU076

5 Solids, liquids and gases have different observable properties and behave in different ways ACSSU077

6 Electrical energy can be transferred and transformed in electrical circuits and can be generated from a range of sources ACSSU097 – How does a smoke cloud make lightning?

Links to curriculum?

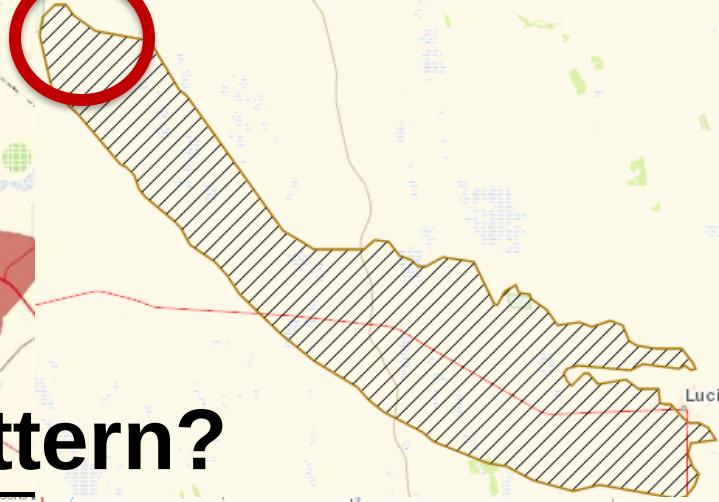
Science Understanding continued:

7 Change to an object's motion is caused by unbalanced forces, including Earth's gravitational attraction, acting on the object ACSSU117 – Buoyancy

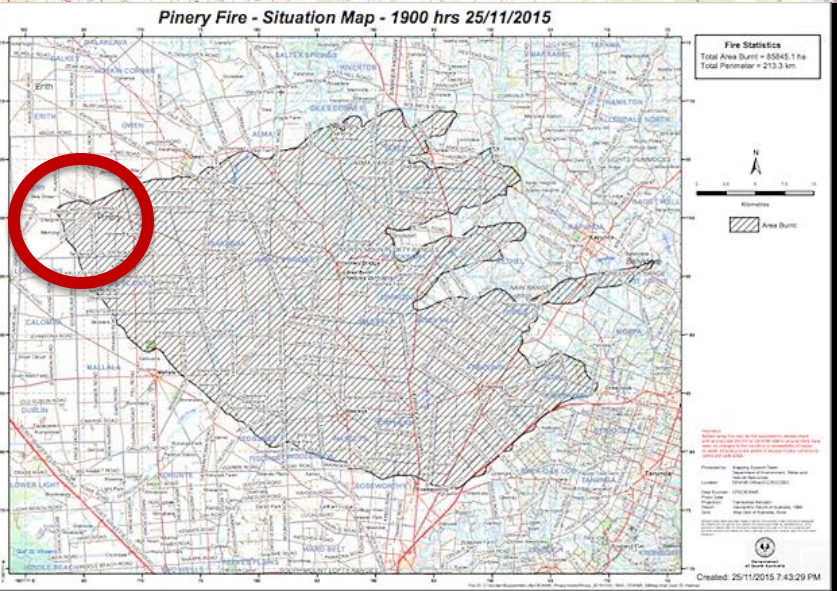
8 Energy appears in different forms, including movement (kinetic energy), heat and potential energy, and energy transformations and transfers cause change within systems ACSSU155

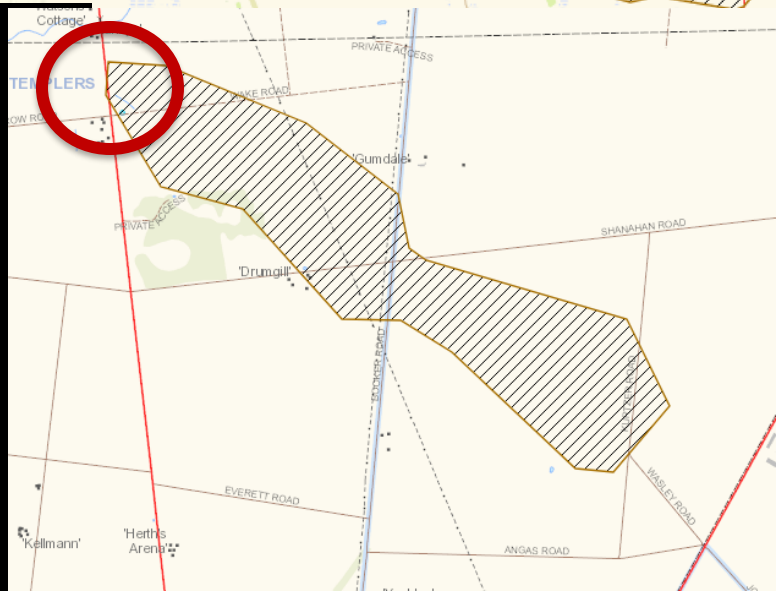
9 Chemical reactions, including combustion and the reactions of acids, are important in both non-living and living systems and involve energy transfer ACSSU179

10 The motion of objects can be described and predicted using the laws of physics ACSSU229

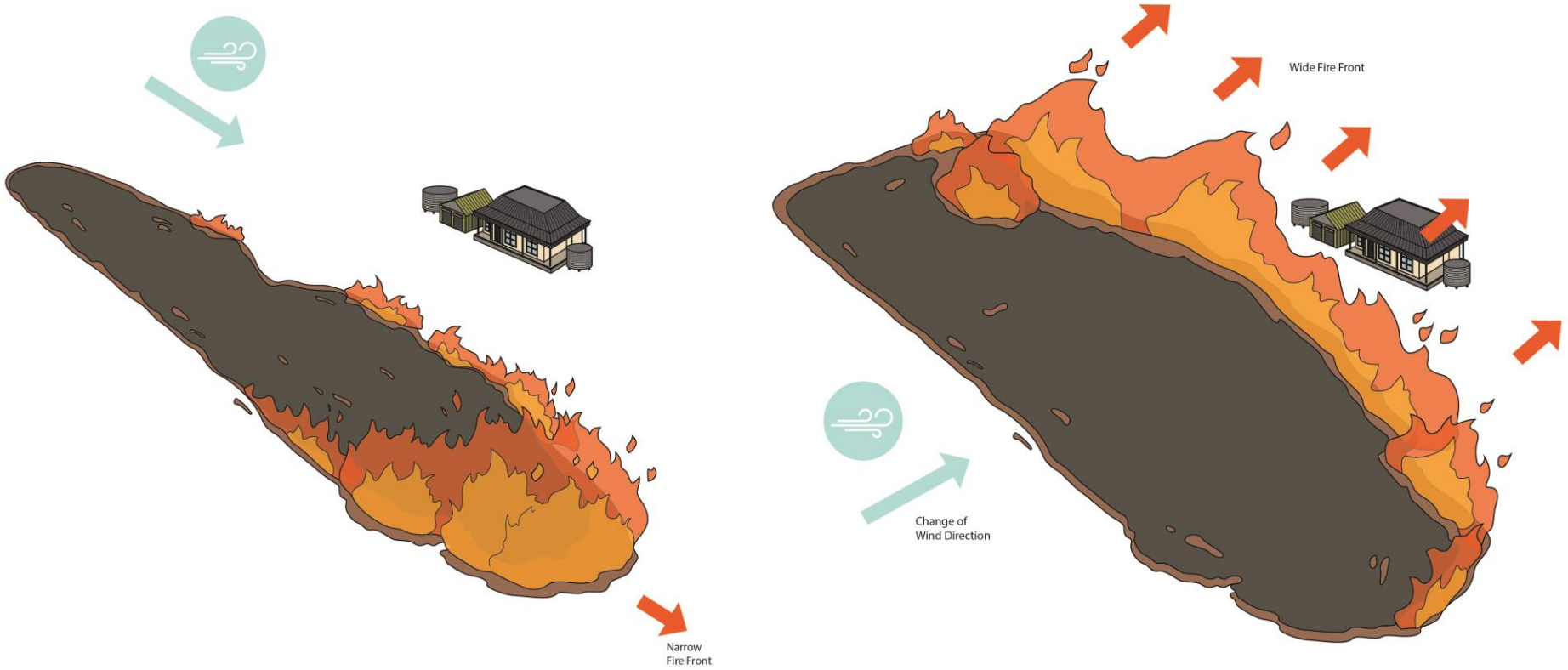


Do you see a pattern?





Effect of wind change



Topography factors affecting bushfire behaviour

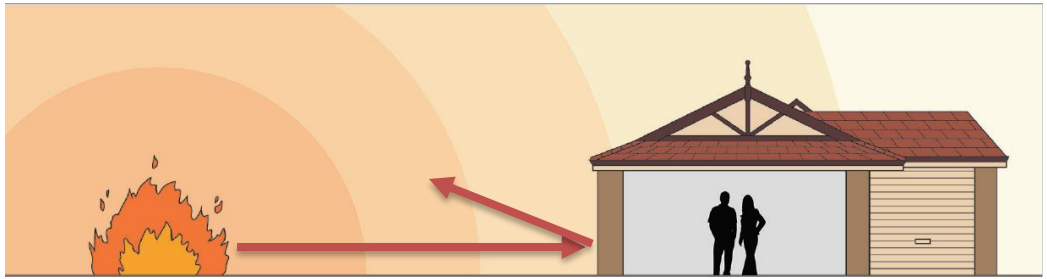
Speed doubles for every 10° of upslope

Fire intensity increases going up hill

Radiant heat

Radiant heat is the major killer

Best protection is distance



Can be blocked by a solid object

Bushfire Safer Places

Bushfire Safer Place 	Adelaide Metropolitan area, outer suburbs and rural towns. Plan to use during forecast bad fire weather or during a bushfire May be subject to sparks, embers and smoke.
Bushfire Last Resort Refuge 	Ovals, buildings in rural areas. Only use if your plan has failed. Not suitable for extended use. Will be subject to sparks, embers and smoke.

The McArthur Fire Danger Index

First developed in the 1960s by McArthur to measure the degree of danger in Australian forests.

Relative humidity + wind speed + temperature + soil dryness = **Forest Fire Danger Index**

Relative humidity + wind speed + temperature + soil dryness + fuel load + slope =

Forward rate of spread and spotting distance

Fire Danger Rating	What does it mean?	What should I do?	
CATASTROPHIC TOTAL FIRE BAN	• These are the worst conditions for a bush or grass fire • Homes are not designed or constructed to withstand fires in these conditions • The safest place to be is away from high risk bushfire areas	• Leaving high risk bushfire areas the night before or early in the day is your safest option – do not wait and see • Avoid forested areas, thick bush and long, dry grass • Know your trigger – make a decision about: – when you will leave – where you will go – how you will get there – when you will return – what you will do if you cannot leave	**100+**
EXTREME TOTAL FIRE BAN	• Expect extremely hot, dry and windy conditions • If a fire starts and takes hold, it will be uncontrollable, unpredictable and fast moving. Spot fires will start, move quickly and will come from many directions • Homes situated and constructed or modified to withstand a bushfire, that are well prepared and actively defended, may provide safety • You must be physically and mentally prepared to defend in these conditions	• Consider staying with your property only if you are prepared to the highest level. This means your home needs to be situated and constructed or modified to withstand a bushfire, you are well prepared and you can actively defend your home if a fire starts • If you are not prepared to the highest level, leaving high risk bushfire areas early in the day is your safest option	**75 - 99**
SEVERE TOTAL FIRE BAN	• Expect hot, dry and possibly windy conditions • If a fire starts and takes hold, it may be uncontrollable • Well prepared homes that are actively defended can provide safety • You must be physically and mentally prepared to defend in these conditions	• Well prepared homes that are actively defended can provide safety – check your Bushfire Survival Plan • If you are not prepared, leaving bushfire risk areas early in the day is your safest option	**50 - 74**
VERY HIGH **HIGH** **LOW – MODERATE**	• If a fire starts, it can most likely be controlled in these conditions and homes can provide safety • Be aware of how fires can start and minimise risk • Controlled burning may occur in these conditions if it is safe – check to see if permits apply	• Check your Bushfire Survival Plan • Monitor conditions • You may need to act • Leave if necessary	**0 - 49**

The McArthur Fire Danger Index

- Has been refined and redeveloped over the years based on research
- New models have been developed for different fuel types
- Less reliable at the extreme end of the scale
- There is a brand new system in development: Fire Behaviour Index

Modern FDI uses

- Determining warnings
- Planning and choosing fire suppression strategies
- Influencing building developments

Spreadsheet…

Research in action

https://www.youtube.com/watch?v=7A0MzSPLGL8

https://www.youtube.com/watch?v=EqobwYgL578

Links to curriculum?

Consider the many links to the Science as a Human Endeavour strand.

CSIRO PyroPage
Putting science into practice

www.csiro.au

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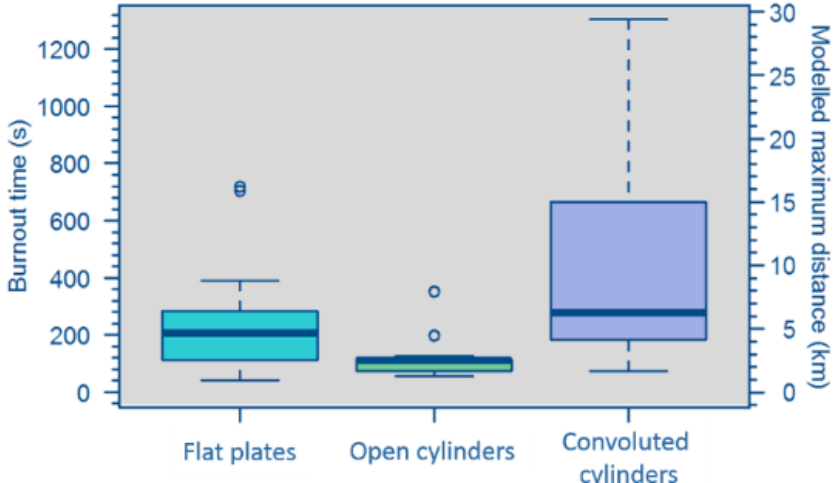
Quantifying the potential for long-distance spotting

Fires burning in forests of ribbon bark eucalypts such as *Eucalyptus viminalis* (manna gum) and *E. rubida* (candlebark) have a notorious reputation for producing firebrands that can travel enormous distances and start spotfires up to 40 kilometres downwind of the main fire. Recent work has investigated the mechanisms by which ribbon bark might travel these distances and determined that a key factor is the shape of the bark.

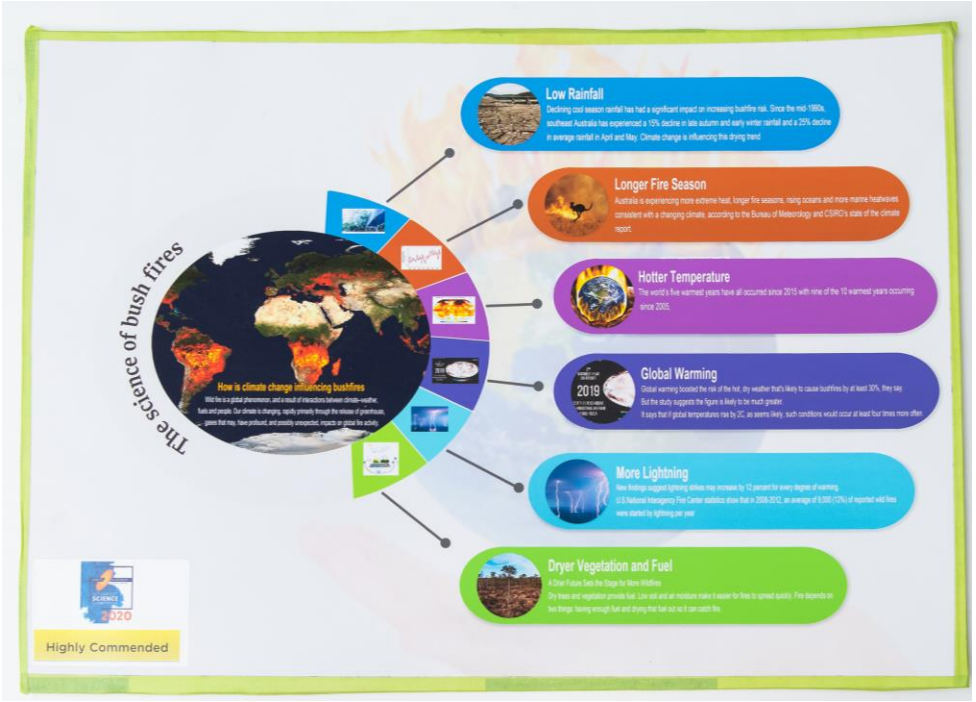
1. Flat plates (less than 0.4 rotations of bark)
2. Open simple cylinders (0.8-1.2 rotations of bark) and
3. Internally convoluted cylinders (more than 1.6 rotations of bark).

Figure 2. The three bark morphologies studied: Flat plate, open simple cylinder, and internally convoluted cylinders.



Burn table demonstration

- Move out to the quadrangle
- We will demonstrate some real life fire behaviour
- How does the CFS use it as a learning tool



What can you design from the burn table?

- What are the variables?
- What could be investigated?
- What could be demonstrated?
- How can it be used in the real world to help people
- Cross curriculum/integrated

Further resources

www.cfs.sa.gov.au

www.schools.aidr.org.au/

www.research.csiro.au/pyropage/

www.bnhcrc.com.au/

www.environment.sa.gov.au/topics/fire-management

www.bom.gov.au/weather-services/fire-weather-centre/