



Disaster Resilience in Victorian Schools: Educating Students Using Interactive Lesson Plans

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Abstract

The purpose of this project was to help Year 8 students at Emerald Secondary College develop knowledge and awareness about bushfire safety to improve local disaster resilience. To accomplish our goal, we developed online lesson plans that combined interactive technology, project-based learning, and community involvement to educate students on how to reduce risk and manage emergencies in their local area. We collected and analyzed student feedback to improve the lessons and provide a strong foundation for future disaster resilience education.

Executive Summary

Every year, Australians are faced with a deadly range of natural disasters from cyclones to bushfires. These disasters cause millions of dollars in damage and can inflict hundreds of casualties (AIDR, 2020). Given Australia's harsh bushfire season and the increasingly dangerous effects of a warming climate, bushfires have become a primary risk for the country. The most recent Australian bushfires in 2019-2020 burned about 25.5 million acres of forest and killed over 1 billion animals and over 30 people (Woodward, 2020). Australian authorities recognize that the most effective way to cope with bushfires and improve disaster resilience is through community involvement and fire management awareness (Brady & Webb, 2013). Furthermore, community involvement can be improved by engaging children in fire management education and connecting them with community experts.

Educating children about **disaster resilience** has proved to reduce the negative impacts of disasters, since children can help spread awareness of disaster resilience strategies throughout their community and improve disaster resilience efforts (Anderson, 2005). Despite the high risk of bushfires in Victoria, some schools currently do not have disaster awareness or resilience incorporated into their curriculum (Pfeffer Baum, 2018). The goal of our project was to help Year 8 students at Emerald Secondary College develop safety, knowledge, and awareness to improve local disaster resilience. To accomplish this, we developed **online lesson plans** that combined interactive technology, project-based learning, and community involvement to effectively educate students on disaster resilience.

We used technology as a backbone to create enriching learning experiences for digital technology students, which included projects and activities that could be used by Emerald Secondary College to assess student learning. We identified the following **objectives** to guide our project work:

1. To assess students' knowledge about disaster resilience at Emerald Secondary College
2. To develop disaster resilience lesson plans for Emerald Secondary College students
3. To remotely deliver lesson plans to students
4. To prepare effective resources for future disaster resilience education

For this project we designed **disaster resilience lesson plans** for students at Emerald Secondary College in Victoria, Australia. Our lesson plans were aimed at teaching three digital technology classes of 20 students each. Since this project was conducted amid the COVID-19 pandemic, the scope of our teaching and method of delivering lesson plans had to be modified given the circumstances. Due to a nationwide lockdown, all Victorian schools switched to remote learning, with our team working remotely from the Eastern US and Dubai, UAE. This meant that we had to deliver our lesson plans remotely, alter our lesson format, and limit software usage to allow students to learn with limited access to computers and internet at home.

Due to the high local risk of bushfires in Victoria, the lessons focus on bushfire disasters in communities and regions in Australia.

We used digital technology to simulate these natural disasters and present methods of response. Students then applied their knowledge by creating their own poster describing the risks of a bushfire emergency and what response actions could be taken. To involve students with their community experts, we contacted fire experts from Country Fire Authority (CFA), Australian Institute for Disaster Resilience (AIDR), and the Australasian Fire and Emergency Service Authorities Council (AFAC) to provide feedback on the student projects and answer any questions the students had about bushfires and emergency response.

To achieve our objectives, we first gathered data about **students' level of interest and knowledge of bushfires** by giving them a pre-assessment form to complete. This provided us with information about what students already knew about bushfires and what they do prevent and prepare for them. The students were also asked what they would like to learn about bushfires, which helped us **create engaging lesson material**. We believed the most effective way to deliver the lesson plans and maximize the student's ability to participate was by creating interactive, visual-based lesson plans that were easily accessible online. Furthermore, each lesson unit concludes in a creative assignment or project that provides students with an opportunity to demonstrate their knowledge and share it with local and national fire experts. To **remotely deliver lesson plans** to students we created a website to host all our lessons using Google Sites. The lesson plans were interactive, visual-based experiences delivered on an accessible, intuitive, and reliable platform. Finally, to **prepare effective resources for future disaster resilience education**, we collected data on the successes and failures of the project by surveying students. The quantitative data from the student surveys was analyzed using simple statistics to compare each students' self-rankings before and after the lesson plans. The feedback extracted from the analysis of student responses was used to suggest improvements to the lesson plans for future use.

The methods laid out above were implemented into the Year 8 Digital Technologies classroom over 3 weeks. The website consisted of 3 units: Disaster Resilience, Fire Dynamics, and Local Risk Profiles. After completing the units, the students created bushfire response posters to demonstrate their learning.

The first unit was **Disaster Resilience**. The unit focused on teaching students about key concepts and terminology that was used throughout the lessons. We also introduced the AIDR and gave the students a broader sense of disaster management and how to build safer, stronger communities for any disaster. We began the lesson by providing students with learning material and terminology relating to disaster resilience. Next, we introduce some games, activities, and quizzes to keep the students engaged in the material while simultaneously assessing their learning. The students then complete an interactive project where they use Google Maps to make an interactive map and add pins to the map that describe disasters in and around Australia. This can be seen in Figure ES1. The last part of the unit was a help and feedback forum created using

Padlet. This provides students the opportunity to voice their concerns and suggest feedback to improve the lesson.



Figure ES1: Unit 1 Student Disaster Map

The second unit is **Fire Dynamics**. This unit starts to focus on bushfires as the most prominent natural disaster in the Emerald area. We present the students with information about how fire spreads and the key factors that affect its behavior, as well as important actions to take before, during, and after a bushfire. We also provide information on how fires spread and introduce the three main elements that affect the spread of fire: terrain slope, wind speed and direction, and fuel density. The unit is concluded with another interactive project that showcases how tree density affects the spread of fire. We gave students access to a simulation model that demonstrates how changing the tree density of an area affects the percent of trees burned. The goal of the project was to let students interact with the simulation and cumulatively establish where a ‘phase shift’ occurs in the simulation curve. The simulation can be seen in Figure ES3. Letting students use technology to explore simple concepts like this encourages them to do their own experiments and draw their own conclusions, which overall leads to a better understanding of the content they are learning.

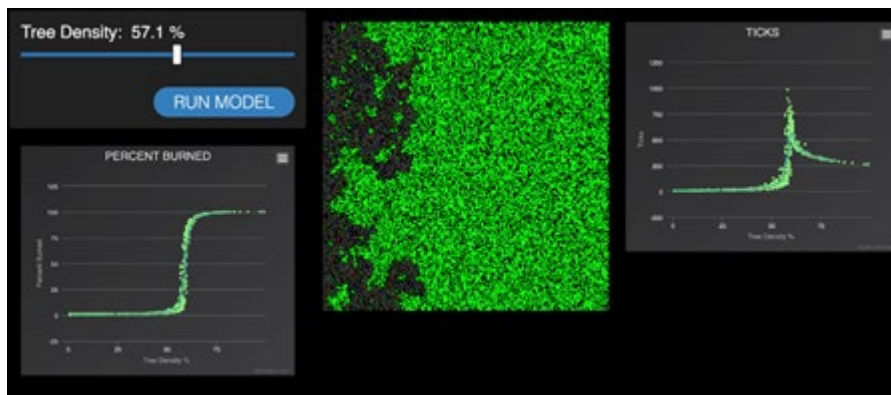


Figure ES2: Bushfire Tree Density Simulation Model

The third unit is **Local Risk Profile**. This unit is a combination of everything the students have learned so far and includes simulating bushfires in their area and how their community might effectively respond. For the first activity in this unit, we made an interactive video lecture where we simulated bushfires in Emerald to explore the three main elements from unit 2: slope, wind, and fuel density. The simulations use a software called AnyHazard, an interactive 3D simulation software, shown in Figure ES3 This allowed us to create scenarios that show how different conditions can affect the spread of fire in a simulation.

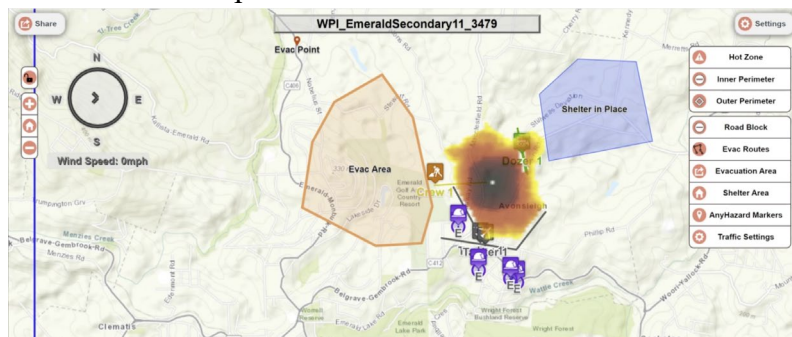


Figure ES3: Example scenario using the AnyHazard Software

We ended our lesson plans with a **Final Student Project**. The project was a culmination of the previous units and required students to apply everything they had learned to create a bushfire response plan for their local community in Emerald. We provided students with a base fire scenario map, as seen in Figure ES5, that students then used to create a community response plan. Students were asked to look at an elevation map of Emerald and the wind direction of the fire to draw and label evacuation zones on the map and safe rally points that people could gather at. Students were also required to mark shelter areas where people needed to wait for response teams to assist them, and identify 3 things on the map that could influence the fire's behavior. A sample bushfire response plan created by one of the students can be seen in Figure ES6.

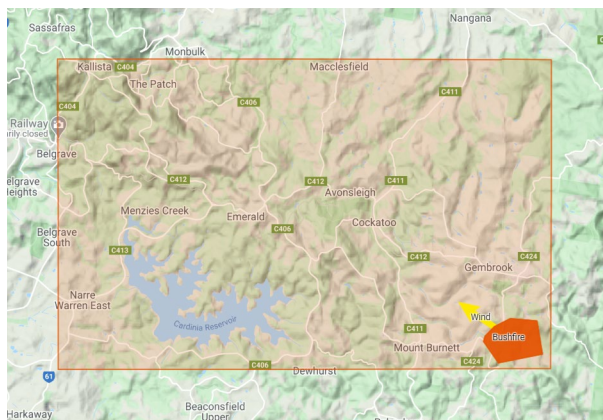


Figure ES4: Base Scenario Map

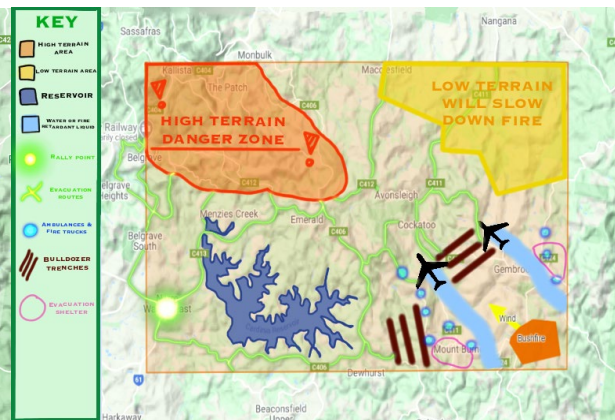


Figure ES5: Example Student Bushfire Response

At the conclusion of the Lesson Program, we proceeded to compare results from the pre- and post-assessments to gather data on quantifying student learning and determining the successes and shortcomings of the Lesson Program. The comparison between data from our pre-assessment and post-assessment showed that there had been a significant improvement in students' self-reported knowledge about bushfires, as seen in figure ES7. Compared to the pre-assessment where most students reported having 'moderate' knowledge about bushfire, after completing our lesson program most reported having 'good' or 'excellent' knowledge about bushfires. Additionally, there was a marked increase in the number of students who correctly identified all stages of disaster resilience from 20% to 39.4%.

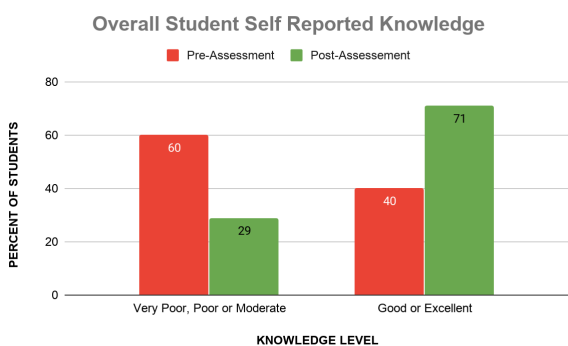


Figure ES6: Self-Reported knowledge of bushfire

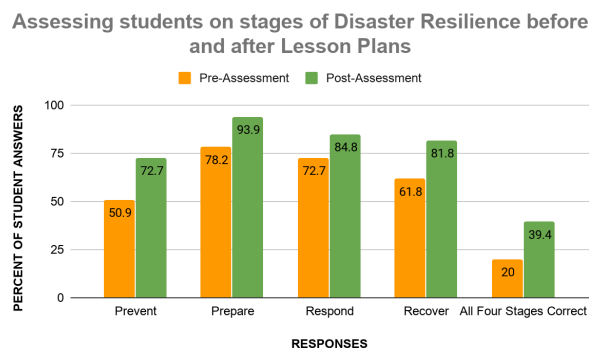


Figure ES7: Stages of Disaster Resilience

Our data also showed that students were able to identify more methods of preventing bushfire than they were able to before completing our lessons. Our analysis showed that after the lesson program, 68% of students were able to identify more than one method of preventing bushfires. Students enjoyed having the local/national fire experts participate in the project experience and felt that they learned more using interactive activities, games, and simulations. When asked about aspects of our projects that students did not like, responses were usually students pointing out that they liked all aspects, but had suggestions on how to improve, which is exactly the type of data we were seeking by prompting this question. We used this data to shape our conclusions and recommendations.

Our results suggest that the Disaster Resilience Lesson Program successfully taught various aspects of disaster resilience and can be used as a resource for creating lessons that improve community resilience. The technological aspects, especially the simulations and games, were extremely popular among students and were effective in maintaining student interest and improving learning. This form of interactive online education was essential for remote student learning during the COVID-19 lockdowns. The types and frequency of games and activities was effective, though we recommend providing more succinct instructions in the process. We also recommend integrating a learning management system with our assessments, so that grades can be recorded and used to track student learning.

Authorship

This paper represents the collaborative work done by all authors, with many modifications made along the way by each author. Contributions by each author were made to each section, although each author initially had certain sections of the paper that they created and continued contributing to. Sections not mentioned in the breakdown of initial section creation were not traceable to an individual initial author and were contributed to in equal parts by each author. The breakdown of initial creation of section by author is as follows: Bradley LaGrasse was the initial creator of sections 2.4, 3.3, 4.1, 4.2, 4.3, 6.2 and 6.3. Aditya Malik was the initial creator of the Abstract and the Executive Summary, as well as sections 2.2, 3.1, and 4.4. Alec Mitkov was the initial creator of sections 2.1, 3.4, 5.1, 5.2, and 6.1.

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Table of Contents

1. Introduction	1
2. Background	3
2.1 Bushfires in Australia	3
2.1.1 History of Bushfires in Australia	3
2.1.2 Local Fire Risk Profile in Victoria	4
2.2 Disaster Resilience in the Community	6
2.2.1 Basics of Disaster Resilience	6
2.2.2 Community Involvement in Fire Resilience	7
2.2.3 Leaders in Victorian Disaster Resilience	7
2.3 Students' Role in Hazard Mitigation	8
2.3.1 Disaster Effects on Students	8
2.3.2 Student Perspective and Potential to Cause Change	9
2.4 Education Techniques for Disaster Resilience	9
2.4.1 Technology Enhances Learning	10
2.4.2 Bushfire Simulation Technology	10
2.4.3 Benefits of Community Involvement in Education	11
3. Methodology	12
3.1 Assessing Student Knowledge on Disaster Resilience	13
3.2 Developing Disaster Resilience Lesson Plans	14
3.2.1 Lesson Development Process	14
3.2.2 Lesson Plan Organization	15
3.2.3 Additional Considerations during Lesson Development	16
3.3 Remotely Delivering Lesson Plans To Students	16
3.3.1 Creating a Website	16
3.3.2 Grading the Students	16
3.4 Preparing Resources for Future Disaster Resilience Education	17
3.4.1 Collecting Student Data and Feedback	17
3.4.2 Analyzing Results to Improve Lesson Plans	17
4. The Final Online Lesson Plans	19
4.1 Unit 1: Disaster Resilience	19
4.2 Unit 2: Fire Dynamics	24
4.3 Unit 3: Local Risk Profile	28
4.4 Student Projects	32

5. Evaluation of Online Lesson Plans	34
5.1 Students' Knowledge Before Lesson Plans	34
5.2 Students' Knowledge After lesson plans	35
5.2.1 Improvement of Knowledge about Disaster Resilience	36
5.2.2 Improvement in Self-reported Knowledge of Bushfires	37
5.2.3 Improvement in Measurable Knowledge of Bushfires	40
5.2.4 Student Feedback on Lesson Plans	42
6. Conclusions, Recommendations and Future Applications	47
6.1 Recommendations Based on Data and Stakeholder Input	47
6.2 Resource Maintenance	48
6.3 Adaptations for In-Person Teaching	48
7. References	50
Appendix A: Lesson Plan Development Resources	53
Appendix B: Student Pre- and Post-Assessments	55
Appendix C: Lesson Plan Website	61
Appendix D: Student Project Instructions and Examples	85
Appendix E: Video Resources	91

1. Introduction

Every year, citizens in Australia are faced with a deadly range of natural disasters from cyclones and floods to fires and earthquakes. These disasters cause millions of dollars in damage and can inflict hundreds of casualties, leaving communities devastated (AIDR, 2020). Recently, Australia has dealt with severe bushfires, making them a primary risk for Australia.

Given the increasingly dangerous effects of a warming climate, Australia has a distinct vulnerability for widespread bushfires. Australia's abundance of dry, dense vegetation combined with the warming climate make it the most susceptible environment on the planet for deadly bushfires. The most recent Australian bushfires in 2019-2020 burned about 25.5 million acres of forest, nearly 100 times more forest destroyed than in California's entire 2019 fire season and nearly 25 times more destructive than the largest fire in United States History (Woodward, 2020).

Australian authorities recognize that community involvement and fire management awareness are the most effective methods for improving disaster resilience (Brady & Webb, 2013). Community involvement can be improved by engaging children in fire management education and connecting them with community experts. One of the central goals of this project is to improve community participation by allowing children to communicate with local experts about fire management education.

In areas where natural disasters occur often, education and prevention measures before disasters occur have proven to decrease the impact of these disasters on affected populations (Webb and Ronan, 2019). Children are one of the groups that are most sensitive to the after effects of disasters (Peek, 2008). Education of children has proven successful in reducing negative disaster impacts, due to their unique perspectives in planning disaster prevention measures (Anderson, 2005). Children can eventually help spread awareness of disaster resilience strategies through their community and improve disaster resilience efforts (Pfefferbaum, 2018). This method could be particularly useful in areas like Victoria, where the impacts from the 2019-2020 fire season were greatest.

Despite the high risk of bushfire in Victoria, some schools currently do not have disaster awareness or resilience incorporated into their curriculum (Pfefferbaum, 2018). Exposing students to palpable issues in their community will help them develop their leadership skills and allow them to take ownership of their learning. Alongside community involvement, another method to make education more engaging and interactive for students is to use technology in conjunction with project-based learning. Implementing mapping and simulation technology into disaster management lesson plans in schools may help promote active learning in the classroom and aid the development of interdisciplinary skills. Educating students in natural disaster awareness and developing their decision making skills will support the growth of a community that is ready to manage local hazards effectively.

The Australian Institute for Disaster Resilience (AIDR) has developed a variety of lesson plans on emergency management for students of all ages. In addition, AIDR connects classrooms

with community disaster management experts because interacting with local professionals allows students to learn about disaster resilience in exciting ways and grow their interpersonal skills. Elsewhere, technology has been used to help students apply their learning and simulate disasters based on their local risk. AIDR sponsored this project with the goal of combining disaster education, community involvement, and interactive technology to enable engaging experiences for children in the classroom. AIDR representative Brigid Little paired us with a digital technology teacher, Gary Vear, at Emerald Secondary College in Victoria, Australia.

The goal of our project is to help Year 8 students at Emerald Secondary College develop their understanding of bushfire risk and emergency management to improve local disaster resilience. To accomplish this, we developed online lesson plans that combine interactive technology, project-based learning, and community involvement to effectively educate students on disaster resilience. In the planning stages of the project, the COVID-19 pandemic arose and we were not able to travel to Australia to complete it in person, but we outline the many limitations that we worked around to still produce effective results. The feedback from the students at Emerald Secondary College was used to improve the lesson plans and provide engaging resources for AIDR to use in future disaster resilience education across Australia.

2. Background

Australia is affected by a large array of natural disasters including flooding, cyclones and bushfire. Flooding and rain are common natural disasters which significantly damage Australia annually. However, bushfire is the most devastating and threatening widespread natural disaster in Australia (The Commonwealth of Australia, 2018). The following sections investigate the prominence of bushfires, covering the role of fire management education and obstacles with current fire management operations in Australian communities.

2.1 Bushfires in Australia

Due to a uniquely dry and fuel-dense environment, Australia is prone to rapid bushfire propagation. As a result, the citizens of Australia frequently deal with devastating fires that take lives and destroy thousands of communities (Woodward, 2020).

2.1.1 History of Bushfires in Australia

The deadly mix of dry and fuel-dense conditions in Australia led to the ignition of the infamous Black Saturday Fires on February 7th, 2009, a chain of bushfires in Victoria that was the most fatal in modern Australian history. The fires killed a total of 173 people, and injured over 400 people. After one million acres of forest burned, it was evident that modern technology methods were inadequate for extinguishing bushfires (National Museum Australia, 2009). Although very deadly, the fires in 2009 were not the largest fires Australia has seen. Generally, Australia's fire seasons tend to be the largest and most devastating of all natural fire events on the planet, many of which can be larger than the 2009 fires (Woodward, 2020). Table 1 below shows that the latest fire season of 2019-2020 is by far the most devastating fire season on record in terms of acres of burnt forest, in both Australia and the world:

Australia fires compared to other major fire events

FIRE NAME	YEAR	NUMBER OF ACRES BURNED
Australia bushfires*	2019–20	25.5M 
Brazilian Amazon fires over 12 months	2019	17.5M 
Siberia fires in July	2019	6.4M 
Alaska fires over the summer	2019	2.5M 
Worst California wildfire season	2018	1.9M 
Peshtigo fire: Worst fire in US history	1871	1.2M 
Australia's Black Saturday bushfires	2009	1.1M 
Latest California wildfire season	2019	260K 
California Camp Fire	2018	153K 

*As of January 7, 2020

Sources: Reuters; IPNE; NASA; Cal Fire; Weather.gov; National Museum Australia

INSIDER

Table 1: Australia Fires Compared to Other Fires The table compares the intensity and impact of other major historic fire events compared to the 2019-20 Australian bushfires. (Shyanne Gal, Insider Magazine 2020)

In recent years, summers in Australia have grown longer with increasing temperatures, turning Australia's dense bush into fuel. In October 2019, a lightning storm struck an area of dry vegetation in New South Wales leading to the largest bushfire in modern history (Tarabay, 2020). Although not as deadly as the Black Saturday bushfires of 2009, the 2019 fires in New South Wales and Victoria alone destroyed a record-breaking 16 million acres of forest by January 2020, nearly eight times more forest than all of California's 2018 fires. Thousands of people had to evacuate in 2019 because of the fire, which destroyed 2500 homes, devastating hundreds of communities in the process (Tarabay, 2020). According to the University of Sydney's Professor Chris Dickman, an environmental scientist and ecological expert working on mammal conservation, approximately one billion animals were killed as a result of the 2019 bushfires, which drove multiple species into a threatened or nearly extinct conservation status (University of Sydney, 2020). Scientists believe that in some isolated areas, the fires caused irreversible damage to the ecosystems in Victoria and New South Wales (Tarabay, 2020). The reasons behind this bushfire's intensity vary greatly, with many complicated factors driving the mechanics of the inception and spread of bushfires.

2.1.2 Local Fire Risk Profile in Victoria

Not every region in Australia is equally at risk to bushfire. Understanding the risk that is presented to any given area is important for both preparedness and response to the risk. Across

Australia, the government and emergency services create local risk profiles for different regions. A local risk profile is the description of the local threats to a specific area, and the impact of these threats to that area. An example of a high risk area would have a lot of urban development in a rural area, which leads to large populations that are very close to dense forests and tall mountains.

As described in the introduction, our project is focused on developing disaster resilience lessons for students in Emerald Secondary College. Emerald is a suburb of Melbourne in the East Central district, which is the highest bushfire risk region in the state of Victoria (Country Fire Authority, 2018). This makes Emerald a very effective target audience for improving disaster resilience through education and community involvement. To visualize the spread of the 2019-2020 fires in relation to Emerald Secondary College, we created a map of the fires in the vicinity of Emerald during the course of the latest fire season, shown in Figure 1 below:

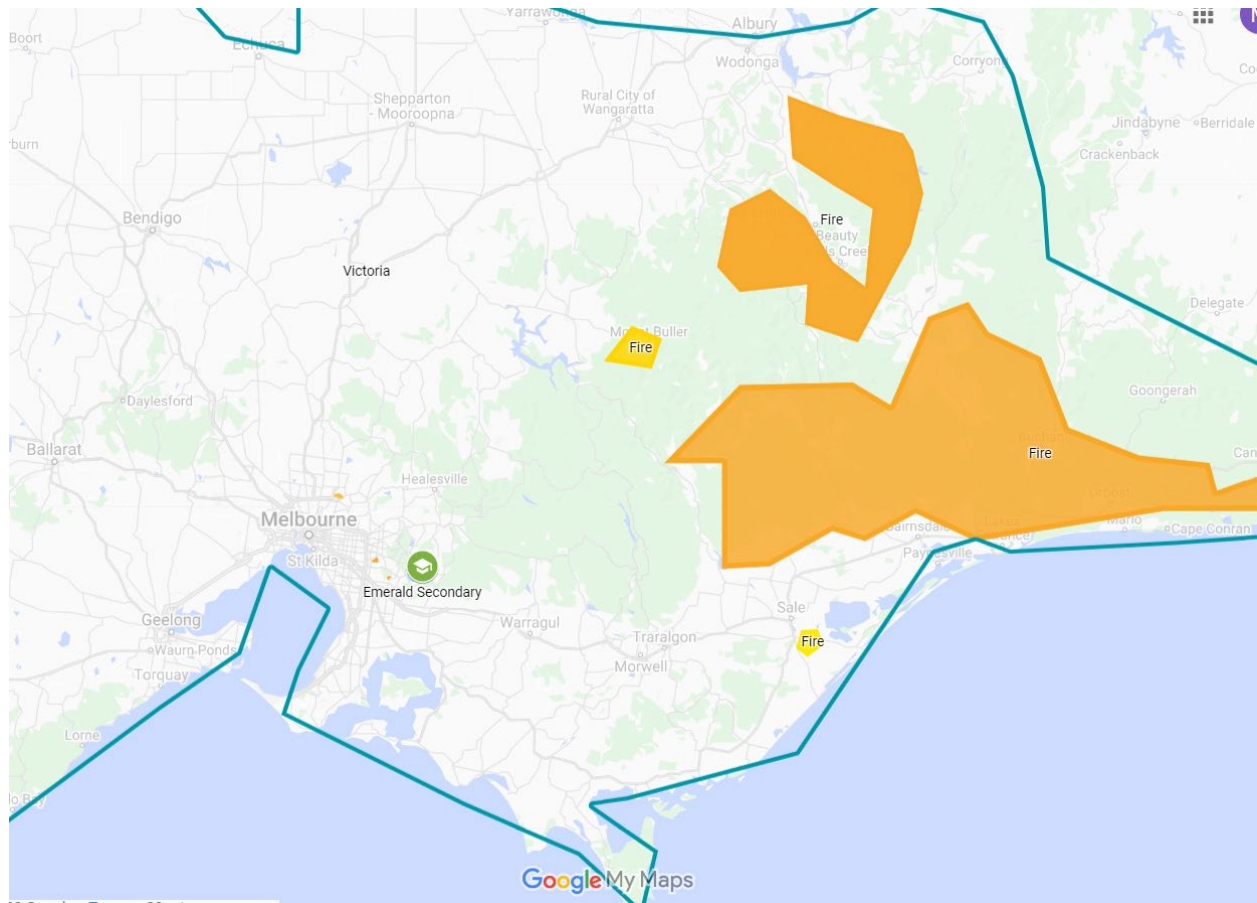


Figure 1: Approximate Fire Locations Relative to Emerald, 2019-2020 The orange and yellow speckles on the map represent some of the approximate locations of fire, as gathered from satellite data (NASA, 2020).

Large Fires came dangerously close to the citizens of Emerald in the 2019-20 bushfire season, and some smaller fires even occurred between Melbourne and Emerald. Disaster resilience—and in particular, fire resilience—is therefore highly relevant to the citizens of Emerald who could potentially benefit from education on these topics.

2.2 Disaster Resilience in the Community

The aptly named Australian Institute for Disaster Resilience (AIDR) focuses on working towards a disaster resilient Australia as part of their mission. In the point of view of AIDR, disaster resilience can be achieved through action at each stage of the disaster management cycle. The stages are Prevention, Preparedness, Response and Recover as shown in Figure 2:



Figure 2: *The AIDR Disaster Resilience Cycle*

2.2.1 Basics of Disaster Resilience

The prevention stage of disaster management focuses on making sure hazards do not cause harm in the future, which could include actions such as reducing the risk of fire and clearing dense bush. The magnitude and speed of a wildfire depends upon ambient temperature, fuel load, fuel moisture, wind speed, and slope angle (Bushfire, 2017). A large presence of fallen branches, bark, and leaf litter in the area will lead to a higher fuel density and more intense fires. Prescribed burning is one of the most established, yet controversial, fuel reduction methods of preventing severe wildfires. It is a coordinated approach to manage fuel density in forests, which mitigates the effects of spontaneous wildfires on humans and the ecosystem (Burrows & McCaw, 2013).

Preparedness covers preparing or planning for a hazard or disaster so that people can be ready before they occur. Examples of this include creating an escape plan or packing a survival kit. People can be taught about these concepts to keep them more prepared, and evidence from a few studies show an increase in disaster resilience knowledge in students and their families (Gibbs et al., 2018).

Response covers all aspects of responding or reacting to a hazard or disaster while it is occurring. This could include airdropping water or fire retardant on a fire, or rescuing civilians in

need. For example, any rescue or fire management operation conducted by the Country Fire Authority (CFA) or other emergency service during a bushfire is considered part of the response stage of disaster resilience.

The recovery stage of disaster resilience shows an area or community recovering from a disaster personally, socially, economically and environmentally such that it is ready to continue with the cycle of disaster resilience, which is prevention, in an effort to stop similar disasters or hazards from occurring. Communities should also plan for shelters where people can gather in time of a wildfire. Fire Adapted communities are based on the understanding that wildfires are a natural phenomenon and should not be interfered with. Therefore, instead of trying to control the spread of wildfires using methods such as prescribed burning, communities could be built to withstand wildfires. The issue with implementing fire management strategies is that their effectiveness largely depends on the region, climate, and vegetation in the area. Furthermore, wildfire control is all about management, values, and choice. The most effective way to deal with conflict is to raise awareness about disaster resilience and different fire management strategies and where they can be utilized successfully.

2.2.2 Community Involvement in Fire Resilience

Although various effective fire management strategies exist, implementing them can be difficult. There is widespread disagreement throughout Australia about the most effective method of fire management: while scientists on the Intergovernmental Panel on Climate Change (IPCC) call for action for managing fire and natural disasters, the public perceives fire management as “a political issue that involves trade-offs between nature, people and assets” (Anderson, Chubb & Djerf-Pierre, 2018, p.938). Most importantly, Australian authorities and emergency responders understand that cooperative communication about bushfire safety is imperative to progress. However, progress is noticeably constrained by politics, media coverage, limiting legislature, and public scrutiny (Brady & Webb, 2013).

These issues indicate that improved public awareness and education on bushfire management is key to developing community fire resilience. The Australian government inquiries into the severity of recent fires in the past few decades show that the central recommendation for improving bushfire safety is improving community participation in the matters that relate to bushfire emergencies and policy (Brady & Webb, 2013).

2.2.3 Leaders in Victorian Disaster Resilience

The sponsor for this project, The Australian Institute for Disaster Resilience (AIDR), is an important contributor to Australian emergency management education. This organization works with the government, communities, and other partners to support a disaster resilient Australia by developing and sharing knowledge and learning through innovative thinking and professional development (AIDR, 2020). The Education for Young People Program is one of the main programs founded by the AIDR, and it aims to promote fun and informational curriculums about natural disasters and emergency management for students in Australian schools. Working in

partnership with The National Council for Fire and Emergency Services (AFAC) and member organisations such as the Victorian Country Fire Authority (CFA), AIDR develops and implements a range of resources and activities to increase understanding of risk, leading to action for disaster resilience. The CFA is a Victorian fire service agency with a particular focus on fires in rural and forested areas, whereas AFAC is a national organisation which brings fire and emergency service agencies from all over Australia together in collaborative groups to develop common strategies, initiatives and resources by agreement. The next step in the team's research would be to determine students' role in disaster prevention and preparedness, explore the effects that disasters have on students, and their potential to bring about change in the community.

2.3 Students' Role in Hazard Mitigation

Schooling is a key contributor to children's well-being as the main source for assistance to children before and after a natural disaster. A range of government, community and not-for-profit organizations involved in youth education hope to expand education regarding disaster awareness and preparedness (Dufty, 2009). There have been few studies to assess the impact of disaster resilience education on student abilities or inclinations to advocate in their community, but evidence from these programs show an increase in disaster resilience knowledge in students and their families (Gibbs et al., 2018).

One specific study implementing disaster resilience education into a geography curriculum found that students had reduced anxiety levels and an average of 39% increase on hazard knowledge from pre- to post-test (Webb and Ronan, 2019). Another study in Victoria implemented and evaluated the "Survive and Thrive" program, which educated about disaster resilience with a cross-curriculum approach in which students interacted with local officials to develop and present fire safety workshops. The study showed that students developed a sense of ownership in their community with a role in disaster mitigation and emotional preparedness (Gibbs et al., 2018). Internationally, disaster resilience education is essential for informing youth and thus the public about how to manage and cope with disasters (Baytiyeh, 2019).

Currently, Australian geography curriculum for Year 8 students outlines opportunities for education about bushfires and decision-making to develop responses to natural disasters (Australian Curriculum). The Victorian Curriculum and Assessment Authority provides countless resources for educators to incorporate fire education, along with lessons to inform students about actions to respond and recover from bushfires (VCAA). Certainly bushfire education and disaster resilience education has the ability to be integrated successfully in Victorian schools.

2.3.1 Disaster Effects on Students

One of the most vulnerable groups regarding disaster impacts is children. Schools are critical in helping to minimize the impact of the distress from disasters. After natural disasters, academic performance tends to drop (Antonji, 2011). In studies of students in areas impacted by Hurricane Katrina in Houston Texas, there were considerable differences in test scores from high

risk areas versus low risk areas (Lai, 2018). Children’s health and development also stunts in the wake of a natural disaster. Disaster effects in a school mirror the vulnerability of the community population as a whole, thus predictions and plans for resilience can be made about the effects of a natural disaster before any type of disaster occurs (Lai, 2018).

2.3.2 Student Perspective and Potential to Cause Change

Children have unique and valuable perspectives on disaster resilience. Researchers are calling for systematic disaster resilience education to increase youth participation in the prevention of disasters to incorporate their voices (Anderson, 2005). Synthesis of disaster education research shows the significance of youth participation in natural disaster reduction activities. By learning from and communicating with local authorities, students are able to build their interpersonal skills and confidence in speaking with professionals. They can eventually help spread awareness of disaster resilience strategies through their community (Pfefferbaum, 2018).

2.4 Education Techniques for Disaster Resilience

Disaster resilience education has been approached in many different ways, most of which involve technology, community involvement, or a combination of the two. Technology is used to provide interest and engagement to student learning, while community involvement promotes voice, self confidence, and leadership. Studies find that many students need to be engaged in interactive lessons to learn effectively (Bergdahl et al., 2019). Through this project, AIDR hopes to combine hazard education with community involvement and simulation technology, as shown in Figure 3, to create interactive and engaging project-based learning for students.



Figure 3: *Combining Three Key Elements for Disaster Resilience*

2.4.1 Technology Enhances Learning

Although some may view technology as a distraction in the classroom, others believe technology can greatly enhance student involvement and result in more reasonable and creative solutions to the learning process. Wardlow claims that giving students increased access to tools and resources through technology allows them to immerse themselves in the material and begin to direct their own learning (2017). In the context of fire management, students would be able to independently apply their knowledge and create their own understanding of evacuation or management plans.

In a study of 12 different primary schools in Spain, Domingo & Garganté concluded that teachers found mobile technology to increase students' access to information, learning opportunities, and engagement in their education (2016). Most aspects that teachers found helpful with technology had to do with learning interest and student engagement. Despite these benefits, teachers also claimed that the use of technology decreased collaborative learning in the classroom. This is mainly due to the nearly infinite access to resources and information that students have with technology. Students may not see the need to collaborate with others when they have this information. To promote collaborative learning, this project uses more interactive technology, rather than independent, mobile technology.

2.4.2 Bushfire Simulation Technology

There are many bushfire simulation softwares available that use data such as wind, slope, and fuel to mimic the behavior of a fire in a given area. Some of these softwares are even used to prepare or train professionals in fire management. Bringing these tools to the classroom can be difficult. Software can be complex to navigate and require many class periods for students to learn how to operate effectively. Additionally, simulation equipment and software may require additional funding from schools, which may not be possible based on budgets. In light of these obstacles, this project focuses on software that is relatively easy to grasp and provides the most interactive benefits to the students.

One easy-to-use, yet deeply impactful technology for simulating bushfires is Simtable. This table acts as a surface for people to craft a custom landscape out of sand based off of projected topography data. It then uses a camera and projector to analyze the scaled terrain and provide information for how bushfires spread in that specific area. Once the terrain is set up, the user can start simulated fires anywhere on the table and watch a timelapse of how that fire is predicted to spread. By combining physically customized models and agent-based ambient computing, Simtable provides a truly interactive experience for local emergency management (Simtable, 2020).

Simtable works directly with a browser app called anyHazard, which allows users to create scenarios on a satellite map of their area and draw evacuation routes or simulate support response times. People can access these scenarios in live time to view this information in the event of an emergency, or they can be uploaded onto the Simtable to create a more interactive experience.

2.4.3 Benefits of Community Involvement in Education

Interacting with the community can help students develop a voice and learn to make decisions. A sense of connection with the community allows students to develop the personal capabilities needed to create healthy relationships and engage meaningfully in society (Bower et al., 2015). Cases given by the Australian Council for Educational Research (ACER) show that when schools share local decision making and responsibilities with their community, students engage more in society and gain more knowledge by applying their learning to the real world (Clerke, 2013).

Studies conducted by ACER present that whether they are volunteering at elderly-care facilities or promoting and organizing events for community groups, connecting students with their communities helps develop social and life skills, as well as leadership, self-confidence and decision making (Clerke, 2013). Incorporating this type of community involvement into fire management could benefit everyone by promoting safety, leadership, and decision making for both the students and their community.

A possibility for connecting students with local firefighters or emergency experts is to facilitate projects in which they present their own ideas for evacuation and planning. This will allow them to receive feedback and interact with their community on their understanding of fire management and what decisions are best. Not only will the students be inspired by experts and learn from them, but the community will also get a sense of how educated students are and how they would act in these situations.

Overall, the result of this research feeds into the central objective of this project: to develop interactive lesson plans that engage students' interests in disaster resilience and how it relates to bushfires. The lesson plans developed from the research promote a collaborative environment where students can learn to make decisions and have their voice be heard. Through this combination of hazard education, interactive technology, and community involvement, this project aims to inspire the next generation of Australian students to build a more disaster resilient Australia.

3. Methodology

The goal of our project is to help Year 8 students at Emerald Secondary College develop an understanding of bushfire risk and emergency management to improve local disaster resilience. The feedback from the students at Emerald Secondary College was used to improve the lesson plans and provide engaging resources for AIDR to use in future disaster resilience education across Australia.

Our background research has shown that many resources exist for teaching children about fire management, but there still lies an opportunity to present this knowledge in engaging ways that benefit student learning. To address this, we developed online lesson plans that combine interactive technology, project-based learning, and community involvement to effectively educate students on disaster resilience. We use technology as a backbone to create enriching learning experiences for digital technology students, which includes projects and activities that can be used by Emerald Secondary College to assess student learning. We identified the following objectives to guide our project work:

1. To assess students' knowledge about disaster resilience at Emerald Secondary College
2. To develop disaster resilience lesson plans for Emerald Secondary College students
3. To remotely deliver lesson plans to students
4. To prepare effective resources for future disaster resilience education

For this project, we designed disaster resilience lesson plans for students at Emerald Secondary College in Victoria, Australia. Our sponsor liaison from AIDR, Brigid Little, paired us with a Year 8 digital technology teacher, Gary Vear, who leads three technology classes of about 20 students each.

Conducted in the midst of the COVID-19 pandemic between March-May 2020, many aspects of this project had to be modified according to the circumstances, particularly impacting the scope of our teaching and the method of delivering lesson plans. Due to concerns over community spread of the virus in Australia, all Victorian schools switched to remote learning. This changed our project operation from teaching students in person to delivering our lesson plans remotely. The lesson format and software usage that we employ is very limited due to difficulties with computer and internet access at home for the students. The technology available to students as outlined by Mr. Vear is weighted as one of the most significant factors in developing lesson plans and related activities.

We developed remote lesson plans that Mr. Vear provided to his students beginning on April 14. The Year 8 students at Emerald did not yet have specific lessons regarding disaster management in their digital technologies classes, so our work focused on lesson plan development with different digital technologies intended for educational purposes.

Due to the high local risk of bushfires in Victoria, the lessons focus on bushfire disasters in communities and regions in Australia. Students learned how fires behave, as well as prevention methods before a bushfire occurs and immediate action plans when a disaster is

imminent. We used digital technology to simulate these natural disasters and present methods of response. Students then applied their knowledge by creating their own poster describing the risks of a bushfire emergency and what response actions could be taken. To involve students with their community experts, we contacted fire experts from CFA, AIDR, and AFAC to provide feedback on the student projects and answer any more questions the students had about bushfires and emergency response.

In this chapter, we describe the methods that were used to achieve our objectives. First, we explain how we gathered data about the students' level of interest and knowledge of bushfires. Next, we demonstrate the steps used for creating lesson plans about disaster resilience that follow a logical format. Then, we describe the tools we used to deliver the lesson plans remotely to the students and facilitate student-led projects that allow them to apply their learning and present it to their community. Finally, we explain how we collected feedback and evaluated our project to prepare effective teaching resources to be used in future Australian classrooms.

3.1 Assessing Student Knowledge on Disaster Resilience

The first objective was to assess students' knowledge about disaster resilience at Emerald Secondary College. This objective provides the team with important information on what students already knew about bushfires and actions that their family already takes to help prepare for and prevent them. The students are also asked what they would like to know about bushfires, which helped the team shape the lessons to keep the students interested and engaged. The data collected from the research questions listed below helped the team form engaging lesson plans based on students' current knowledge and interests:

1. What is the level of understanding that students currently have with regards to fire management?
2. How interested are they in learning more about the issue and how they can deal with it in their community?
3. What level of technology is currently available to the students?

The specific survey questions can be found in Appendix B.

The primary methods of data collection were surveys and feedback forms targeted at students in Emerald Secondary College who participated in the project. Surveys are an effective method of collecting data for this objective since they effectively characterize a large population, which maximizes the amount of data we can gather from the students. We sent out the surveys before the curriculum began. The surveys included a quantitative ranking of students' interest in learning about fire management and multiple choice questions to test their background knowledge and the hazards of wildfires and fire management strategies. By analyzing this data we were able to tailor our lesson plans to include relevant and engaging information to the students that will further their knowledge of fire management.

At the very end of the lesson plans, a similar survey was given to the students. The results before and after the lesson plans were compared to provide metrics that describe whether the students learned from the lesson plans. This post-survey also asked students what they liked, disliked, and learned from the lesson plans, which helped when making slight changes to the lesson plans before providing AIDR with resources for future education.

3.2 Developing Disaster Resilience Lesson Plans

The second objective was to develop engaging lesson plans for the Emerald Secondary College students. This section of the methodology details the decisions and methods that we employed in the creation of a structured lesson plan that can be delivered to Emerald Secondary College Students. We describe the general structure of each distinct unit within the lesson plan and how they are formatted. This section also outlines considerations made to maximize student participation in our lesson plans.

3.2.1 Lesson Development Process

Lesson plans are outlined for specific activities and information presented in each class period. The lesson plan is a specific collection of resources with a document describing the learning objectives for students, materials needed, and the timing of activities and other lesson components. Each plan uses some of the guidelines specified in Grant Wiggins and Jay McTighe's "Understanding by Design" lesson plan template (see Appendix A) (Wiggins and McTighe 2011). Data from the first objective about the prior knowledge and the academic abilities of students guided the process of determining which resources to use and in what capacities.

Lesson plan development begins with the learning objectives (LO's). LO's are created by directly gathering the teaching objectives of AIDR and Emerald Secondary College. By co-designing the curriculum with the stakeholders, the best results can be achieved. We also gathered problem statements from community experts, such as the CFA, to guide the LO's.

Stating the LO's at the beginning of each unit provides clarity for students about the intention of the lesson. An LO may begin with the sentence stem: "Students will understand that/Students will be able to." An example of an objective may be the following: "Students will be able to identify the key elements that affect how a fire spreads."

Once the LO's are determined, the specific activities for that lesson were selected and implemented. The benefits and drawbacks of each option were weighed considering the activity length, student access to technology, and topic relevance to fire management studies. Due to changes from the COVID-19 pandemic and school closures, we had to give a heavier weight on student access to technology above all other factors, because many students have limited access to the internet and computers at home. All lesson plans and activities also had to be weighted by the time allotment of Mr. Vear's digital technology course in proportion with the remainder of the student's schedule. Online lessons are required to fit into a certain time frame at the discretion of the school, so we designed our lesson plans around those constraints.

We must also create the lesson plans so that they can be modified to be delivered in front of a classroom, in order to fulfill our fourth objective - prepare useful teaching resources for the future. However, these lesson plans must be ready to be delivered through the available online platforms for Emerald Secondary College students. The next section describes the organization of the lesson plans into separate units, which divides the lesson into logical sections.

3.2.2 Lesson Plan Organization

We believed the most effective way to deliver the lesson plans and maximize the student's ability to participate was by creating interactive, visual-based lesson plans that are easily accessible online. Mr. Vear delivered the lesson plans to the students one section at a time, following the class schedule set by the school. To make it easier for Mr. Vear and the students, we separated the lesson plans into logical units that we designed to be completed in the allotted time. Each unit follows the lesson plan structure shown in Figure 4, which aims to maximize student engagement.

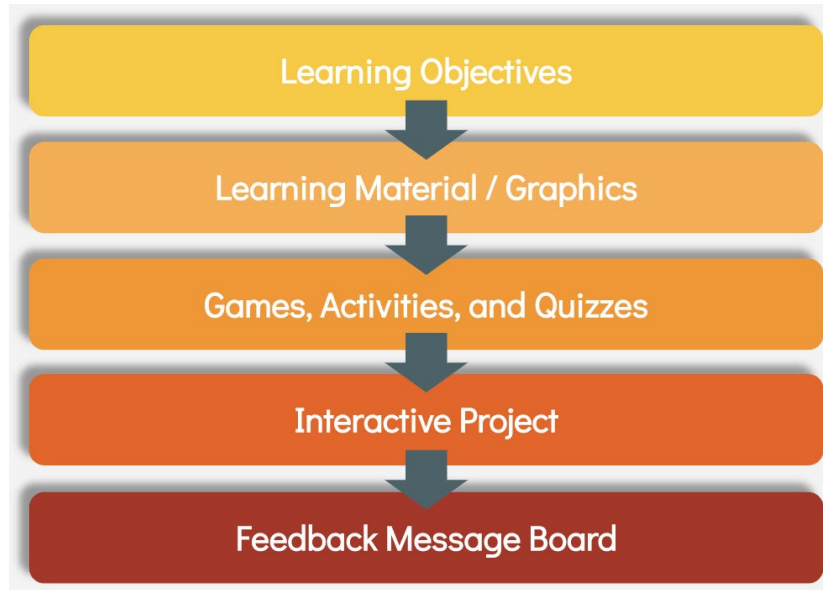


Figure 4: Structure of Units This is the main structure that each unit in the lesson plans follows.

Furthermore, the entire lesson program concludes in a creative assignment or final project that provides students with an opportunity to demonstrate their knowledge and share it with local and national fire experts. Our background research supports the conclusion that community involvement is one of the best ways for students to learn and retain their knowledge. This final project was designed to consider differences in students' abilities and resources, and gives every student an equal chance to create something they are proud to share with their community. Upon the completion of these projects, the experts were able to provide feedback to the students and answer any questions, which offers a deeper connection between the students and their community.

3.2.3 Additional Considerations during Lesson Development

There are many ethical concerns that had to be considered during lesson planning. Because children are involved, we must pay extra attention to the information that we present to them and how we present it. Also, we must consider the sensitivities when discussing emergency management and fire evacuation, which can be a difficult topic depending on students' life experiences. For this reason, we included some support options for students who feel concerned or uncomfortable at any point in our lessons.

Additionally, we must be sure that our project is well understood and accessible by everyone involved. Internet connection is not universally rapid or available, and inevitably leaves many students in a position where they are not able to participate. In order to maximize student participation and minimize our intrusion into their lives—as we are foreign students that are not natively familiar with their culture—we made the lesson plans short and entertaining, and attempted to cater as well as possible to existing student skill levels and participation that was gathered in section 3.1.

Now that we have described the lesson plan organization, the next section focuses on how to effectively deliver these lesson plans to the students.

3.3 Remotely Delivering Lesson Plans To Students

The third objective is to remotely deliver the lesson plans to students. The limitations put down by the COVID-19 pandemic introduce a variety of difficulties related to students accessing and completing the lesson plans. This section describes the tools that were used to deliver the lesson plans as effectively as possible.

3.3.1 Creating a Website

The lesson plans needed to be interactive, visual-based experiences delivered on an accessible, intuitive, and reliable platform. We determined that creating a Google Site for the lesson plans was the best way to accomplish this. Google Sites are very easy to design and let us create new content and review it before posting it to the actual website. This was especially useful for releasing each unit one-by-one because we could create all of the units on the website, but only publish one of them.

Each unit had its own tab on the website to allow easy navigation between sections. Mr. Vear assigned two class periods for each unit. The first period would be for completing all of the learning material, activities, and games. The second period would be for doing the interactive project at the end of each unit. Organizing the units into tabs on the website made it easy for the students to pick up where they left off.

3.3.2 Grading the Students

Because this is still a standard classroom environment, the biggest consideration for Mr. Vear was how the students can be graded on this lesson plan. Mr. Vear already uses Compass, an online learning management system that allows him to create assignments that require students

to upload a submission. Students uploaded screenshots at the end of each game or activity to Compass, which shows that they completed it. This was supplemented with periodic quizzes, made by us using Google forms. These were graded by Mr. Vear more on accuracy, rather than just completion, and they also served as data collection for us to conclude whether the students learned the material from the lesson plans.

At the very end of the website, we published the post-assessment survey, which gave us information on what the kids learned and how to improve our lesson plans. The next section describes how we collected and analyzed this data to modify our resources for future use by AIDR.

3.4 Preparing Resources for Future Disaster Resilience Education

The final objective is to prepare effective resources for future disaster resilience education. Following the completion of the lesson plans, we collected data on the successes and failures of our project. The overall goal of our project involves creating an effective method of teaching disaster resilience at the secondary school level. To gauge whether or not the previous objectives met this goal, we went directly to the key stakeholders - the students.

3.4.1 Collecting Student Data and Feedback

The primary method for collecting this feedback was through the use of surveys. The questions were targeted at students who participated in the lessons. The survey contained some of the same questions that were on the pre-assessment survey that was given before the lesson plans, including the self-evaluation of their knowledge on bushfires. Following these questions were some more short-answer questions and a rating scale to collect data on what the students thought about the lesson plans. The specific survey questions can be found in Appendix B.

The combination of quantitative and qualitative questions, which is a form of data triangulation, was a way of using more than one method to collect data on the same topic. This allows students to explain their reasoning behind scoring the lessons in a particular way. This also enables our group to link positive feedback and critiques about our project with the quantitative data to draw more accurate conclusions for feedback.

3.4.2 Analyzing Results to Improve Lesson Plans

The quantitative data from the student surveys was analyzed using simple statistics to compare each student's self-rankings before and after the lesson plans. The qualitative data, such as long-answer responses on the surveys, was coded into a variety of categories. We read through all of the responses and created codes for responses that contained said key words or phrases, and categorized each response based on this code. These responses were quantified by recording the number of occurrences of each of the codes, from which we were able to gather sentiment data, as well as gather feedback and critiques. For example, when students were asked "Identify two aspects of the Lesson Program you enjoyed", responses that included "Interactive activities" as an enjoyed aspect would be marked with (INT) to indicate that the response contained this

answer. Responses could be coded with multiple categories, as the question prompted students to name multiple aspects, rather than one.

Using triangulation, we matched quantitative and qualitative data to pair low student rankings with negative statements or critiques and high student rankings with positive statements or recommendations. The feedback extracted from triangulation was used to suggest improvements to the lesson plans, while satisfying the expectations of the AIDR for future teaching resources. Using these improvements, we provided AIDR and Victorian schools with the necessary resources to replicate our lesson plans in the future, along with recommendations for implementing the lesson plans into an actual classroom environment.

4. The Final Online Lesson Plans

The methods laid out above were implemented into the Year 8 Digital Technology class at Emerald Secondary College, lasting a total of three weeks (April 15th to May 6th). During this time, a new unit was released each week and students had two class periods to complete each unit. The website consists of three main units:

1. Disaster Resilience
2. Fire Dynamics
3. Local Risk Profile

After completing all of these units, the students created bushfire response posters to demonstrate what they learned about the risks and strategies of responding to a bushfire in their area. The website consists of five tabs, or pages, as shown in the top of Figure 5. The first is the introduction, then the next three are the lesson plan units, and the last one is for the students' final projects. Screenshots of the entire website are included in Appendix C.



Figure 5: Website Home Page

The website begins with an introduction page that includes a video of us describing who we are and why we are doing this project. Then, we describe the 3 units and their learning objectives to give students an idea of what they will be learning. At the bottom of the page, there is the Pre-Assessment Form that we created to gather data on what the students already knew, as well as what they wanted to learn.

4.1 Unit 1: Disaster Resilience

The first unit is Disaster Resilience. This unit has two main goals. The first is to teach the students about some key concepts and terminology that we use throughout the lesson plans. The second is to introduce them to AIDR and give them a broader sense of disaster management and how to build safer, stronger communities for any disaster. The following list is a basic outline of Unit 1:

1. Introduce Learning Objectives and the AIDR vision:
 - a. Key terminology

- b. Graphics/Infographics covering Disaster Resilience and AIDR information
2. Matching activity about Disaster Impacts
3. Emergency Kit Info and Interactive Game
4. Interactive Activity: Mapping Hazard Impacts
5. Feedback/Questions Padlet

At the very beginning of the unit, we state the following learning objectives for this unit:

After completing this unit, you will be able to:

1. Understand the difference between a hazard and a disaster
2. List the different types of impacts a disaster can have on people and places
3. Identify the four stages of the disaster management cycle
4. Explain how you can prepare for a disaster before it occurs
5. Identify natural hazards that occur in and around Australia and how they impact communities

Then, the learning material begins. These are simple graphics with information for the students to scroll through and learn about some terminology having to do with disaster resilience. Due to the online, asynchronous learning style that was forced by COVID-19, we were not available to immediately answer student questions or clear up confusions as they read through the information. So these materials needed to be as specific as possible, but also be pleasant to look at and read through. Figure 6 shows an example of these learning graphics, which were developed with the help of Brigid Little from AIDR.

HAZARD VS. DISASTER



RISK

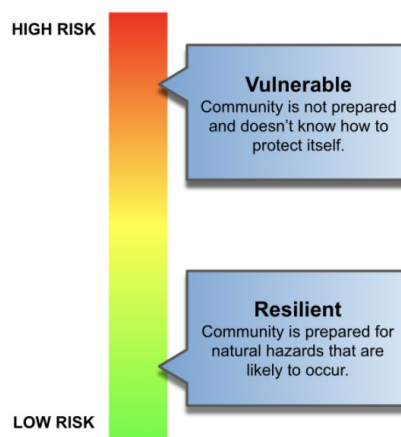


Figure 6: Unit 1 Learning Graphics

Next, we introduce some games, activities, and quizzes to keep the students engaged in the material while simultaneously assessing what they have learned. The first activity on the page is a small quiz about disaster impacts, see Appendix C. This quiz was created using Educaplay - a free online educational game creator - then embedded into the website. The goal is to match each example statement with the type of impact that it represents by clicking two boxes to create a match. Once the students finished, Mr. Vear requested that they take a screenshot of their quiz results and upload it to Compass, an online learning management system that Mr. Vear uses for his class. This allows us to ensure that the students completed the activity, and also allows Mr. Vear to grade them using their results.

After this, there are some more learning graphics about the disaster resilience cycle and how to properly prepare for an emergency. Then, there is an online flash game about creating an emergency kit, shown in Figure 7. This game was created by the U.S. Department of Homeland Security as part of the 2003 Ready campaign. In the game, students advance through different rooms of a house, picking items that they find useful for creating an emergency kit. After clicking 'Ready?', the game tells students which of their items were good choices and bad

choices, as well as why. It will not go to the next level until the student has chosen all useful items in the room. Games like this are very important to include in our lesson plans because they are easy for students to play on their own time, but also provide feedback when they make mistakes. Once the students completed this game, they uploaded a screenshot to Compass.



Figure 7: Emergency Kit Game This is one of the games on our website that students played (U.S. Department of Homeland Security, 2019)

After the games, activities, and quizzes, the next part of the unit is the interactive project. The idea of this project was developed in cooperation with Mrs. Little and Mr. Vear to ensure a smooth experience for the students. We decided to use Google My Maps to make an interactive map that students can add pins to that describe past disasters in and around Australia. This map is shown in Figure 8. We created a short instructional video on how to open the map and add a pin to it. We also provided them with a link to the AIDR Knowledge Hub, where they can view a map similar to the one they are about to create. This map shows all disasters in the Australia region back to the year 1870 and provides information on them. The instructions were to use the AIDR Knowledge Hub and research a disaster in the South Pacific region and learn about where it happened, when it occurred, and 3 ways that it impacted that community. All of this information was then included on a pin that students added to the Google map with their name.

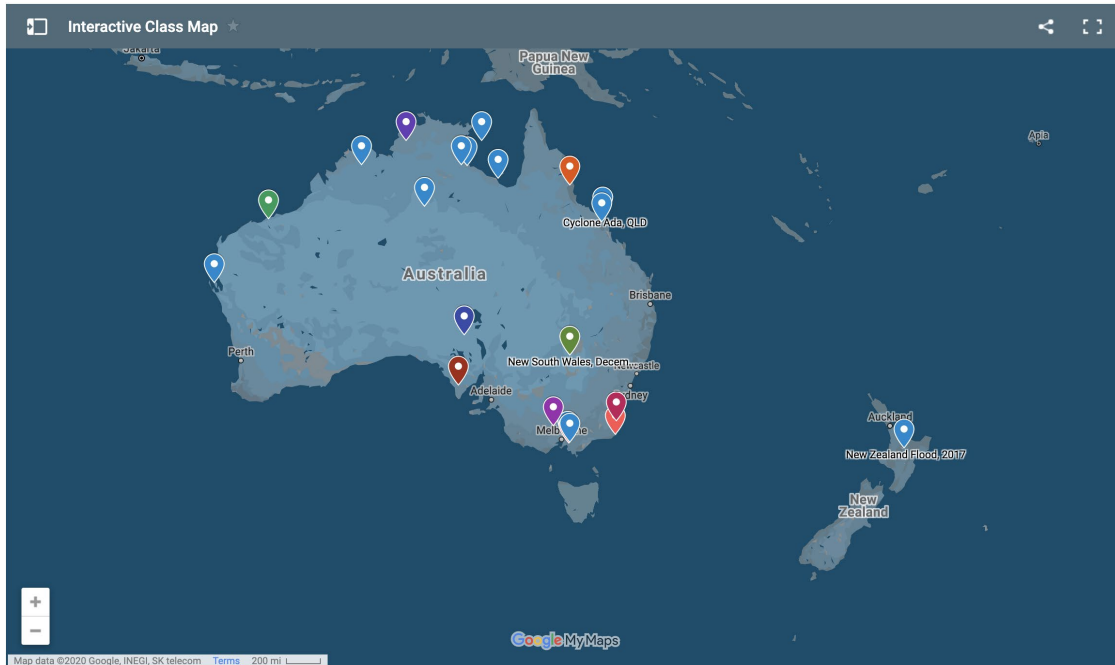


Figure 8: Unit 1 Student Disaster Map Each pin on this Google map was created by a student to describe a disaster.

The goal of this end-of-unit project was to let students see the number and intensity of disasters in their area and do their own research to learn about the impacts that disasters can have on communities. We embedded the map on the website so students can actively see when their classmates add a new disaster, which creates more of an interactive classroom environment. By having projects like this in each unit, we hope to engage the students more and allow them to learn better remotely by providing them with resources to do their own research and present their findings for others to see.

The last part of the unit was a help and feedback forum created using Padlet, a free online service that allows you to create virtual bulletin boards that you can share with others. We embedded a Padlet at the bottom of each unit so students can post their questions or feedback for us to read and respond to them. This was a really helpful way for students to anonymously share their feedback on our lesson plans, as well as post any issues or questions that need our attention. As shown in the Padlet in Figure 9, there was an issue with the map at first, but we were able to see their concerns and respond as soon as possible to fix it.

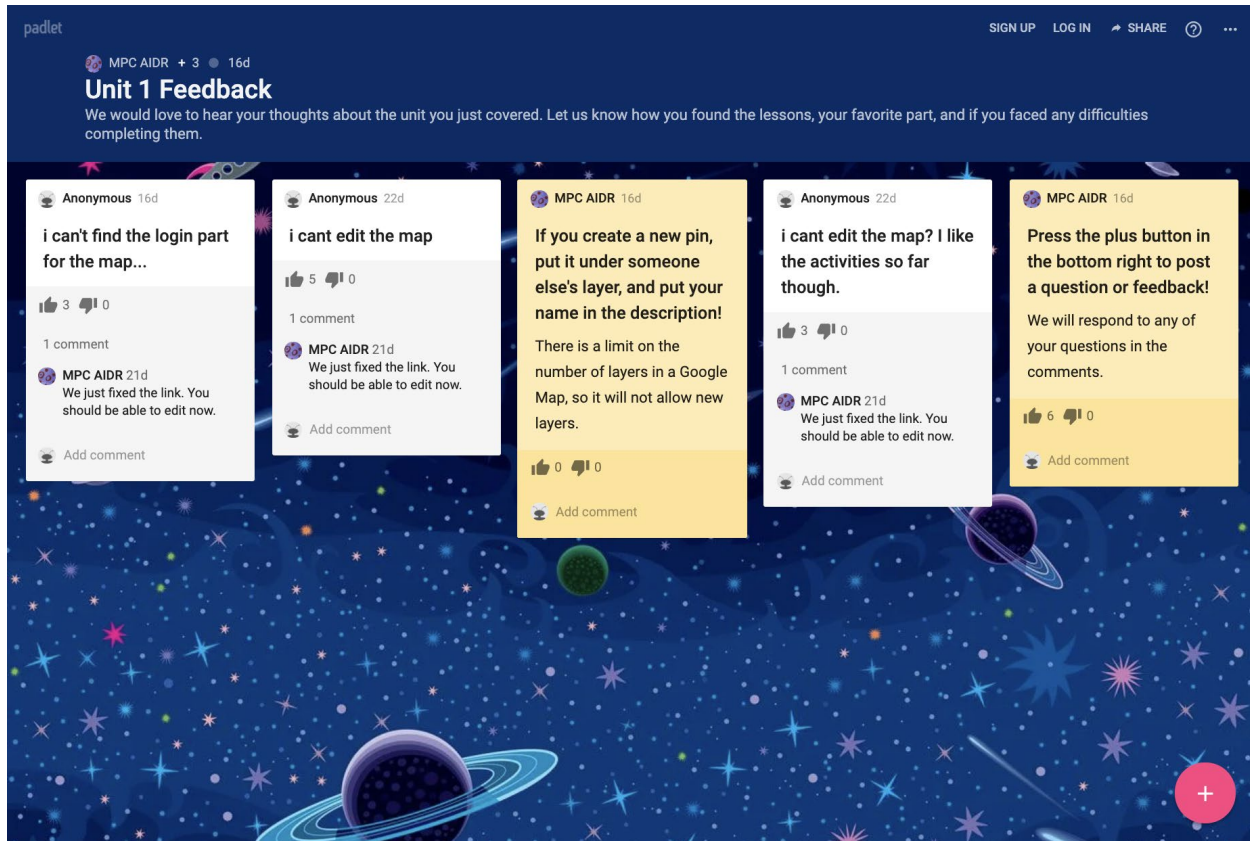


Figure 9: Unit 1 Help and Feedback Padlet

4.2 Unit 2: Fire Dynamics

The second unit is Fire Dynamics. This unit starts to focus on bushfires as the most prominent natural disaster in the Emerald area. We present the students with information about how fire spreads and the key factors that affect its behavior, as well as important actions to take before, during, and after a bushfire. The following list is a basic outline of Unit 2:

1. Learning Objectives
2. Graphics on the various aspects of Fire Dynamics/Resilience
3. Interactive CFA Fire Safety game
 - a. Short Quiz
4. Interactive Activity using Fuel Density Simulation
 - a. Video lecture of fuel density simulation on redfish.com/csss
 - b. Discuss fire dynamics as a whole
 - c. Short quiz for students to report their findings
5. Feedback/Questions Padlet

First, we state the following learning objectives:

After completing this unit, you will be able to:

1. Explain why fires are so dangerous to people and property
2. Recognize the Fire Danger Rating system and appropriate actions to take at each level
3. Identify the key elements that affect how a fire spreads
4. Describe appropriate actions to reduce the impact of bushfires on your home

Then, there are some learning graphics about how fire spreads, as shown in Figure 10. This gives students some simple information to read about the different kinds of things that can affect the spread of fire. The three main elements that we mention in our lesson plans are slope, wind, and fuel density.

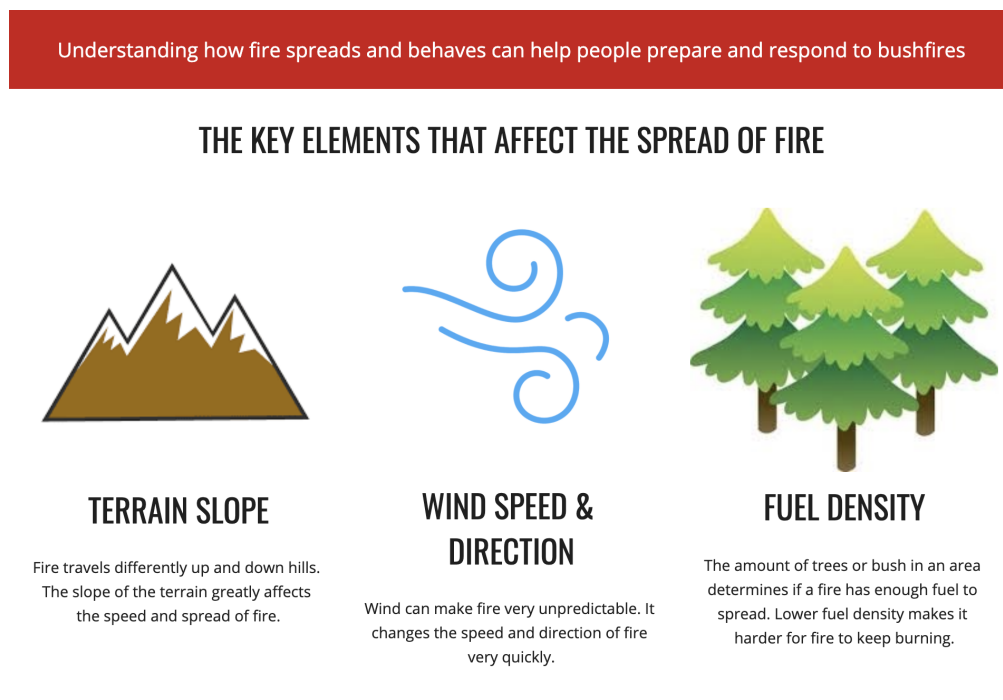


Figure 10: Unit 2 Learning Graphics

After these learning graphics, there is another flash game for the students to play, shown in Figure 11. It was created by the Victorian Country Fire Authority (CFA) in an effort to educate primary and secondary school students on fire behavior and safety. It includes a lot of expert information about bushfires, especially in the Emerald area, which makes the knowledge more personal to the students.



Figure 11: *Fire Safety and Behavior Game* This is another game that students played on the website (Country Fire Authority)

The CFA game takes about 10-15 minutes to complete and it contains a lot of really useful information. Once the students completed the game, they uploaded a screenshot to Compass for Mr. Vear to see. To ensure they understood the information, we created a Google Forms quiz to ask them about some key takeaways from the game. The full quiz can be found in Appendix C.

The unit is then concluded with another interactive project and the feedback/questions board. For this project, we focused on one of the main elements that affect fire spread - tree density. We used a simple online modeling agent provided to us by Dr. Stephen Guerin, CEO of Simtable. The purpose of this model is to simulate fire spread with only one changing variable: tree density. Tree density refers to how closely trees are packed together in a forest. High tree density represents a dense forest with lots of trees really close together and minimal room to walk between them, whereas low tree density represents more sporadic tree placement, which is usually a better idea for high bushfire risk areas.

As shown in Figure 12, the model has a very simple user interface and is easily accessible to anyone with the url. The 'Tree Density' slider on the left allows you to adjust how dense the forest in the simulation is. Each green dot in the simulation window represents a tree in a forest. When you click 'run model', the fire begins on the left side of the window and burns to the right. The black dots in the simulation window represent trees that have been burned. Notice how in this simulation, the tree density was not high enough for the fire to make it all the way through the forest, and it eventually stopped burning.

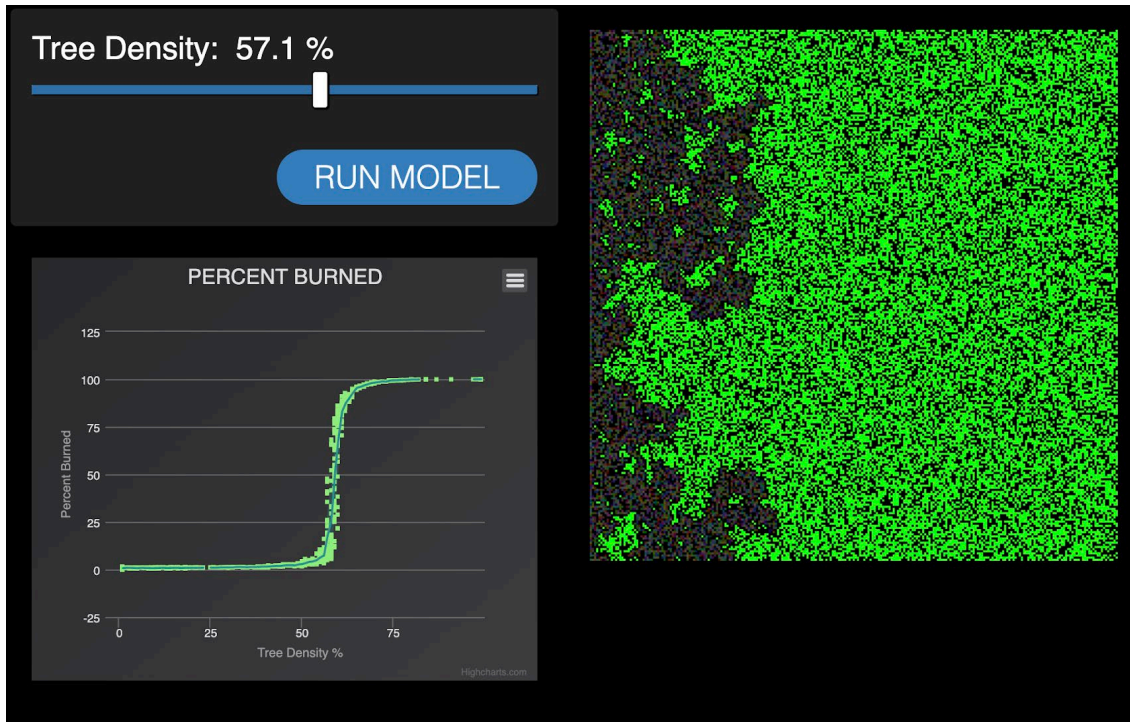


Figure 12: Bushfire Tree Density Simulation Model

The graph on the bottom left shows the percentage of trees that were burned vs. the tree density that the simulation was run at. This graph is actively updated, so every point represents each time someone ran the model.

We created an instructional video to teach the students how to use this model and how to interpret the graph. Then we asked them to repeatedly run the model at different tree densities to explore the outcome of the fire. They were able to see other students running the model as their points showed up on the graph, which adds a small sense of interactivity between classmates. The goal was to have the students realize that there is a ‘phase shift’ in the model, which happens to be around 60% tree density. As explained by the graph in Figure 12, if the tree density is below this amount, the fire will most likely burn less than 10% of the trees. But as soon as the tree density grows above this amount, the fire reaches the right side of the window and burns more than 75% of the trees nearly every time.

Following the model is a short Google Forms quiz that the students completed to ensure they understood what they were supposed to figure out. This quiz can be found in Appendix C. By giving students access to this simple model, it allows them to play around with it and explore what happens when they move the slider without the worry of getting lost or confused in a complicated software. Letting students use technology to explore simple concepts like this encourages them to do their own experiments and draw their own conclusions, which overall leads to a better understanding of the content they are learning.

4.3 Unit 3: Local Risk Profile

The third unit is Local Risk Profile. This unit is a combination of everything the students have learned so far and includes simulating bushfires in their area and how their community might effectively respond. We gave the students an opportunity to combine technology with community involvement and gain a personal responsibility to help build a safer, stronger community. The following list is a basic outline of Unit 3:

1. Learning Objectives
2. Student support resources
3. Interactive H5P AnyHazard Emerald Fire Simulation Basics
4. Infographics on Evacuation and Shelter, Fire Response
5. Interactive H5P AnyHazard Emerald Evacuation and Response Simulation
6. Student Questions for Local/National Fire Experts
7. Feedback/Questions Padlet

First, we state the following learning objectives:

After completing this unit, you will be able to:

1. Understand how different elements affect the spread of fire in the Emerald area
2. Create an effective evacuation plan to perform during an emergency
3. Recognize the best shelter options and when to use them
4. Use technology to present your ideas to community experts

Immediately after the learning objectives, we provided students with some support services they could contact if they experience any concerns or uncomfortable feelings. We felt it was important to consider this, especially in this unit, because the students were watching simulations of bushfires in their hometown, which can be frightening or triggering to some. We listed the three best support services that were recommended by project collaborators. This list contains two Australian support services, as well as the international Kids Helpline. See Figure 13.

SUPPORT SERVICES AVAILABLE TO YOU

This lesson program contains content about **bushfires** in the Emerald area. If you have been **affected** by a bushfire or other emergency, and participating in these lessons raises any concerns or **uncomfortable feelings**, there are a number of **support options** available to you. You can pause the lesson at any time to **take a break**. Remember, your **mental health** comes first!



Kids Helpline is a private and confidential 24/7 counselling service for children and young people aged 5 to 25. The fastest way to talk with a counselor is on the phone 1800 55 1800. It's free to call - even from mobiles. If you can't get to a phone or prefer to chat online, you can connect one-on-one with a Kids Helpline counselor through WebChat.

[Click here to access WebChat](#)



Headspace provides free online and telephone support and counseling to young people aged 12 to 25 and their families and friends. If you're based in Australia and going through a tough time, headspace can help. You can speak one-on-one with a counselor, or participate in a group chat with other people going through a similar situation.

[Click here for more information](#)



Beyond Blue provides information and support to help everyone in Australia reach their best possible mental health. They provide information and support on issues such as anxiety, depression, and suicide. They also provide support and tips on how to cope with the COVID-19 pandemic.

[Click here for more information](#)

Figure 13: Support Services Provided to the Students in Unit 3

The first activity in this unit was an interactive video of us simulating bushfires in Emerald to explore the three main elements from unit 2: slope, wind, and fuel density. The simulations use a software called AnyHazard, mentioned in section 2.4.2. Dr. Steve Guerin, the CEO of SimTable, has generously allowed us to use the AnyHazard interactive 3D simulation software. This allows us to create scenarios that show how different conditions can affect the spread of fire in a simulation that uses extensive data and modeling to predict bushfire behavior in specific areas around the world. Furthermore, the software can simulate evacuation and shelter areas, as well as traffic interaction on roads. That ability, along with the flexibility to choose a local area for simulation, makes this software incredibly effective at teaching fire response and recovery in conjunction with local risk profiles. A screen capture of the fire simulation actively running is shown in Figure 14.

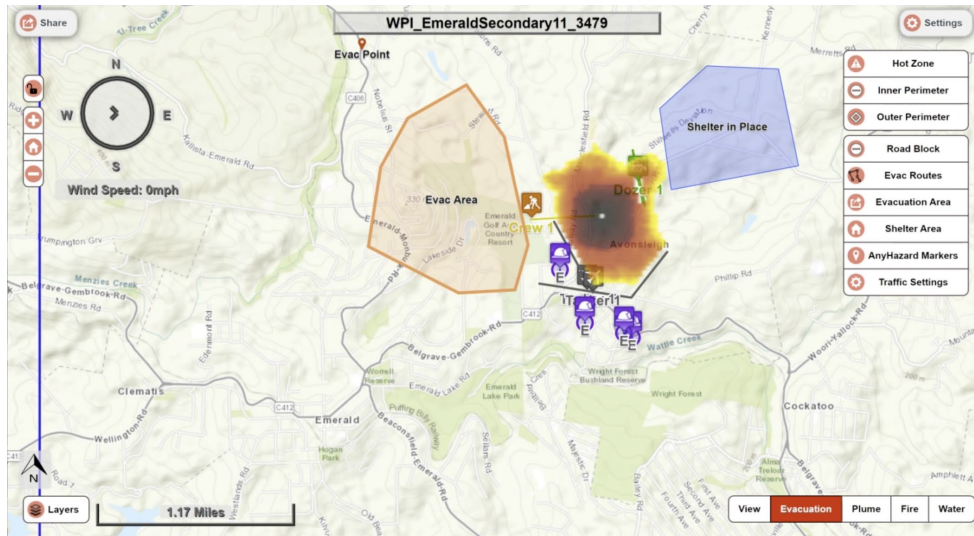


Figure 14 Example Scenario Using SimTable AnyHazard Software

We screen captured many simulations and recorded audio from a script, then combined the two into a comprehensive video that walks the students through the scenarios. After creating the video, we used the H5P service to add interactive questions that the students completed while watching the video. Using html5 script, H5P is a content creation hub that allows you to create interactive videos. First, we uploaded our video to YouTube, then we created a free account on hp5.org to modify the existing video. We added multiple choice questions throughout the video for students to answer and make sure they were grasping the key takeaways. At certain points, the video would pause and a question would pop up, as shown in Figure 15. The students must click the correct answer for the video to continue, regardless of how many attempts it takes.



Figure 15: *Interactive Video Tutorial Using AnyHazard and H5P*

Once the interactive video was created, it needed to be hosted on a server with html5 compatibility. Very few options existed for this at the time, so we used h5p.com (different than h5p.org) and signed up for a free 30 trial to host the content. We were able to embed the videos into our Goggle Site using the url, making it a seamless service. But, h5p.com does require a paid subscription after the 30 days, which will be decided by the sponsor.

Next, the focus of the unit moves on to preparation and response options for evacuation and shelter. There is learning material about how to evacuate and where to go before and during a bushfire emergency, see Appendix C. This information comes from recommendations by the local Country Fire Authority, CFA. Then, we created one more interactive simulation video using AnyHazard and h5p. In this video, we present a bushfire emergency in Emerald and discuss the best strategies for evacuation, shelter in place, and emergency service response. The students could get an idea for how difficult it is to manage a bushfire and how much planning needs to be done by emergency services to keep the community safe.

As covered in section 2.2, our research showed that community interaction is one of the most effective ways of improving disaster resilience and educating youth. Even after seeing these simulations and hearing us talk about bushfires, we elected to include the experts themselves in this project. Mrs. Little was able to get contacts from AIDR, CFA, and AFAC - some of the top local and national fire and emergency experts. We embedded another Padlet forum on the website for students to ask questions to these **experts**. Figure 16 shows just a few of the questions students asked and the great responses they got from some of these experts.

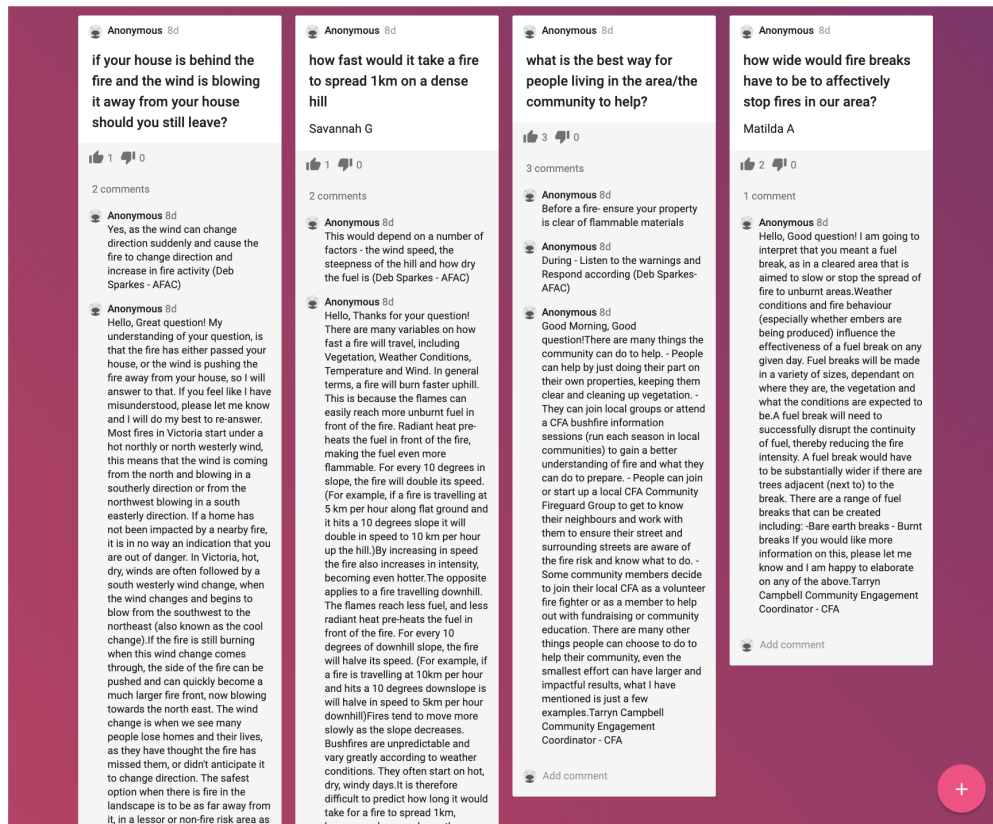


Figure 16: Padlet Forum for Student Questions to Experts

4.4 Student Projects

Due to time constraints, the end-of-unit project for unit 3 was made to be a bit larger and served as the final student project for the entire lesson program. There were many limitations and considerations for the format of this project. The students only had one class period left, so it had to take about an hour to complete. It needed to use technology that is intuitive and easy to learn, yet allows more motivated students to create spectacular projects. Considering these limitations and the main goal of these lesson plans - to improve local disaster resilience by combining hazard education, technology, and community involvement - we designed project guidelines with the help of Mr. Vear and Mrs. Little. These specific instructions can be found in Appendix D.

The final project called for each student to create an electronic poster that represents a bushfire response plan for the area around Emerald. We provided them with a base fire scenario on a map, see Appendix D. Students then inserted that image into any drawing/photo editing software that they preferred and added shapes, colors, and text to identify some main risks and create a community response plan. Figure 17 is an example of a student project that highlights these risks and possible evacuation plans, as well as response options for emergency services. See Appendix D for more student projects.

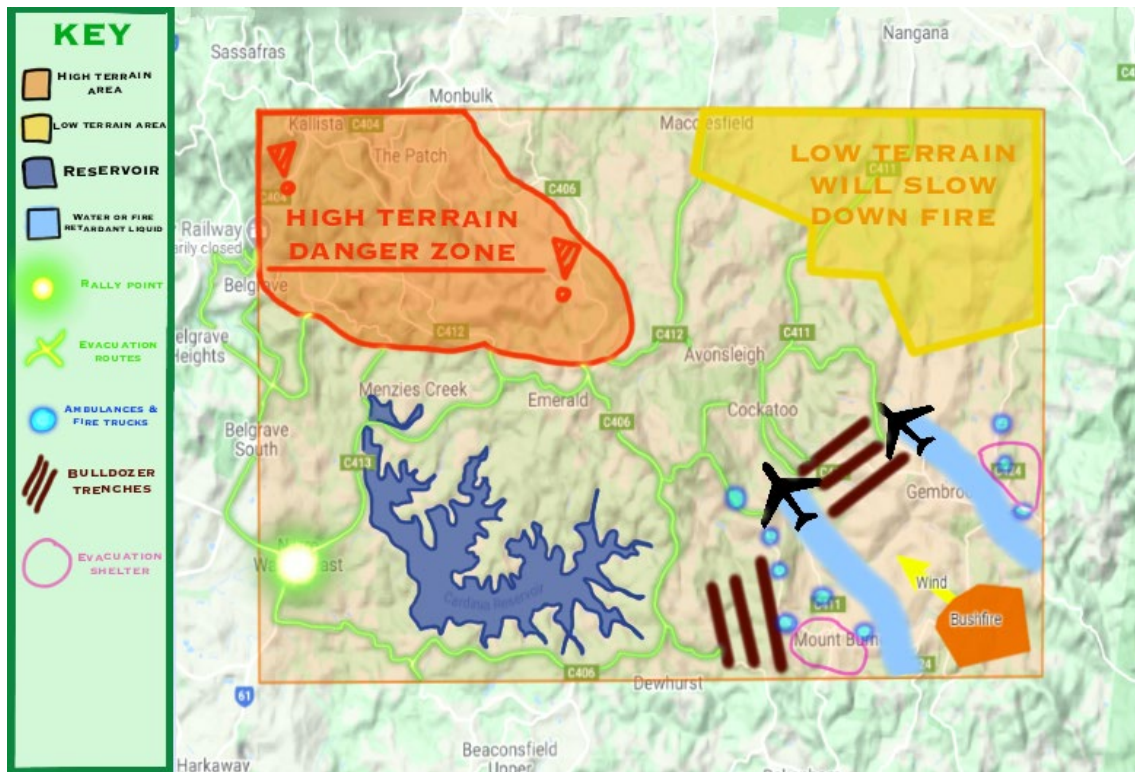


Figure 17: Example Bushfire Response Poster Created by a Student

After completing their projects, the students posted them on a Padlet in the Student Projects page on the website. This allows them to see other projects and like/comment on them, which creates more of an interactive classroom environment. This was also important in the next step, which was to share these projects with fire experts from AIDR, CFA, and AFAC. Captain Paul Yandle from the Emerald Fire Brigade of the CFA recorded a video of him discussing the importance of this knowledge in building disaster resilient communities. He also addressed some of the students' most asked questions from the Local Risk Profile unit and expressed his interest in their posters. The goal of this final piece was to incorporate community involvement with the students' projects to ensure they feel like they are a part of their community effort to manage emergencies effectively.

Overall, the website turned out to be an effective way of delivering the lesson plans to students remotely. We were able to effectively combine the three key elements that make up effective disaster resilience education: hazard education, interactive technology, and community involvement. The next section looks into the data gathered from the students that was used to assess the success of the lesson plans and make further improvements.

5. Evaluation of Online Lesson Plans

This section includes all pre- and post-assessment data from the surveys that were completed by 55 students at Emerald Secondary College that participated in the Lesson Program. Using some of the methods outlined in section 3.4, we took data initially just from the pre-assessment to make decisions that guided the development of the lesson plans. Then, at the conclusion of the Lesson Program, we proceeded to compare results from the pre- and post-assessments to gather data on two primary subjects: quantifying student learning and improvements after completing the Lesson Program, and determining the successes and failures of the Lesson Program.

5.1 Students' Knowledge Before Lesson Plans

For the pre-assessment alone, we primarily focused on student background knowledge as well as any key data that points to specific weaknesses of students, or even ascertaining whether adjustments would have to be made to accommodate for special needs such as trauma. The first important piece of data gathered is shown below in Figure 18:

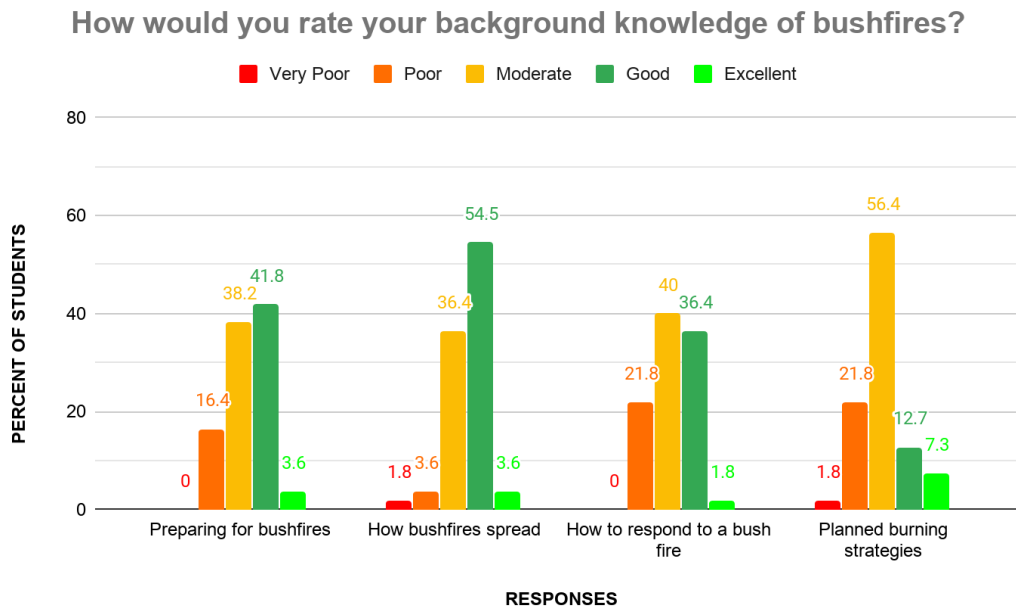


Figure 18: Students' Self-Ranking of Bushfire Knowledge

Using this chart, we were easily able to identify visually that many students were self-reporting their knowledge as Moderate, with only some reporting about Good, and very few reporting Excellent knowledge. This data in particular highlights that even though Emerald students are in one of the highest bushfire risk areas on the planet, most students are still self-reporting moderate knowledge about bushfires. One primary goal of our Lesson Program is to improve student knowledge on these various aspects of bushfire. Another important finding is highlighted in Figure 19, when students were asked if they are aware of options to prepare for a bushfire, or if they are aware of a plan with their family in the event of a bushfire:

Student Pre-Assessment: What actions do you and your family take to prepare for the bushfire season?

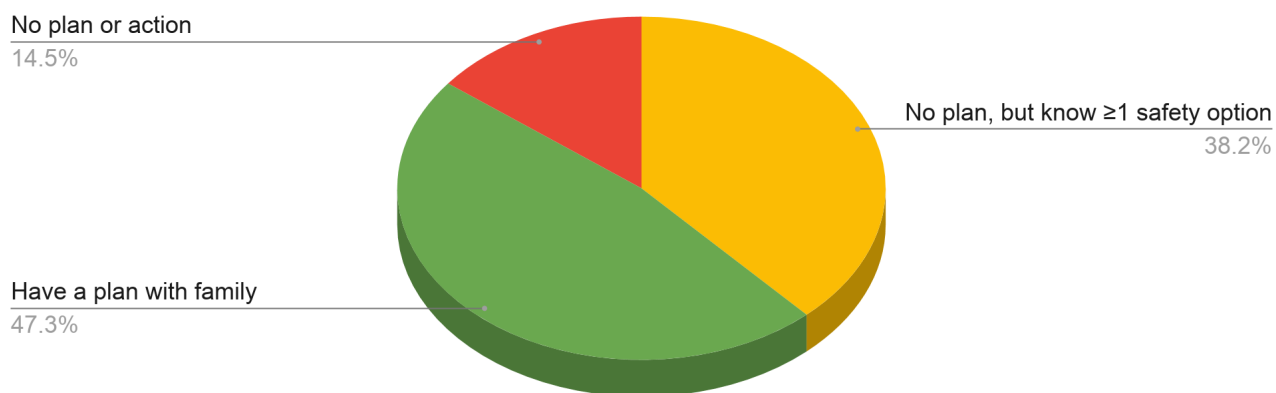


Figure 19: Percentage of Students With a Household Bushfire Plan

The student responses show that a rather surprising 14.5% of students responding did not mention any actions they take to prepare for bushfires, and are not aware of their households having a plan for bushfires. Only 47.3% of students have a plan with their family, and the remaining 38.2% are not aware of a household bushfire plan but do know at least one option to prepare for bushfire seasons. We were expecting that in such a high bushfire risk area, more students would be aware of plans to prepare or know options of how to prepare. These issues highlighted that we needed to address student knowledge on bushfires as well as planning rather heavily in our Lesson Program. As a result, the Final Project described in section 4.4 prompted students to create a type of bushfire plan that encouraged students to consider various ways to prepare and respond to bushfire.

5.2 Students' Knowledge After lesson plans

A decrease in student participation in the assessments had a marked decrease through the progress of the Lesson Program. Mr. Vear, the instructor for these classes at Emerald, and our team noticed that there was a steady decline in student participation. As expected, there wasn't 100% submission initially: at the beginning of the Lesson Program there was an overall submission rate of approximately 87% of total students. At the end of the Lesson Program, there was approximately 60% participation in the assessments and activities. Mr. Vear concluded several possible reasons for the decrease: "I suspect that declining submission rates can be attributed to a couple of factors: (1) remote and flexible learning fatigue which is seeing a gradually growing number of students not engaging with online classes, and (2) the relatively short time-frame to complete the Student Project" (G. Vear, personal communications, May 10th, 2020). We considered these factors and the remaining data while creating our recommendations.

Upon the completion of the Lesson Program, we had to ascertain whether our Lesson Program was successful, and to quantify this success as well as student learning. The following list breaks down the general process that was used to gather data:

1. Quantify student learning from start to finish of the Lesson Program
 - a. Tracking improvement in understanding the disaster resilience cycle
 - b. Using coding of long responses on bushfire questions
 - c. Quantifying self-reported ranked knowledge

2. Determining successes and failures of the lesson program
 - a. Analyzing self-reported and ranked questions
 - b. Coding long responses to ascertain failures and successes
 - c. Correlate student feedback with statistics

Once all submissions were accepted for the post-assessment, the list of entries in the pre and post assessment were sorted in a list by email used, in two separate lists. Repeated entries were removed from both lists and the total number of entries were counted separately for each list. We tracked statistical trends for changes between the pre and post assessment without normalizing for each student entry, in order to simplify the data analysis and extract broad trends. We assumed that certain advanced students may have scored high but show very little improvement or change if they already knew the material. This would diminish the overall improvement of all participants. By tracking the overall shift of knowledge improvement we can approximate how effective the lesson programs would be for students at any level, which is important for future applications of our Lesson Program.

5.2.1 Improvement of Knowledge about Disaster Resilience

On both the pre- and post-assessments, students were prompted to identify the four stages of Disaster Resilience: Prevent, Prepare, Respond and Recover. They were given a large array of choices and told to select all those that apply. From these questions, we gathered the results in Figure 20 below:

Assessing students on stages of Disaster Resilience before and after Lesson Plans

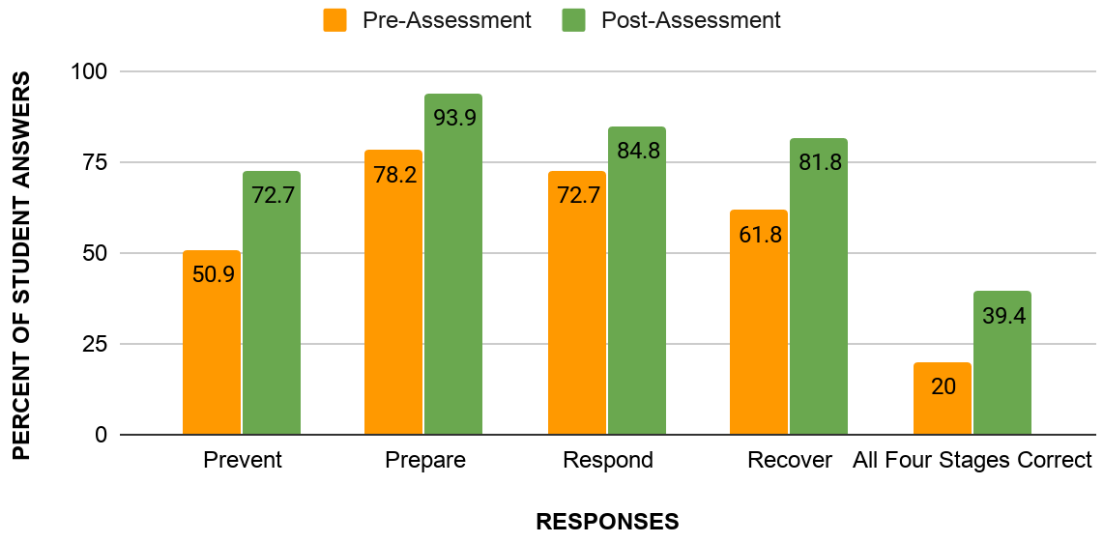


Figure 20: Student Assessment on Stages of Disaster Resilience

As we had hoped, there is a marked improvement in students being able to identify each stage of Disaster Resilience. In fact, the number of students who were able to correctly identify all stages doubled from 20% to 39.4%. This result conclusively confirms that our Lesson Program helped students learn about Disaster Resilience.

5.2.2 Improvement in Self-reported Knowledge of Bushfires

Students were prompted to self-report their knowledge about bushfires on a rating scale from Very Poor to Excellent as in Figure 18 in section 5.1. To visually represent student improvement, we charted the pre- and post-assessments on the same graphs, but split it into each aspect of bushfire so that we can specifically point to areas of improvement shown in Figures 21 - 24 below:

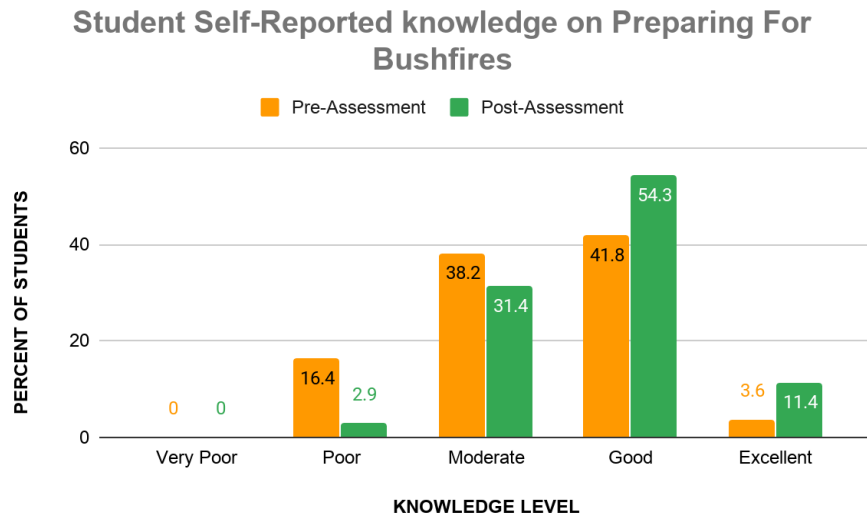


Figure 21: Student Self-Reported Knowledge on Preparing for Bushfires

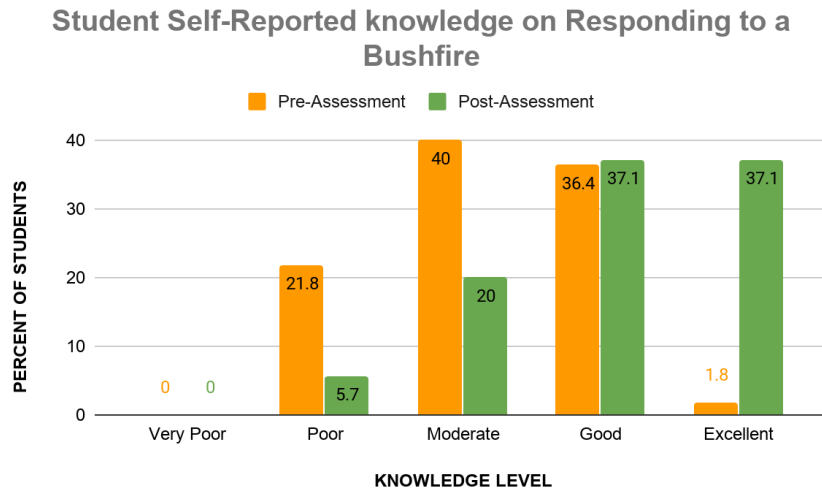


Figure 22: Student Self-Reported Knowledge on Responding to a Bushfire

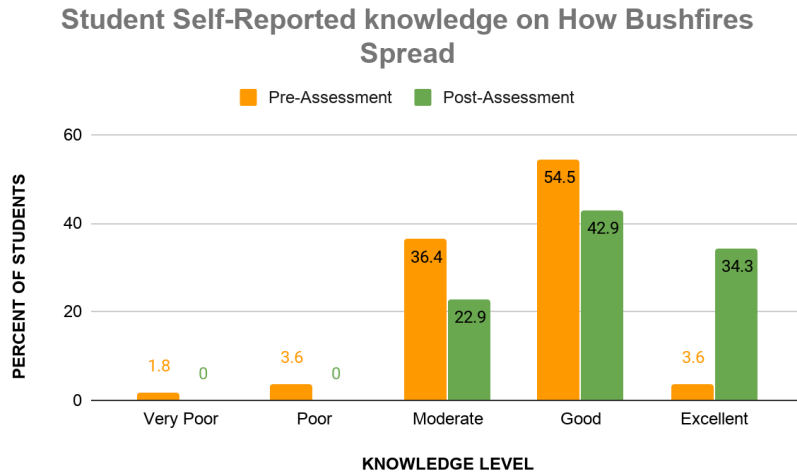


Figure 23: Student Self-Reported Knowledge on How Bushfires Spread

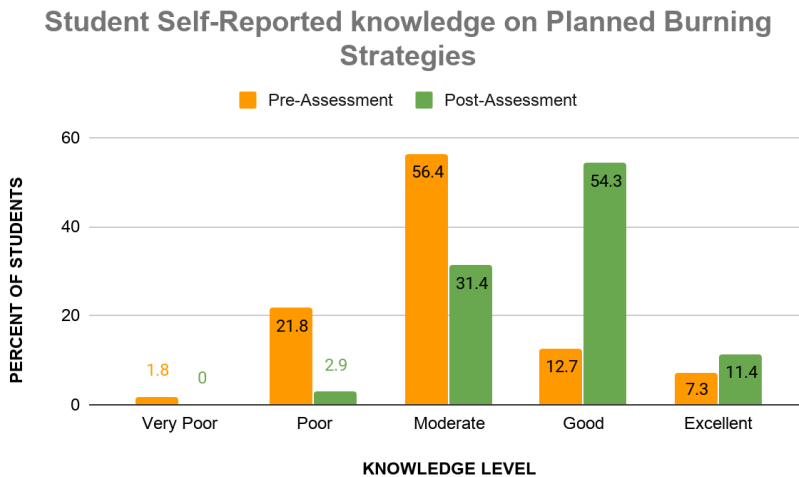


Figure 24: Student Self-Reported Knowledge on Planned Burning Strategies

From these graphs, we can see that there were **zero** reported “very poor” levels of knowledge on the post-assessment. Also, we can see a general shift of students answering “Good” or “Excellent” as a self-reported level of knowledge on these various topics. In order to get a more broad understanding of how students rated their knowledge across all aspects of bushfire, we tabulated the number of responses in Very Poor, Poor or Moderate compared to Good or Excellent in Figure 25 below:

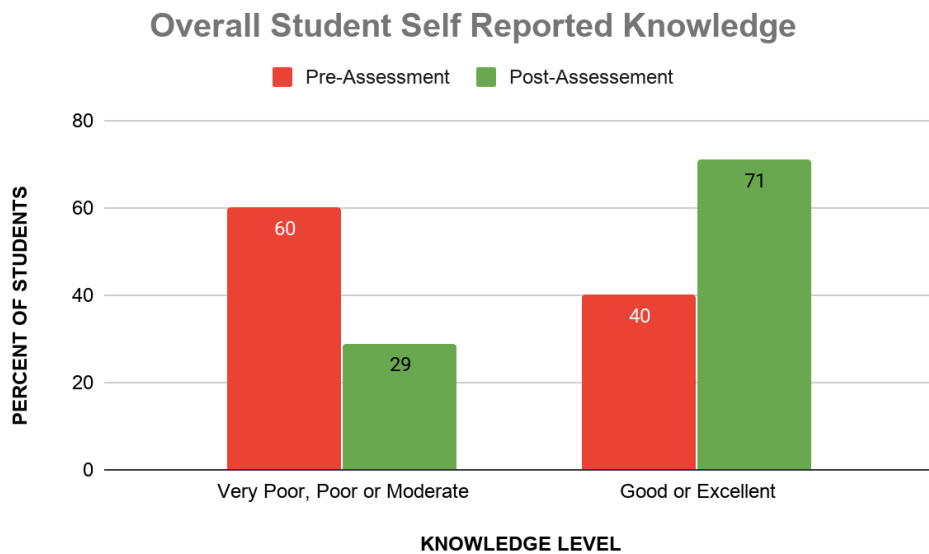


Figure 25: Overall Student Self-Reported Knowledge

From this chart, it is very clear that there was a large shift of students reporting Good or Excellent levels of knowledge on various aspects upon the completion of the Lesson Program. Although these are just self-reported metrics that don't reflect actual student knowledge, it is important that students feel like they have learned. Furthermore, the change to 71% of students reported Good or Excellent knowledge is significant enough that we can use this data to conclude that our Lesson Program effectively taught the students various aspects of bushfires and response.

5.2.3 Improvement in Measurable Knowledge of Bushfires

In order to gather a metric of student knowledge of bushfire, we prompted students to answer a long response on the pre- and post-assessment about what actions can be taken to protect an area from or prevent a bushfire. Their responses were coded as in the methods described in 3.4, and the results of the coding is shown below in Figures 26 and 27:

Student Pre-Assessment: What actions can be taken to prevent bushfires?

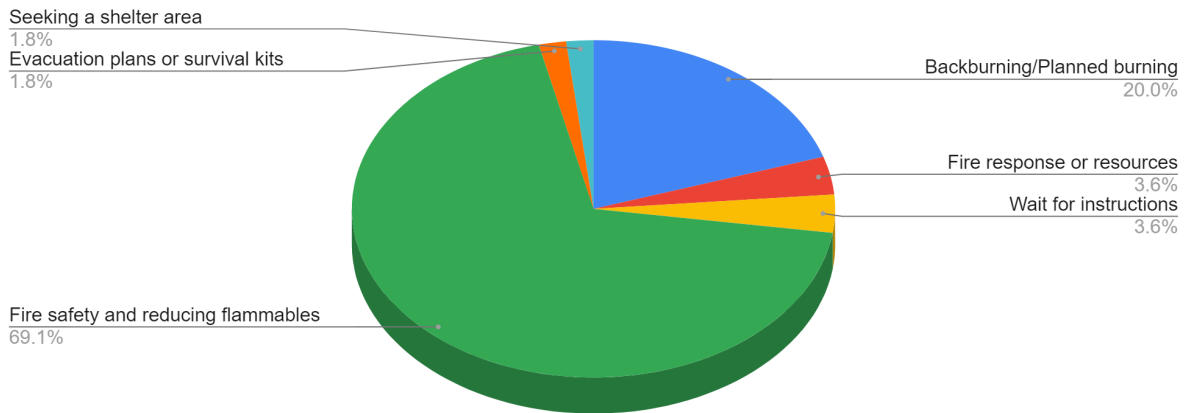


Figure 26: Pre-Assessment Data on Bushfire Preparation Actions

Student Post-Assessment: What actions can be taken to prevent bushfires?

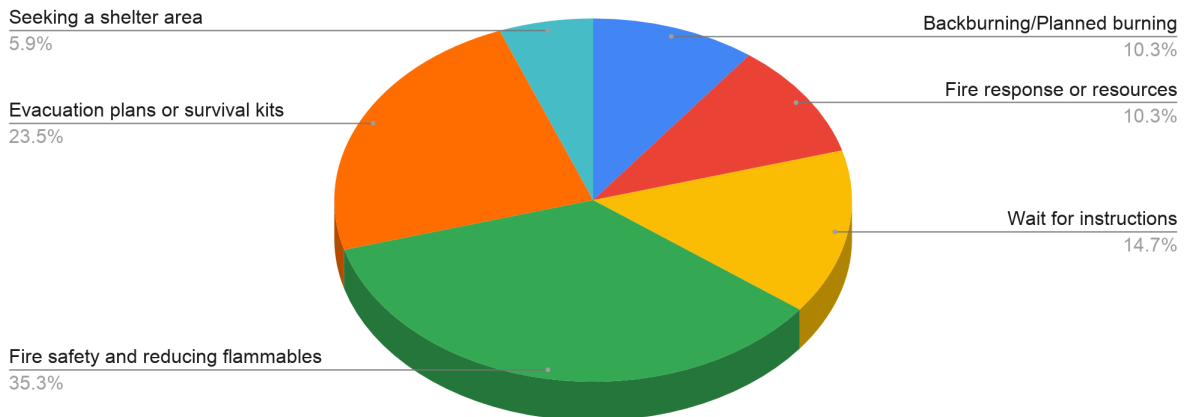


Figure 27: Post-Assessment Data on Bushfire Preparation Actions

Visually, it is clear that in the post-assessment, students had a larger variety of answers, which points to students being able to come up with many more methods for protecting an area should they have to come up with a plan. In order to come up with a numeric representation for this improvement in knowledge, we had to measure the variety of answers in both the pre- and post-assessments. In order to do this, we assigned each code response a certain arbitrary number value between 1-10. Each response entry was marked with such a number based on the code that is contained within the response entry. Mathematically, variance (σ^2) is a good way of measuring the variety in which the answers “strayed” from the mean value entry, which would just be the most commonly answered response. In the pre-assessment survey, student answers had a variance of $\sigma^2 = 0.85$ responses, which roughly shows that 68% of student responses stayed within one response value of the most common answer. In the post-assessment survey, student answers had a variance of $\sigma^2 = 1.88$ responses, which roughly shows that 68% of student

responses ventured to at least one response outside of the most common answer. Statistically, this is a significant change in student answer variety, which could potentially mean that students now have a **higher understanding** of various ways to plan for bushfires.

5.2.4 Student Feedback on Lesson Plans

In the post-assessment, students were asked various questions that were geared to gathering data on their opinions of various aspects of the Lesson Program. First, with basic “yes or no” questions, students were asked if having local/national fire experts respond to questions helped their learning, as well as if the technology used in the Lesson Program helped their learning. The results to these polls are shown below in Figures 28 and 29:

Student Feedback: Did communicating with your community experts (CFA, AIDR, AFAC) help you learn

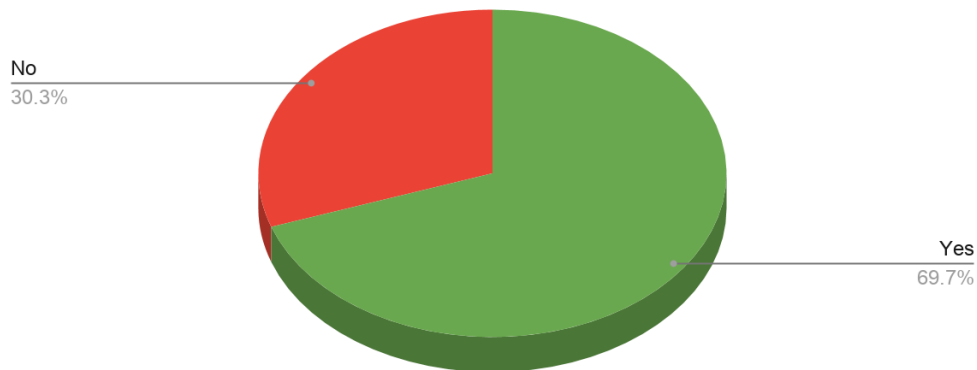


Figure 28: Student Feedback on Community Involvement

Student Feedback: Did using technology (games, simulations, etc.) help you learn more?

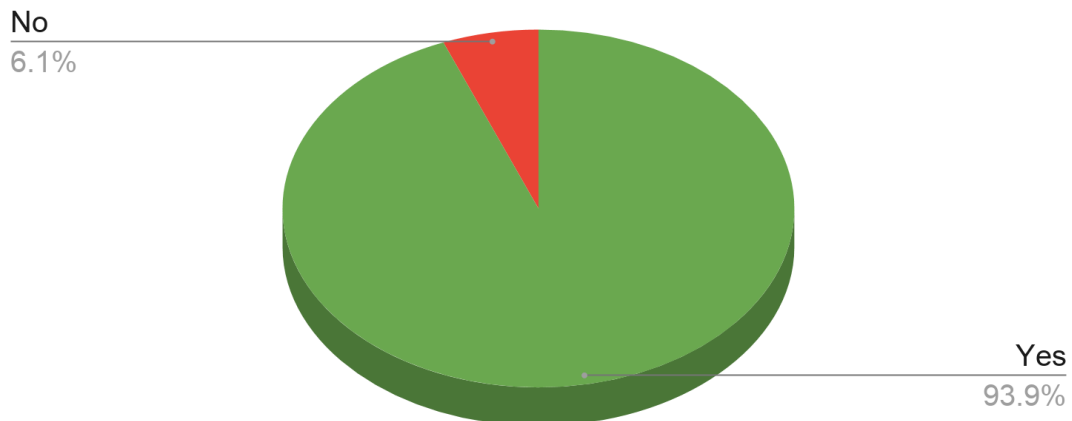


Figure 29: Student Feedback on Technology Use

These results show that the majority of students enjoyed having the local/national fire experts participate in the project experience. We believe that had this participation been more personal, students would have enjoyed it even more. Furthermore, the vast majority of students answered that the technology and software used in the Lesson Program helped them learn. This supports what we expected based on our research.

We also created another polling question which asked students to rank various aspects of the Lesson Program. The results are shown in Figure 30.

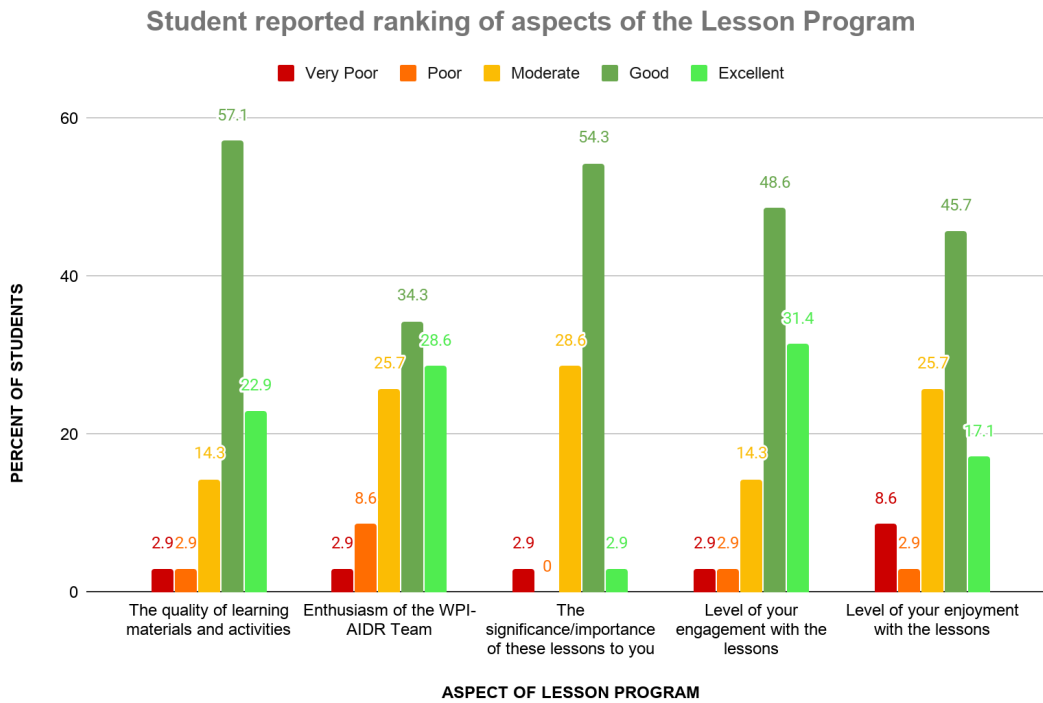


Figure 30: Student Ranking of the Lesson Program

Visually, it is clear that for most aspects of the project, students either said good or excellent as the most common responses for a given aspect. An interesting result to note is that the number of Good rankings far outnumbers the Excellent rankings, which goes to show that although our project was successful in teaching the students, there is definitely a lot of room for improvement to shift the student responses in a positive direction. To get a better overall idea of student sentiment based on this poll, we split the responses into Very poor or Poor, Moderate, and Good or Excellent. The resulting graph is shown in Figure 31:

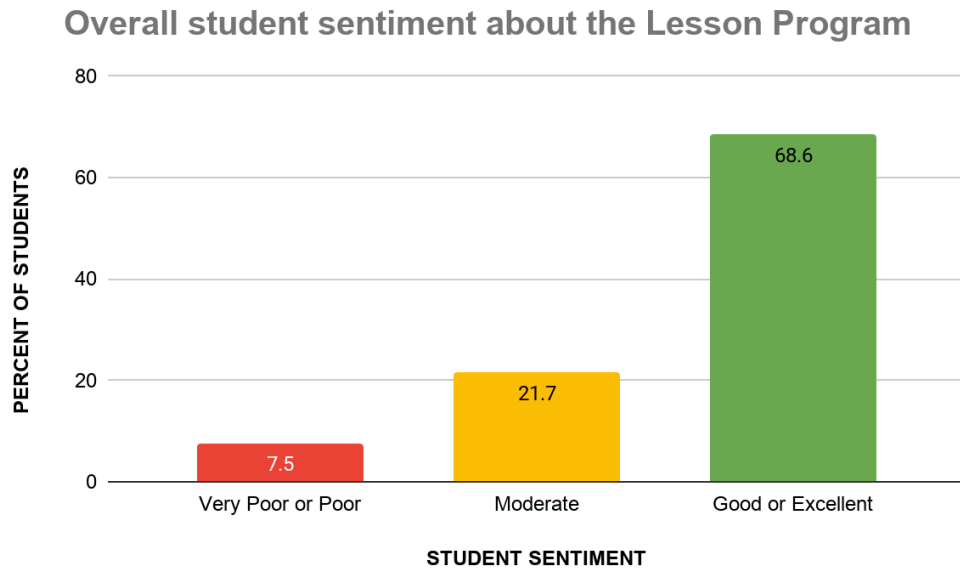


Figure 31: Overall Student Ranking of Lesson Program

Here, it is more clear that the vast majority of student sentiment lies within Good or Excellent. Despite this, it is still clear that there is room for improvement; a more desirable result would be to have very few or no students answer in the Very Poor or Poor column, but it is unclear from our data if that result is possible with a large range of student abilities and interests.

At the end of the post-assessment, students were asked to respond in a long-response format about two aspects of the Lesson Program they enjoyed and one or two aspects of the Lesson Program they disliked. The long responses were coded and analyzed using the same methods as in section 5.2.3. The results for aspects of the Lesson Program that students enjoyed are shown in Figure 32.



Figure 32: Aspects of the Lesson Program that Students Enjoyed

From this data, we can see that most students enjoyed the fact that they learned a lot, were able to use interactive activities and games, as well as simulations. These were the aspects of the Lesson Program that we were most excited about originally, so it is a promising result that students also enjoyed these aspects of the project. We were also surprised and happy to see that students chose to say that one of their most enjoyed aspects of the project was our team. Without being prompted to answer this, the students pointed out that we were an enjoyable part of the experience. Some student responses reflected that students were upset that they did not get to meet us in person, a sentiment that our team also shares about the students.

For the last part of the analysis, we had to ascertain what aspects of the Lesson Program students disliked the most. The last question on the post-assessment was a long response, similar to the one above, asking students to identify a couple aspects of the project they disliked. The resulting responses were coded and were charted in Figure 33.

Student long response: Identify aspects of the Lesson Program you dislike

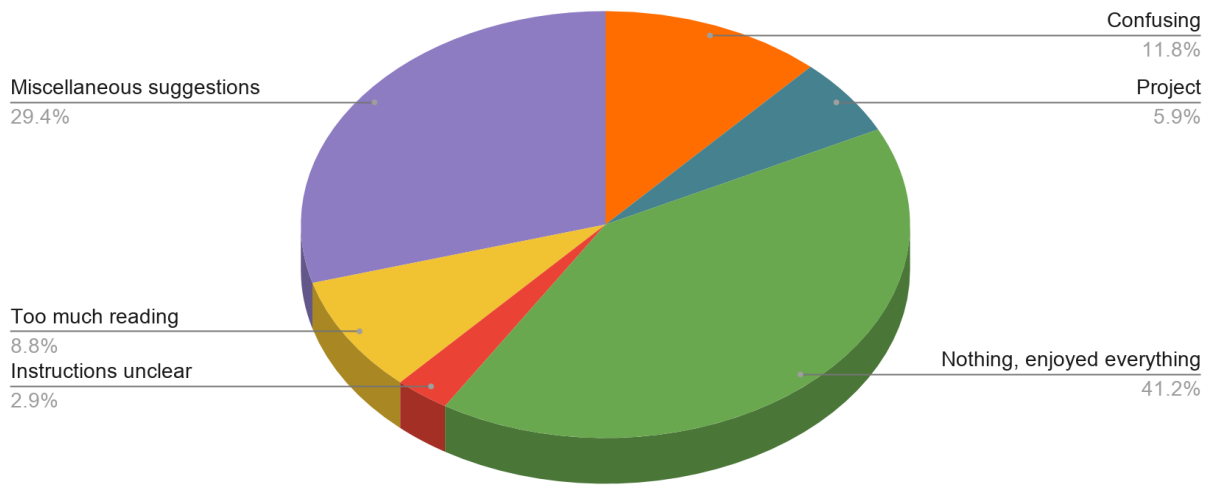


Figure 33: Aspects of the Lesson Program that Students Disliked

A somewhat surprising result was that the most frequent response to this question was that students enjoyed every aspect of the Lesson Program and disliked none of it. Although this does further reinforce that our Lesson Program was successful in both teaching and engaging the students, it isn't as useful for gathering feedback on how to improve our Lesson Plan for the future. Actual critiques and dislikes included confusing steps or unclear instructions, an excess of reading, and some students disliked the Final Project. The miscellaneous suggestions response was used for the wide array of responses that didn't fit into the other categories. These responses were usually students pointing out that they liked all aspects, but had suggestions on how to improve, which is exactly the type of data we were seeking by prompting this question.

Responses included potential improvements such as:

- Improving the website so that it is less clunky
- Accepting submissions directly to Compass (or other learning management platforms)
- Include more intra-student interactivity that allows classmates to collaborate, compete or communicate with each other better
- Allowing navigation in the interactive videos so that students aren't forced to watch all the way without being able to go back

We used these critiques and suggestions to develop recommendations for improvements to the Lesson Program that can be made for the future. After all of this data was gathered and analyzed, we conducted further qualitative analysis by comparing the data sets with each other to get a better idea of other improvements that could be made which weren't explicitly revealed or written in the responses to the questions we asked. This was done by using triangulation and other methods described in section 3.4.

6. Conclusions, Recommendations and Future Applications

This section is dedicated towards outlining the conclusions produced from data analysis. We put forward recommendations on how to improve our Lesson Program using the conclusions we came up with as well as input from students and stakeholders. Finally, we discuss the future applications of these recommendations which intend to make the layout of the Lesson Plan we have developed to be used in the future to teach students about disaster resilience in an engaging and effective way.

6.1 Recommendations Based on Data and Stakeholder Input

Some of the central conclusions reached from the statistical analysis that was outlined in the Data Analysis sections can be summarized in the following list:

1. After completing the Lesson Program, students demonstrated significant knowledge improvement in various aspects of disaster resilience (see Figure 20)
2. Overall student self reported knowledge on various aspects of bushfires shifted significantly towards Good or Excellent by over 30% after completing the Lesson Program (see Figures 21-25)
3. Measurable aspects of fire knowledge in students improved, with student answers including greater variety and knowledge of concepts following the completion of the Lesson Program (see [section 5.2.3](#))
4. 69.7% of students thought working with local/national fire experts helped their learning (see Figure 28)
5. An overwhelming 93.9% majority of students reported that the use of technology in the Lesson Program helped their learning (see Figure 29)
6. Overall student sentiment about the Lesson Program was Good or Excellent (Figure 31)

These conclusions point to the fact that our Lesson Program successfully taught various aspects of disaster resilience and can be used as a template for how to incorporate learning material into an engaging structure. The technology aspects, especially the simulations and games, were extremely popular among students and we believe these are essential in maintaining student interest as well as enhancing learning. We recommend using many of the games and interactive activities we have implemented as a model for which activities to implement and how frequently to implement the activities without detracting from learning, but providing more succinct instructions in the process.

Having received feedback from the students, their teacher Mr. Vear, and the AIDR representative Ms. Little, about how to improve the Lesson Program, we then coupled this feedback with the data gathered and analyzed in section 5. The following list includes several key recommendations to improve the Lesson Program:

1. Follow a strict set of rules on how to succinctly deliver instructions for all activities to maintain clarity

2. Have any website for the Lesson Program include the same strict set of rules for organization and layout, thus making for a cleaner and less clunky experience
3. Use a better website creation platform than Google Sites, perhaps a paid platform, in order to have better results with activities that rely on Java/Flash/HTML5
4. When using the H5P interactive video software, enable backwards navigation for students to allow for a better learning experience, and incorporate feedback into the questions when students select a wrong answer
5. Using a learning management system or platform such as Compass, Canvas, Blackboard etc. to integrate with the lesson for submissions would significantly improve workflow for both students and teachers
6. Use a forum or message based system for more intra-student interaction and involvement
7. Create a more effective and thought out Final Project which encapsulates more of the concepts learned in the Lesson Program, as well as allowing more time and creative freedom for students to create and contribute ideas for disaster resilience. It can also be decreased in scope and focus on their house so that they are not working on concepts handled exclusively by experts.
8. Conduct Lesson Plans over a longer period of time to improve student participation

Many of these recommendations became apparent through the development and deployment of the Lesson Program. Many of the issues that arose were due to intense time constraints as well as large time zone differences. If a future party wanted to create a more successful Lesson Program, **the most essential recommendation** that we can give is allowing for more time than 7 weeks for a full development and deployment cycle of a lesson program, which we had to employ.

6.2 Resource Maintenance

These lesson plans include videos that we created and then used the H5P service to add interactive content to. The main issue with this was that it costs money to host the H5P content on an HTML5 compatible server. Luckily, we were able to receive a 30-day free trial, but if the content needs to be used in the future, it will need a host server, which would need to be paid for. The only other option is to host it on a learning management system, such as Canvas or Moodle. These platforms support HTML5 content, so you could host the videos from one of these systems. This would of course mean that you have a paid subscription for a classroom in one of these platforms.

6.3 Adaptations for In-Person Teaching

The biggest limitation to this project was not being able to travel to Australia and carry out the lesson plans in the classroom. Aspects like remote delivery and time zone differences arose great challenges. There are two main aspects of the project that had to be dropped after finding out about these limitations.

The first is SimTable, and the second is inviting community experts to the school. In the last unit, we used AnyHazard simulation software to create bushfire scenarios in the Emerald area. This software is meant to be directly compatible with the SimTable sand table. The scenario can be projected onto the sand table, allowing for more interaction with the terrain and simulation. The original plan for the project was to invite experts from the CFA to Emerald Secondary College to do a demonstration on the SimTable. Then the students could all create their own scenarios and see them come to life on the table. This also allows for much more interaction between the local fire experts and the students. We believe that we did the best for this project with the circumstances we were under, but implementing these two things for future in-person lesson plans could make a pronounced difference in student engagement.

7. References

- AIDR: Australian Institute for Disaster Resilience. (n.d.). Retrieved January 25, 2020, from <https://www.aidr.org.au/>
- AIDR. (2020). Australian Disasters: Disaster Mapper. Retrieved from <https://knowledge.aidr.org.au/disasters>
- Altonji, J., Mansfield, R., Duncan, G., Murnane, R. (2011) Whither Opportunity? Rising Inequality and the Uncertain Life Chances of Low-Income Children (pp. 339–359).
- Anderson, D., Chubb, P., & Djerf-Pierre, M. (2018). Fanning the Blame: Media Accountability, Climate and Crisis on the Australian “Fire Continent”. *Environmental Communication*, 12(7), 928–941.
- Anderson, W. (2005). Bringing children into focus on the social science disaster research agenda. *International Journal of Mass Emergencies and Disasters*, 23(3), 159-175.
- Arriagada, N. B., Bowman, D. M., Palmer, A. J., & Johnston, F. H. (2020). Climate Change, Wildfires, Heatwaves and Health Impacts in Australia. In *Extreme Weather Events and Human Health* (pp. 99-116). Springer, Cham.
- Baytiyeh, H. (2019). Why school resilience should be critical for the post-earthquake recovery of communities in divided societies. *Education and Urban Society*, 51(5), 693-711. doi:10.1177/0013124517747035
- Bergdahl, N., Nouri, J., Fors, U., & Knutsson, O. (2019). Engagement, disengagement and performance when learning with technologies in upper secondary school . *Computers & Education*, 149. <https://doi.org/10.1016/j.compedu.2019.103783>
- Borchers Arriagada, N., Bowman, David M. J. S., Palmer, A. J., & Johnston, F. H. (2020). Climate change, wildfires, heatwaves and health impacts in australia. In R. Akhtar (Ed.), *Extreme weather events and human health: International case studies* (pp. 99-116). Cham: Springer International Publishing. doi:10.1007/978-3-030-23773-8_8 Retrieved from https://doi.org/10.1007/978-3-030-23773-8_8
- Bower, J. M., van Kraayenoord, C., & Carroll, A. (2015). *Building social connectedness in schools: Australian teachers’ perspectives* doi:<https://doi.org/10.1016/j.ijer.2015.02.004>
- Brady, D., & Webb, N. (2013). Communicating Bushfire Safety in Australia: The Challenge for Government of Increasing Community Participation. *Asia Pacific Media Educator*, 23(2), 351–365.
- Bureau of Meteorology. (2020). Annual australian climate statement 2019. (). Retrieved from <http://www.bom.gov.au/climate/current/annual/aus/>
- Burrows, N., & McCaw, L. (2013). Prescribed burning in southwestern australian forests. *Frontiers in Ecology and the Environment*, 11, e25-e34. doi:10.1890/120356
- Bushfire. (2017). Retrieved from <https://www.ga.gov.au/scientific-topics/community-safety/bushfire>

- Cai, W., Santoso, A., Wang, G., Weller, E., Wu, L., Ashok, K., . . . Yamagata, T. (2014). Increased frequency of extreme indian ocean dipole events due to greenhouse warming. *Nature*, 510(7504), 254-258. doi:10.1038/nature13327
- Clerke, S. (2013). *Partnering for school improvement : Case studies of school-community partnerships in australia*. Camberwell, Victoria, 3124, Australia: Australian Council for Educational Research Ltd. Retrieved from <http://parlinfo.aph.gov.au/parlInfo/search/summary/summary.w3p;query=Id:%22library/catalog/00657554%22>
- Clode, D., & Elgar, M. A. (2014). Fighting fire with fire: Does a policy of broad-scale prescribed burning improve community safety? *Society & Natural Resources*, 27(11), 1192-1199. doi:10.1080/08941920.2014.905894
- Domingo, M. G., & Garganté, A. B. (2016). *Exploring the use of educational technology in primary education: Teachers' perception of mobile technology learning impacts and applications' use in the classroom*. <https://doi.org/10.1016/j.chb.2015.11.023>
- Dufty, N. (2009). Natural hazards education in Australian schools: How can we make it more effective?. *Australian Journal of Emergency Management, The*, 24(2), 13
- Gibbs, L., Ireton, G., Block, K., & Taunt, E. (2018). Children as bushfire educators--"just be calm, and stuff like that". *Journal of International Social Studies*, 8(1), 86-112.
- Lai, B., Esnard, A., Wyczalkowski, C., Savage, R., Shah, H. (2018) Trajectories of School Recovery After a Natural Disaster. *Risk and Protective Factors. Risks, Hazards, and Crisis in Public Policy*. 10(1), 32-51. doi:10.1002/rhc3.12158.
- NASA. (2020). Fire Information for Resource Management System (FIRMS). Retrieved from <https://earthdata.nasa.gov/earth-observation-data/near-real-time/firms>
- National Museum Australia. (2019). Black Saturday Bushfires. Retrieved from <https://www.nma.gov.au/defining-moments/resources/black-saturday-bushfires>
- Nolan, R. H., Boer, M. M., Collins, L., Resco de Dios, V., Clarke, H., Jenkins, M., . . . Bradstock, R. A. (2020). Causes and consequences of eastern Australia's 2019–20 season of mega-fires. *Global Change Biology*, n/a doi:10.1111/gcb.14987
- Peek, L. (2008). Children and disasters: Understanding vulnerability, developing capacities, and promoting resilience — an introduction. *Children, Youth and Environments*, 18(1), 1-29. Retrieved from <http://www.jstor.org/stable/10.7721/chilyoutenvi.18.1.0001>
- Pfefferbaum, B., & Van Horn, R. L. (2018). Involving children in disaster risk reduction: the importance of participation. *European journal of psychotraumatology*, 9(sup2), 1425577. doi:10.1080/20008198.2018.1425577
- Preparing for bushfires. Retrieved from <https://bushfireeducation.vic.edu.au/secondary/preparing-for-bushfires/secondary-preparing-for-bushfires.html>
- Simtable. (2020). Retrieved February 2, 2020, from <http://www.simtable.com>

- Tarabay, J. (2020). Why These Australia Fires Are Like Nothing We've Seen Before. Retrieved from <https://www.nytimes.com/2020/01/21/world/australia/fires-size-climate.html>
- The Commonwealth of Australia. (2018). Disaster Assist. Retrieved from <https://www.disasterassist.gov.au/Pages/australian-disasters.aspx>
- U.S. Department of Homeland Security. (2019, August 7). *Build a Kit Game*. Ready.gov. <https://www.ready.gov/kids/games/data/bak-english/index.html>
- U.S. Department of the Interior. (2015, June 12). Interior Department awards \$10 million to bolster wildland fire resilience projects across the country. *States News Service*. Retrieved from https://link.gale.com/apps/doc/A417636376/AONE?u=mlln_c_worpoly&sid=AONE&xid=06b8491f
- University of Sydney. (2020). More than one billion animals impacted in Australian bushfires. Retrieved from <https://sydney.edu.au/news-opinion/news/2020/01/08/australian-bushfires-more-than-one-billion-animals-impacted.html>
- van de Pol, J., Volman, M., Oort, F. et al. (2015) The effects of scaffolding in the classroom: support contingency and student independent working time in relation to student achievement, task effort and appreciation of support. *Instr Sci* 43, 615–641. <https://doi.org/10.1007/s11251-015-9351-z>
- Wardlow, L. (2017, June 22). How technology can boost student engagement. Retrieved from <https://www.pearsoned.com/technology-can-boost-student-engagement/>
- Webb, M., & Ronan, K. R. (2014). Interactive hazards education program for youth in a low SES community: A quasi-experimental pilot study. *Risk Analysis*, 34(10), 1882-1893. doi:10.1111/risa.12217
- Wiggins, G., & McTighe, J. (2011). *The Understanding by Design guide to creating high-quality units*. Alexandria, VA: ASCD.
- Woodward, A. (2020). Australia's fires are 46% bigger than last year's Brazilian Amazon blazes. There are at least 2 months of fire season to go. Retrieved from <https://www.insider.com/australia-fires-burned-twice-land-area-as-2019-amazon-fires-2020-1>

Appendix A: Lesson Plan Development Resources

The following resources were used by the team to organize the lesson plans. They were not directly used or filled out, rather used as a basis for producing the lesson plans in a consistent structure.



Lesson Plan Title: [Click here to enter text.](#)

Teacher's Name: [Click here to enter text.](#) **Subject/Course:** [Click here to enter text.](#)

Unit: [Click here to enter text.](#) **Grade Level:** [Click here to enter text.](#)

Overview of and Motivation for Lesson:

[Click here to enter text.](#)

Stage 1-Desired Results	
Standard(s): <ul style="list-style-type: none"> Click here to enter text. 	
Aim/Essential Question: <ul style="list-style-type: none"> Click here to enter text. 	
Understanding(s): <i>Students will understand that...</i> <ul style="list-style-type: none"> Click here to enter text. 	
Content Objectives: <i>Students will be able to...</i> <ul style="list-style-type: none"> Click here to enter text. 	Language Objectives: ELD Level Choose an item. <i>Students will be able to... in English</i> <ul style="list-style-type: none"> Click here to enter text. ELD Level Choose an item. <i>Students will be able to... in English</i> <ul style="list-style-type: none"> Click here to enter text.
Key Vocabulary <ul style="list-style-type: none"> Click here to enter text. 	
Stage 2-Assessment Evidence	
Performance Task or Key Evidence <ul style="list-style-type: none"> Click here to enter text. 	
Key Criteria to measure Performance Task or Key Evidence <ul style="list-style-type: none"> Click here to enter text. 	

Stage 3- Learning Plan

Learning Activities:

Do Now/Bell Ringer/Opener: [Click here to enter text.](#)

Learning Activity 1:

[Click here to enter text.](#)

Learning Activity 2:

[Click here to enter text.](#)

Application

[Click here to enter text.](#)

Summary/Closing

[Click here to enter text.](#)

Multiple Intelligences Addressed:

- | | | | |
|-------------------------------------|---|--|---|
| <input type="checkbox"/> Linguistic | <input type="checkbox"/> Logical-Mathematical | <input type="checkbox"/> Musical | <input type="checkbox"/> Bodily-kinesthetic |
| <input type="checkbox"/> Spatial | <input type="checkbox"/> Interpersonal | <input type="checkbox"/> Intrapersonal | <input type="checkbox"/> Naturalistic |

Student Grouping

- | | | | |
|--------------------------------------|--------------------------------------|--------------------------------|-------------------------------------|
| <input type="checkbox"/> Whole Class | <input type="checkbox"/> Small Group | <input type="checkbox"/> Pairs | <input type="checkbox"/> Individual |
|--------------------------------------|--------------------------------------|--------------------------------|-------------------------------------|

Instructional Delivery Methods

- | | | |
|---|----------------------------------|--|
| <input type="checkbox"/> Teacher Modeling/Demonstration | <input type="checkbox"/> Lecture | <input type="checkbox"/> Discussion |
| <input type="checkbox"/> Cooperative Learning | <input type="checkbox"/> Centers | <input type="checkbox"/> Problem Solving |
| <input type="checkbox"/> Independent Projects | | |

Accommodations

[Click here to enter text.](#)

Modifications

[Click here to enter text.](#)

Homework/Extension Activities:

[Click here to enter text.](#)

Materials and Equipment Needed:

- [Click here to enter text.](#)

Adapted from Grant Wiggins and Jay McTighe-*Understanding by Design*

Appendix B: Student Pre- and Post-Assessments

Student Pre-Assessment Survey

Pre-Assessment Form

Please complete the survey below, filling in answers honestly. This will not be graded/marked. It will help us gain an understanding of your background knowledge related to bushfires.

Please provide your school email address:

* Required

Email address *

Your email _____

Name *

Please provide your first and last name

Your answer _____

What are the four stages of the disaster management cycle? *

- Learn
- Manage
- Prepare
- Recover
- Respond
- Prevent
- Recuperate
- Act

How would you rate your background knowledge of bushfires? *

	Very Poor	Poor	Moderate	Good	Excellent
Preparing for bushfires	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How bushfires spread	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How to respond to a bushfire	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Planned burning strategies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

What actions can you take to prevent a bushfire from occurring? *

Your answer

What actions, if any, do you and your family take to prepare for the bushfire season? *

Your answer

What would you like to learn about managing bushfires? *

Your answer

Is there anything we should know about your personal experiences with fire before we explore these topics?

Your answer

Submit

Student Post-Assessment Survey

Post-Assessment Form

Please complete the survey below, filling in answers honestly. This will help us gauge your learning, and also give you the opportunity to let us know how you feel about our lesson plans.

PLEASE USE THE SAME NAME AND EMAIL AS THE PRE-ASSESSMENT

* Required

Email address *

Your email

Name *

Please provide your first and last name

Your answer

What are the four stages of the disaster management cycle? *

- Prepare
- Act
- Recuperate
- Recover
- Learn
- Prevent
- Respond
- Manage

How would you rate your knowledge of bushfires now that you have completed all the lessons? *

	Very Poor	Poor	Moderate	Good	Excellent
Preparing for bushfires	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How bushfires spread	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How to respond to a bushfire	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Planned burning strategies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

What actions can you take to protect people, property, and the environment in your local area from bushfires? *

Please describe at least 2 actions in detail

Your answer

Next

Now, let us know how we did!

Please answer honestly so we know where we can improve!

How would you rate your learning experience and the lesson plans? *

	Very Poor	Poor	Moderate	Good	Excellent
The quality of learning materials and activities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Enthusiasm of the WPI team	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The significance/importance of these lessons to you	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Level of your engagement with the lessons	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Level of your enjoyment with the lessons	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Did using technology (games, simulations, etc.) help you learn more? *

Yes

No

Did communicating with your community experts (CFA, AIDR, AFAC) help you learn more? *

Yes

No

Please identify one or two specific things you liked about the lessons and why *

Your answer

What aspects of the project did you not like? Please describe one or two specific things we could do to improve student learning. *

Your answer

Back

Submit

Appendix C: Lesson Plan Website

<https://sites.google.com/view/wpi-aidr-lessons/introduction>

Introduction Page



The goal of these lesson plans is to help you develop knowledge and skills for dealing with disasters in your area, especially bushfires

OVERVIEW OF LESSONS

Each lesson starts by outlining the **learning objectives** for that lesson. Go through the learning objectives to understand what content the lesson contains. The learning material in the lessons are designed to provide you with the background necessary to complete the **games and quizzes** throughout the lesson. **Make sure that you scroll down and complete the activities on each page before clicking on a new tab**

UNIT 1: DISASTER RESILIENCE



UNIT 2: FIRE DYNAMICS



UNIT 3: LOCAL RISK PROFILE



Expand

Unit 1: Disaster Resilience



If you have questions or feedback about this unit, scroll to the bottom of this page and add a comment to the bulletin board

LEARNING OBJECTIVES

After completing this unit, you will be able to:

1. Understand the difference between a hazard and a disaster
2. List the different types of impacts a disaster can have on people and places
3. Identify the four stages of the disaster management cycle
4. Explain how you can prepare for a disaster before it occurs
5. Identify natural hazards that occur in and around Australia and how they impact communities



THE AIDR VISION

AIDR works to support students:

- to develop knowledge, skills, and confidence to take action before, during, and after an emergency
- by providing opportunities for students to build safer, stronger communities

Australian Institute for
Disaster Resilience



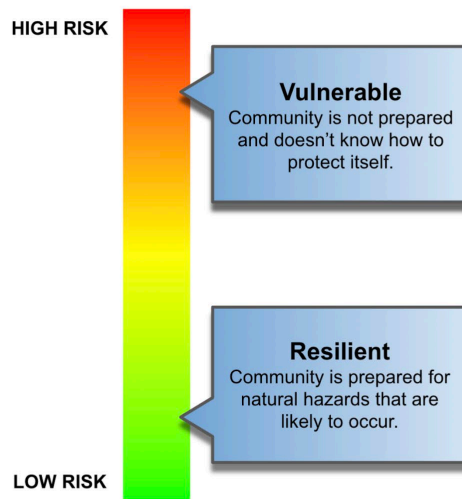
The goal of disaster resilience is to build strong communities who understand local hazards and how to protect themselves from harm.

HAZARD VS. DISASTER



RISK

⊙



TYPES OF IMPACTS

⊙

Impacts are the **effects** or **consequences** of disasters on people and places

Flip through the cards to explore the different types of impacts that can be caused by disasters

Physical

Injury, illness, or death.



MATCH EACH STATEMENT WITH ITS TYPE OF IMPACT BY CLICKING ON MATCHING DEFINITIONS

Click **Start** to begin this small quiz. You have **3 strikes** before the quiz ends. You can **try again** as many times as you'd like!

The screenshot shows a quiz interface with a green background. On the left, there is a diagram of four boxes connected by lines. The main area contains the title 'Disaster Impacts' and the instruction 'Group the examples by their type'. Below this is a box showing '3 NUM. TRIES' and a large orange 'Start' button. At the bottom, it says 'Author: Bradley LaGrasse' and has three small icons.

Once you are done, upload a screenshot of your quiz results to Compass for the 'Disaster Impacts' learning task!



THE 4 STEPS OF DISASTER RESILIENCE

Prevent

Preventing future hazards from causing harm

- e.g. restricting building permits in high risk areas, land management and planned burning

Recover

Recovering from a hazard after it occurs

- e.g. repairing property, treatment for illness or injury



Prepare

Preparing for a hazard in case it occurs

- e.g. creating an evacuation plan, clearing vegetation

Respond

Responding to advice and warnings from emergency services

- Putting your preparedness plans into action

BUILDING AN EMERGENCY KIT

One of the easiest ways you can be **prepared** for a disaster is to build a family **emergency kit**.

Things you should include:

- Water
- Non-perishable Foods
- Paper Goods
- First Aid Kit
- Hygiene Supplies
- Comfortable Clothes
- Sleep Items
- Flashlight
- Batteries/Battery-powered radio
- Entertainment

NOW CREATE YOUR OWN EMERGENCY KIT!

Read the text on the game screen, then click **Ready?** to start the game

Note: After completing level 5, do **NOT** click "You're all set! Print your checklist." Just take a screenshot of the level 5 completion screen

* Make sure to turn on Scripts and Flash in your browser! *

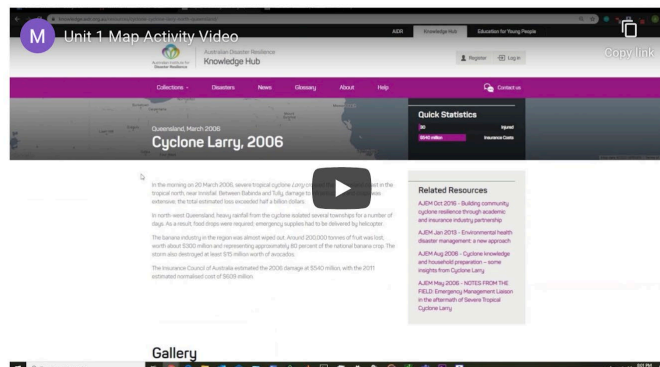


①

Once you complete level 5, upload a screenshot to Compass for the 'Emergency Kit' learning task!

DISASTERS IN YOUR AREA

As a class, you will create an **interactive map** that shows **disasters** in your area and their **impacts** on those communities. Watch the **video** instructions below to add a disaster pin to the map!



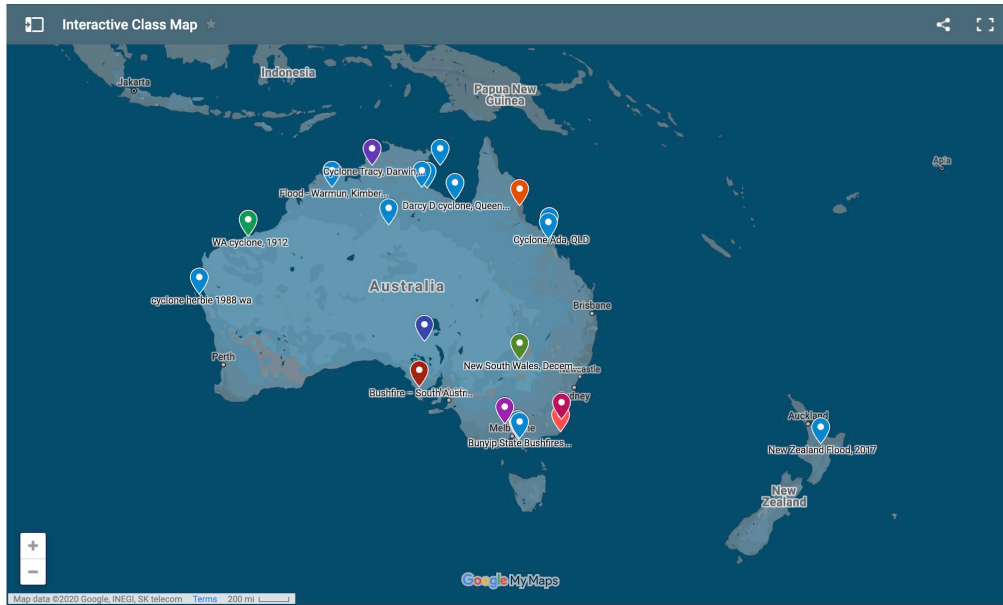
[Click here to go to the ADR Knowledge Hub](#)

②

CLICK THE FULLSCREEN BUTTON IN THE TOP RIGHT CORNER TO EDIT THE MAP

Note: You need a **Google account** to edit the map. After you fullscreen the map, click **Sign in** in the top right corner to log in, or make a new account if you don't have one already.

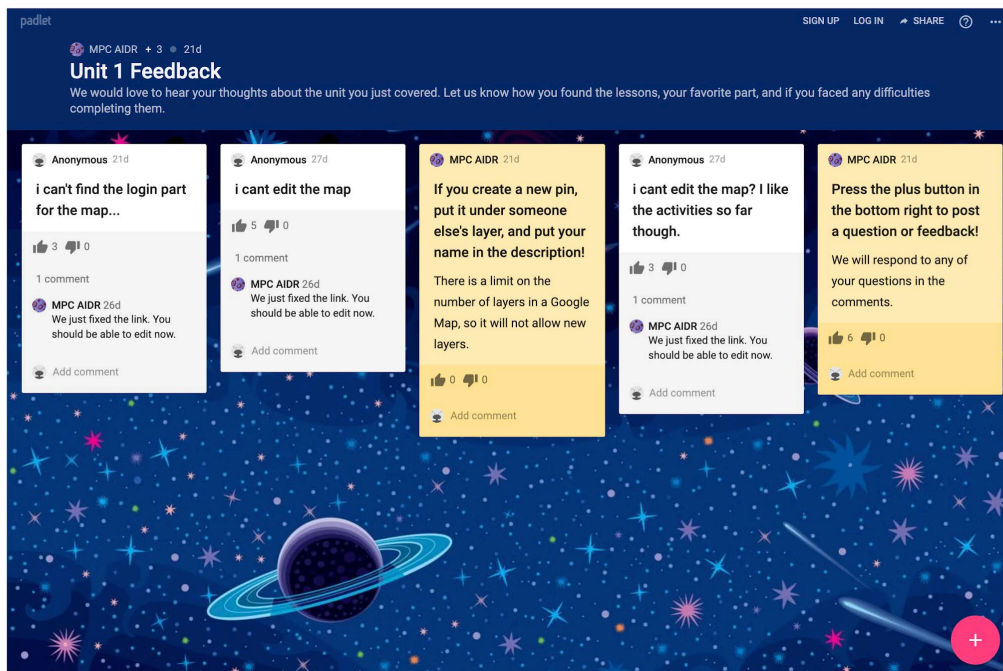
UPDATE: Please don't create a new layer with your name. You can just add a pin to someone else's layer. Then write your name in the description of that pin.



①

HELP AND FEEDBACK

If you are **stuck**, need **help**, or want to provide **feedback**, please post in the bulletin below!



①

Unit 2: Fire Dynamics

FIRE DYNAMICS

Photo by Benjamin Lizardo on Unsplash

If you have questions or feedback about this unit, scroll to the bottom of this page and add a comment to the bulletin board

LEARNING OBJECTIVES

After completing this unit, you will be able to:

1. Explain why fires are so dangerous to people and property
2. Recognize the Fire Danger Rating system and appropriate actions to take at each level
3. Identify the key elements that affect how a fire spreads
4. Describe appropriate actions to reduce the impact of bushfires on your home

Understanding how fire spreads and behaves can help people prepare and respond to bushfires

THE KEY ELEMENTS THAT AFFECT THE SPREAD OF FIRE



TERRAIN SLOPE

Fire travels differently up and down hills. The slope of the terrain greatly affects the speed and spread of fire.



WIND SPEED & DIRECTION

Wind can make fire very unpredictable. It changes the speed and direction of fire very quickly.



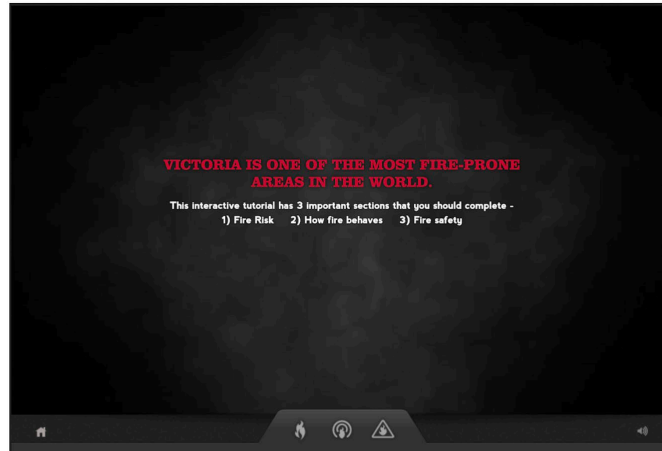
FUEL DENSITY

The amount of trees or bush in an area determines if a fire has enough fuel to spread. Lower fuel density makes it harder for fire to keep burning.

PLAY THE INTERACTIVE GAME BELOW TO LEARN MORE ABOUT HOW FIRES BEHAVE AND WHAT YOU SHOULD DO TO BE PREPARED

Start by clicking on the game. It will open a new tab. To **start** the game, click **skip** in the top right corner.

We recommend turning your **sound on** so you can hear the woman talking. Begin each section by clicking one of the **embers**. Once you complete that section, you will be brought back to the main screen and that ember will be put out. Be sure to **read** all of the information and flip through the sections using the **grey arrows** on the right hand side. **DO NOT turn on Accessibility** on the top right, it will cause an error.



Once you complete the Safety & Awareness section, upload a screenshot of the 'Prepare. Act. Survive.' screen to Compass for the 'CFA Fire Behavior' learning task!

①

TAKE THE QUIZ BELOW TO SEE WHAT YOU'VE LEARNED

Fire Behavior and Safety Quiz

Answer these questions to see what you've learned from the game!

Please provide your school email address

*** Required**

Email address *

Your email

Name *

First and Last name

Your answer

Next

②

HOW FUEL DENSITY AFFECTS BUSHFIRES

Watch the video below to begin this Simulation activity:



[Click here to go to the Simulation website](#)

Bushfire Fuel Density Simulation

Use the tree density simulation and graphs to answer these questions. If the graphs are empty, run the simulator at least 20 times at different tree densities before taking the quiz.

Please provide your school email address

* Required

Email address *

Your email

Name *

Your answer

A forest at 75% tree density will most likely completely burn down *

- True
 False

A forest at 10% tree density will most likely survive a fire

- True
 False

At what tree density does the fire start to reach the other side of the screen? This is called the phase shift. *

Your answer

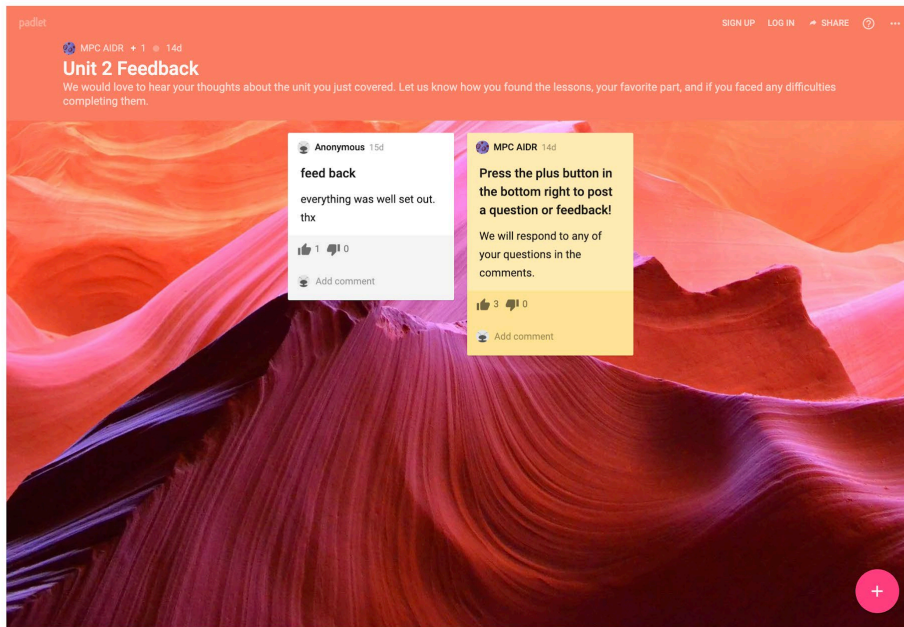
What are some ways that firefighters could control how many trees are in a forest? Feel free to do some research online *

Your answer

Submit

HELP AND FEEDBACK

If you are stuck, need help, or want to provide feedback, please post in the bulletin below!



①

Fire Safety and Behavior Quiz

**VICTORIA IS ONE OF THE MOST FIRE-PRONE
AREAS IN THE WORLD.**

This interactive tutorial has 3 important sections that you should complete -
1) Fire Risk 2) How fire behaves 3) Fire safety



Fire Behavior and Safety Quiz

Answer these questions to see what you've learned from the game!

Please provide your school email address

* Required

Email address *

Your email

Name *

First and Last name

Your answer

Next

Fire Risk

In Victoria, the highest Fire Danger Rating is *

- Extreme
- Catastrophic
- Code Red

The best way to protect yourself from radiant heat is *

Your answer _____

The most common way houses catch fire during bushfires is from *

- The Flames
- The Heat
- The Embers

Back

Next

Fire Behavior

Why is wind such a dangerous influence on fires? *

Your answer

How does fire behave on a hill? *

Your answer

Why do you think fire behaves like that on a hill? Feel free to do some research online *

Your answer

Back

Next

Fire Safety

What should you do on a Code Red day? *

Select all that apply

- Leave the area as soon as possible
- Avoid grassy and forested areas
- Pick up twigs and leaves in your yard

How can you reduce the impact of bushfires on your home? *

Your answer

Back

Submit

Bushfire Fuel Density Quiz

Bushfire Fuel Density Simulation

Use the tree density simulation and graphs to answer these questions. If the graphs are empty, run the simulator at least 20 times at different tree densities before taking the quiz.

Please provide your school email address

* Required

Email address *

Your email

Name *

Your answer

A forest at 75% tree density will most likely completely burn down *

- True
- False

A forest at 10% tree density will most likely survive a fire

- True
- False

At what tree density does the fire start to reach the other side of the screen?
This is called the phase shift. *

Your answer _____

What are some ways that firefighters could control how many trees are in a forest? Feel free to do some research online *

Your answer _____

Submit

Unit 3: Local Risk Profile



If you have questions or feedback about this unit or the project, scroll to the bottom of this page and add a comment to the bulletin board.

LEARNING OBJECTIVES

After completing this unit, you will be able to:

1. Understand how different elements affect the spread of fire in the Emerald area
2. Create an effective evacuation plan to perform during an emergency
3. Recognize the best shelter options and when to use them
4. Use technology to present your ideas to community experts

①

SUPPORT SERVICES AVAILABLE TO YOU

This lesson program contains content about **bushfires** in the Emerald area. If you have been **affected** by a bushfire or other emergency, and participating in these lessons raises any concerns or **uncomfortable feelings**, there are a number of **support options** available to you. You can pause the lesson at any time to **take a break**. Remember, your **mental health** comes first!



Kids Helpline is a private and confidential 24/7 counselling service for children and young people aged 5 to 25. The fastest way to talk with a counselor is on the phone 1800 55 1800. It's free to call - even from mobiles. If you can't get to a phone or prefer to chat online, you can connect one-on-one with a Kids Helpline counselor through WebChat.

[Click here to access WebChat](#)



Headspace provides free online and telephone support and counseling to young people aged 12 to 25 and their families and friends. If you're based in Australia and going through a tough time, headspace can help. You can speak one-on-one with a counselor, or participate in a group chat with other people going through a similar situation.

[Click here for more information](#)



Beyond Blue provides information and support to help everyone in Australia reach their best possible mental health. They provide information and support on issues such as anxiety, depression, and suicide. They also provide support and tips on how to cope with the COVID-19 pandemic.

[Click here for more information](#)

①

SIMULATING BUSHFIRES IN EMERALD

As you learned in Unit 2, the three main elements of bushfire spreading are **terrain slope**, **wind speed/direction**, and **fuel density**.

PLAY THE VIDEO BELOW TO EXPLORE THESE ELEMENTS IN AN ACTIVE SIMULATION

Note: The videos in this unit are just **simulations** and don't necessarily reflect the full **reality** of bushfires. Always be prepared and **have a plan**. Above all, always listen to your local **Emergency Services** for guidance on how to respond in a bushfire emergency!



The best way to be prepared for a bushfire is to have a plan. If you are informed of an upcoming high-risk day, leaving early is always the safest option!

EVACUATION AND SHELTER PLANS

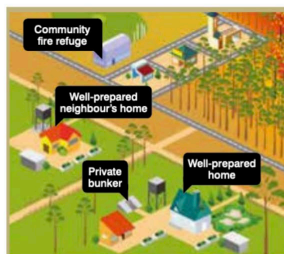
Information Source: Victoria Country Fire Authority



LEAVE EARLY

- › When the Fire Danger Rating is Code Red, leaving early is always the safest option.
- › Leave early destinations could include homes of family and friends who live outside the risk area, a nearby town or other built-up area.

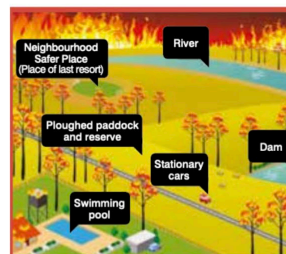
Always the safest option



WELL PREPARED

- If leaving the high risk area is no longer an option, there may be options close to where you are that could protect you. These include:
- › a well-prepared home (yours or your neighbour's) that you can actively defend on Severe and Extreme Fire Danger Rating days only
 - › private bushfire shelter (bunker) that meets current regulations
 - › designated community fire refuge.

Your safety is not guaranteed



LAST RESORT

- In situations where no other options are available, taking shelter in one of the below may protect you from radiant heat:
- › Neighbourhood Safer Place (Place of Last Resort)
 - › stationary car in a clear area
 - › ploughed paddock or reserve
 - › body of water (i.e. beach, swimming pool, dam, river, etc).

High risk of trauma and injury

Please note that the last resort options are truly a **last resort**. You should do **everything possible** to avoid having to use these options. They will **not** fully protect you if the fire gets close enough.

SIMULATING EVACUATION AND RESPONSE

Fighting a fire is very difficult for everyone, including emergency services. The information they provide you is the best chance you have at surviving.

PLAY THE VIDEO BELOW TO SEE A SIMULATION OF HOW A BUSHFIRE MIGHT BE DEALT WITH BY EMERGENCY SERVICES

Note: The videos in this unit are just **simulations** and don't necessarily reflect the full **reality** of bushfires. Always be prepared and **have a plan**. Above all, always listen to your local **Emergency Services** for guidance on how to respond in a bushfire emergency!



⌚

QUESTIONS FOR THE CFA, AFAC OR AIDR

The Victoria **Country Fire Authority (CFA)**, the **National Council for Fire and Emergency Services (AFAC)**, and the **Australian Institute for Disaster Resilience (AIDR)** have offered to **answer** some of your most asked **questions** about bushfire safety and emergency response! **Post** your questions below so they can provide you with their answers. You can ask them about **anything** you learned in these lessons, or even something you didn't learn, but want to!

Anonymous 12d

if your house is behind the fire and the wind is blowing it away from your house should you still leave?

1 comment

2 comments

Anonymous 12d

Yes, as the wind can change direction suddenly and cause the fire to change direction and increase in fire activity (Deb Sparkes - AFAC)

Anonymous 12d

hello, Great question! My understanding of your question, is that the fire has either passed your house, or the wind is pushing the fire away from your house, so I will answer to that. If you feel like I have misunderstood, please let me know and I will do my best to re-answer. Most fires in Victoria start under a hot northerly or north westerly wind, this means that the wind is coming from the north and blowing in a southerly direction or from the northwest blowing in a south easterly direction. If a home has not been impacted by a nearby fire, it is in no way an indication that you are out of danger. In Victoria, hot, dry winds are often followed by a south westerly wind change when the wind changes and begins to blow from the southwest to the northeast (also known as the cool change) if the fire is still burning when this wind change comes through, the side of the fire can be pushed and can quickly become a much larger fire front, now blowing towards the north east. The wind change is when we see many people lose homes and their lives, as they have thought the fire has missed them, or didn't anticipate it to change direction. The safest option when there is a fire in the landscape is to be as far away from it, in a lease or non fire risk area as you can. Tarryn Campbell Community Engagement Coordinator - CFA.

Add comment

Anonymous 12d

how fast would it take a fire to spread 1km on a dense hill

Savannah G

1 comment

2 comments

Anonymous 12d

This would depend on a number of factors - the wind speed, the steepness of the hill and how dry the fuel is (Deb Sparkes - AFAC)

Anonymous 12d

hello, Thank for your question! There are many variables on how fast a fire will travel, including Vegetation, Weather Conditions, Temperature and Wind. In general terms, a fire will burn faster uphill. This is because the flames can easily reach more abundant fuel in front of the fire. Radiant heat pre-heats the fuel in front of the fire, making the fuel even more flammable. For every 10 degrees in slope, the fire will double its speed. (For example, if a fire is travelling at 5 km per hour along flat ground and it hits a 10 degree slope it will double in speed to 10 km per hour up the hill. By increasing in speed the fire also increases in intensity, becoming even hotter. The opposite applies to a fire travelling downhill. The flames reach less fuel, and less radiant heat pre-heats the fuel in front of the fire. For every 10 degrees of downhill slope, the fire will halve its speed. (For example, if a fire is travelling at 10km per hour and hits a 10 degree downslope it will halve in speed to 5km per hour downhill.) Fires tend to move more slowly as the slope decreases. Bushfires are unpredictable and vary greatly according to weather conditions. They often start on hot, dry, windy days. It is therefore difficult to predict how long it would take for a fire to spread 1km, because unless you know the conditions on the day and where the fire will start we are unable to map this. Any bushfires that starts in dense vegetation on high risk days

Add comment

Anonymous 12d

what is the best way for people living in the area/the community to help?

3 comments

Anonymous 12d

Before a fire ensure your property is clear of flammable materials

Anonymous 12d

During - Listen to the warnings and Respond according (Deb Sparkes - AFAC)

Anonymous 12d

Good Morning, Good question! There are many things the community can do to help. - People can help by just doing their part on their own properties, keeping them clear and cleaning up vegetation. - They can join local groups or attend a CFA bushfire information sessions (in each season in local communities) to gain a better understanding of fire and what they can do to prepare. - People can join or start up a local CFA Community Fireguard Group to get to know their neighbours and work with them to ensure their street and surrounding streets are aware of the fire risk and know what to do. - Some community members decide to join their local CFA as a volunteer fire fighter or as a member to help out with fundraising or community education. There are many other things people can choose to do to help their community, even the smallest effort can have larger and impactful results, what I have mentioned is just a few examples. Tarryn Campbell Community Engagement Coordinator - CFA.

Add comment

Anonymous 12d

how wide would fire breaks have to be to affectively stop fires in our area?

Matilda A

1 comment

Anonymous 12d

Hello, Good question! I am going to interpret that you meant a fuel break, as in a cleared area that is aimed to slow or stop the spread of fire to unburnt areas. Weather conditions and fire behaviour (especially whether embers are being produced) influence the effectiveness of a fuel break on any given day. Fuel breaks will be made in a variety of sizes, dependant on where they are, the vegetation and what the conditions are expected to be. A fuel break will need to successfully disrupt the continuity of fuel, thereby reducing the fire intensity. A fuel break would have to be substantially wider if there are trees adjacent (next to) to the break. There are a range of fuel breaks that can be created including: Bare earth breaks - Burnt breaks if you would like more information on this, please let me know and I am happy to elaborate on any of the above. Tarryn Campbell Community Engagement Coordinator - CFA.

Add comment

STUDENT PROJECTS

For details on the project, see the [Student Projects](#) page

[Student Projects Page](#)

HELP, FEEDBACK, AND PROJECT QUESTIONS

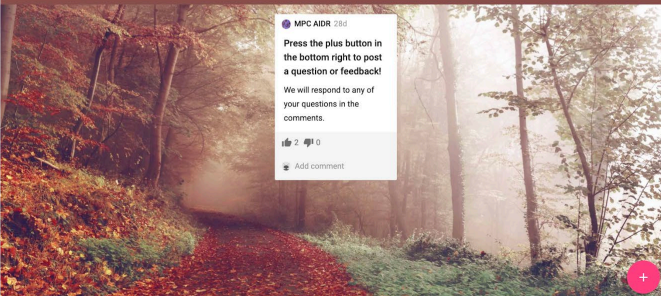
If you need **help**, want to provide **feedback**, or have any questions about the **project guidelines**, please post in the bulletin below!

Sign up | Log in | Share

MPC AIDR 13d

Unit 3 Feedback

We would love to hear your thoughts about the unit you just covered. Let us know how you found the lessons, your favorite part, and if you faced any difficulties completing them.



MPC AIDR 28d

Press the plus button in the bottom right to post a question or feedback!

We will respond to any of your questions in the comments.

2 comments

Add comment

Student Projects



Each of you will create an electronic '**poster**' representing a bushfire emergency, showing various risks and response options. Check out the **link below** to view the guidelines for the project. It is **due** by the end of the day on **Wednesday, May 6**.

[Project Guidelines](#)

STUDENT PROJECTS

In the **Padlet** below, students post their **projects** with their project **titles**, and their **names** in the descriptions. Local or national **experts** and **community members** can view these projects.

They can comment on the projects in the Padlet below, and they will also make a video of their response and feedback that we will post soon!

MPC AIDR + 36 6d

Student Projects

Post your Unit 3 project here for the community and local emergency services to see! You can upload your poster pictures using the buttons on the new post pop-up. Put your first name and last initial in the post title to give yourself credit.

Anonymous 6d
ralph

Add comment

Anonymous 6d
Sophie G

Add comment

Anonymous 6d
enrique s

Add comment

Anonymous 6d
Jamie P

Add comment

Anonymous 7d
Danielle P

Add comment

Anonymous 7d
Cadence T

Add comment

ara00071 7d
Yoni

Add comment

Anonymous 7d
Ben L

Add comment

Anonymous 7d
Matilda A

Add comment

Anonymous 7d
r

Add comment

Anonymous 7d
jackson k,e

Add comment

Anonymous 8d
Blake

Add comment

Anonymous 7d
aisha

fire thing Powerpoint presentat... padlet drive

1 comment

Anonymous 7d
i love yours Cadence T

Add comment

Anonymous 8d
Tamsyn P

Add comment

Anonymous 8d
Brooklyn

Bushfires Word document padlet drive

Add comment

Anonymous 8d
Savannah G

Add comment

Anonymous 8d
Mitchell O

Bushfire response pl... Word document padlet drive

Add comment

Anonymous 8d
Christina C

The WPI AIDR Team ... Powerpoint presentat... padlet drive

Add comment

Anonymous 8d
Chloe

Add comment

Anonymous 8d
lucy b

Add comment

Anonymous 8d
chelsea l

Add comment

Anonymous 8d
Nayara

Add comment

Anonymous 8d
Toby

Add comment

Anonymous 8d
jas butler

bushfire map

Add comment

Anonymous 8d
jasmine durrell

Add comment

Anonymous 8d

Add comment

COMMUNITY RESPONSE

The CFA has made a video in reaction to your questions and posters! Watch this video to see what your local experts have to say about living in a high risk bushfire area and how you can manage that as a community.



Appendix D: Student Project Instructions and Examples

Project Instructions

STUDENT PROJECT INSTRUCTIONS

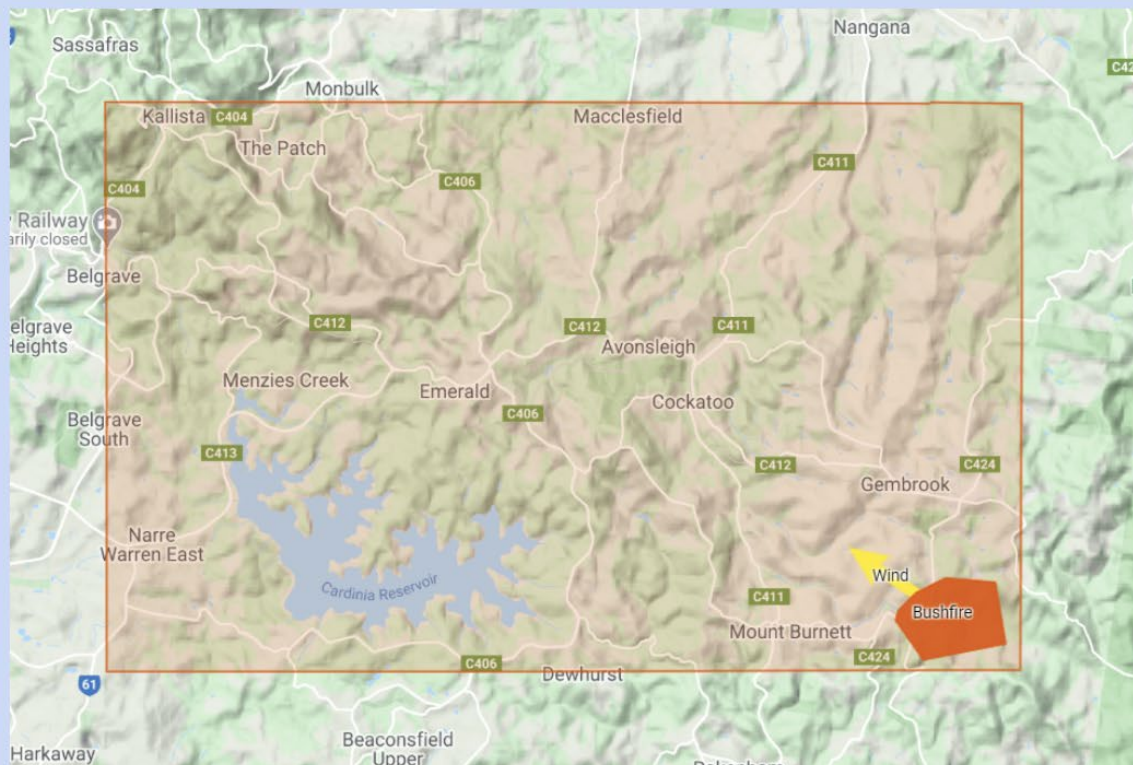
Please read all of the instructions carefully about how to create and share your project with your classmates and the CFA. When you're done, scroll to the bottom to see our example poster.

Below, we created a map of a **bushfire scenario** in the Emerald area, similar to the simulations you watched earlier. You will create your own poster for this scenario, showing various risks and response options.

Follow the instructions below step by step to complete your project

BUSHFIRE SCENARIO

In this map image, there is a **bushfire that has ignited in the South East** corner of the scenario. There is a **strong wind that is pointing in the North West** direction. Use this information and copy or [download \(click here\)](#) this image to your software of choice to begin making your poster.



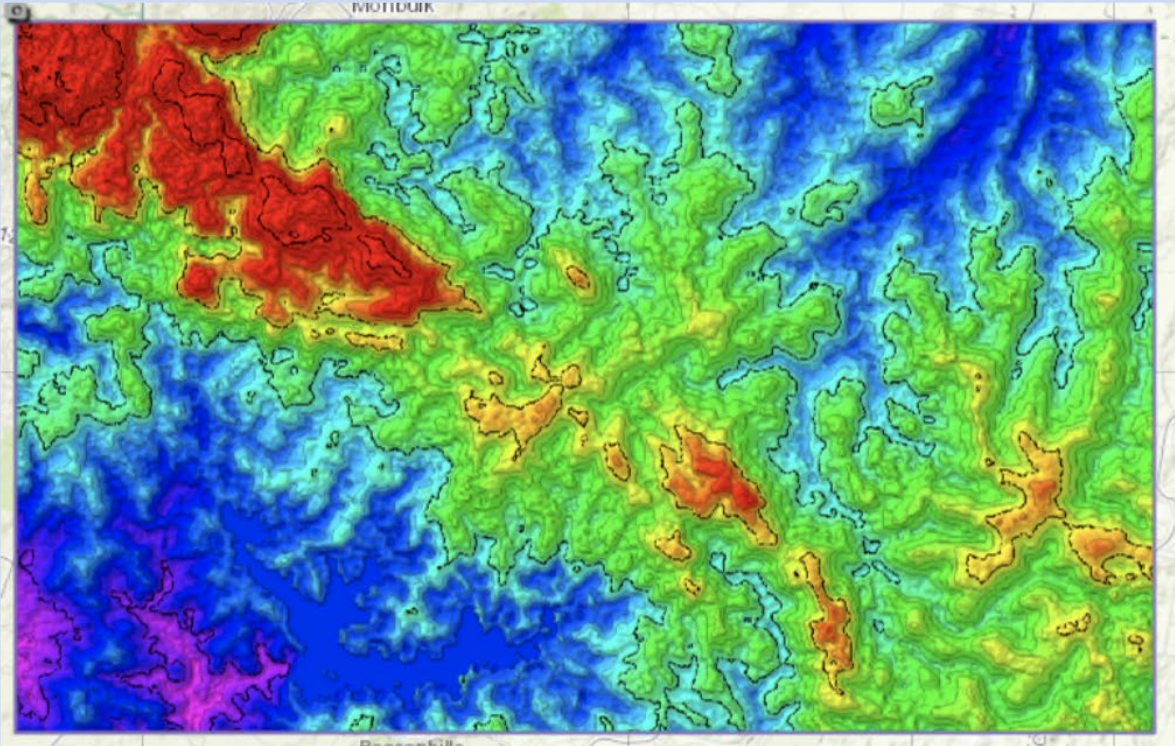
See below for instructions and our examples!

1. Copy or [download \(click here\)](#) the bushfire map image above and paste it into any graphics/editing software or website you want. Here are some options (feel free to get creative!):

- a. **Microsoft Paint** (included on all microsoft computers)
- b. **Google Drawings** (requires free Google account, use through Google Drive)
- c. **Microsoft Word/PowerPoint**
- d. **Canva:** <https://www.canva.com/> (requires free account)
- e. **Adobe Photoshop** (requires paid or edu Adobe subscription)
- f. Any other software or website of your choice

ELEVATION MAP OF EMERALD

You can use this elevation map of Emerald as a **reference to look at** when thinking about how hills affect the fire.



AnyHazard Simulation Map

See our instructions for how to design your poster below!

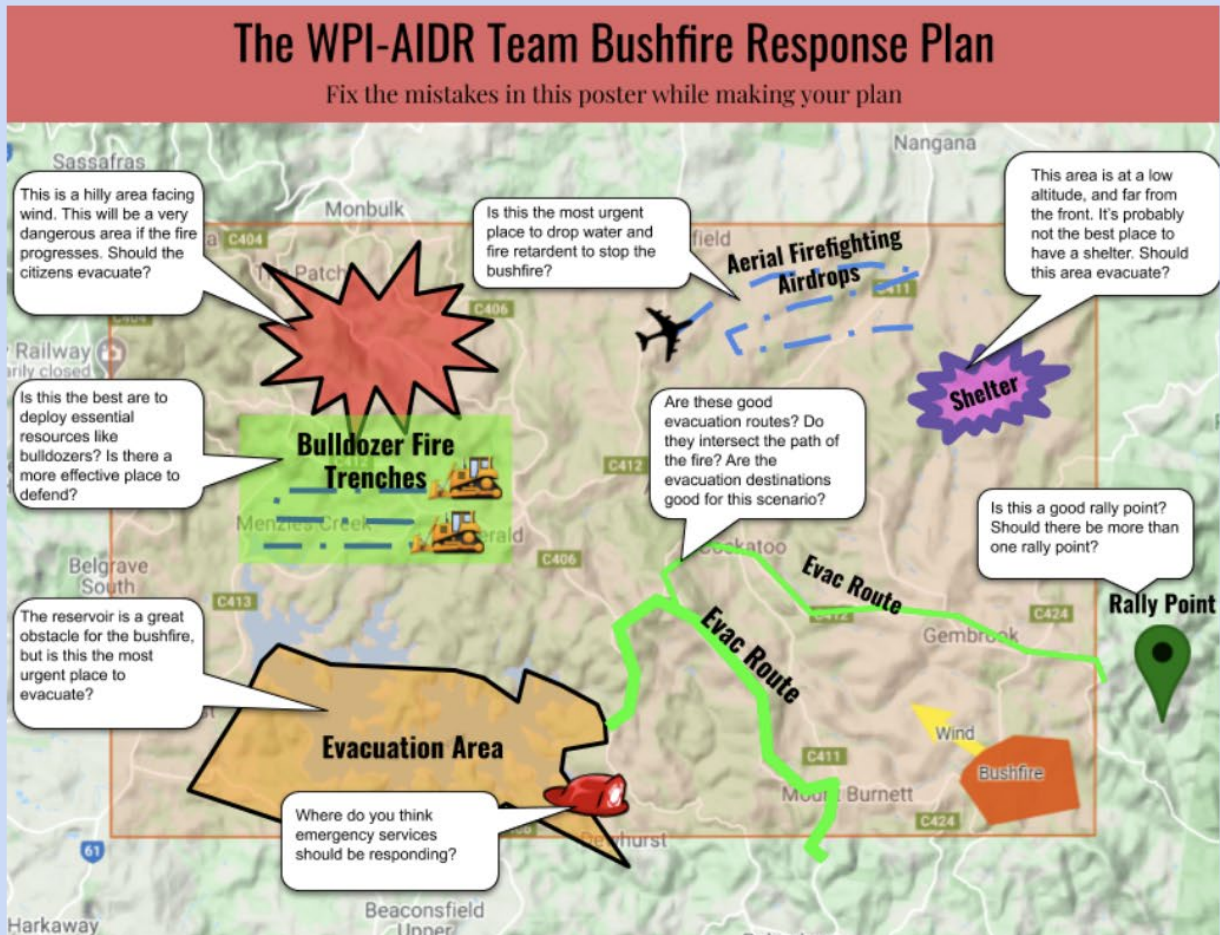
2. **Mark up the image** with **shapes** and **text** on or around the map with the following:
- a. Draw and label **evacuation zones** on the map and safe **rally points** for the people to gather at. **Briefly explain** your decisions with text bubbles.
 - b. Draw and label **shelter zones** that may need to wait for **response teams** to assist them. **Briefly explain** your decisions and what kinds of things could be done to help them.
 - c. Identify **three** things anywhere on the map that will **influence** the fire's behavior. These could be different terrain types or features that **increase or decrease** the risk of the fire spreading. **Circle or highlight** them and add **text** to describe **why** you chose them.
 - d. Make it **look good!** Design your poster using any shapes, bubbles, colors, or word art that you'd like.
 - e. Once you are done, **save** your poster as a **PNG file, JPEG file**, or take a **screenshot**. Then go to the lesson plan website on the Student Projects page. **Add a post to the Padlet**. Give it a title and description if you'd like (**be sure to include your name!**) and choose to upload a file from your computer. Select your poster and it will automatically upload your post.

See below for an incomplete example of what your poster can look like!

Example Poster

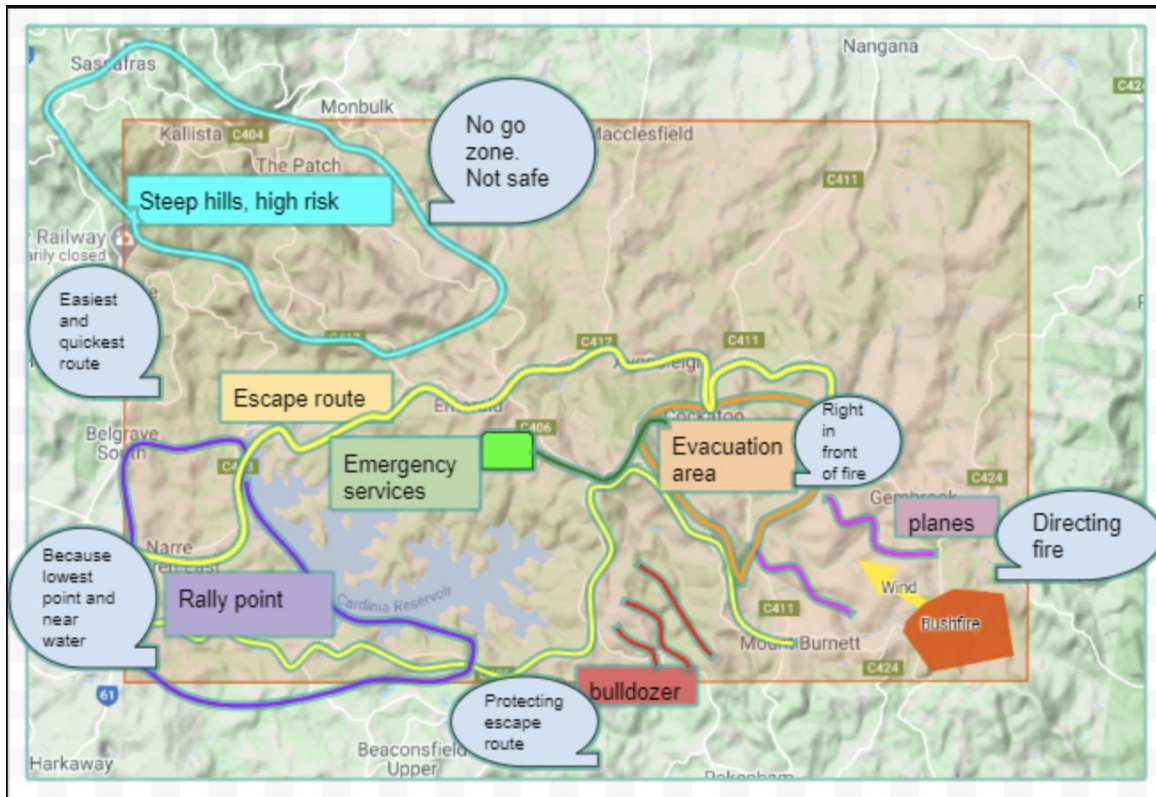
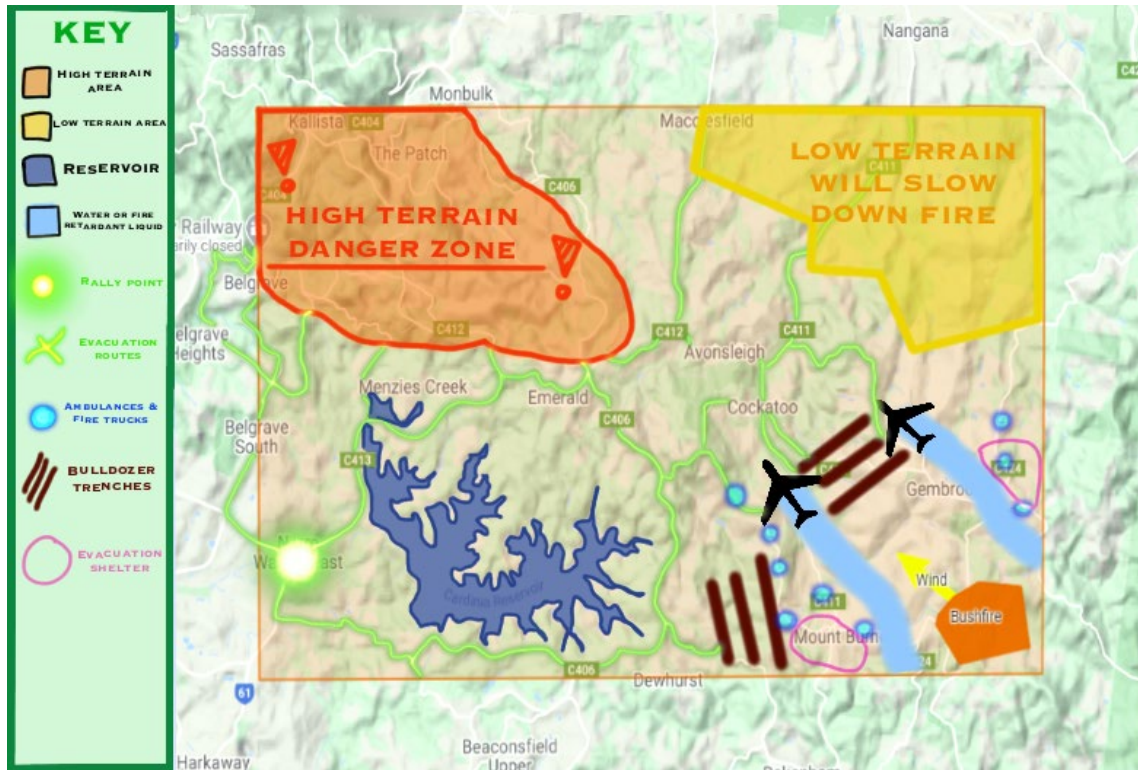
Below is an example of what your poster could look like. We made this using Google Drawings.

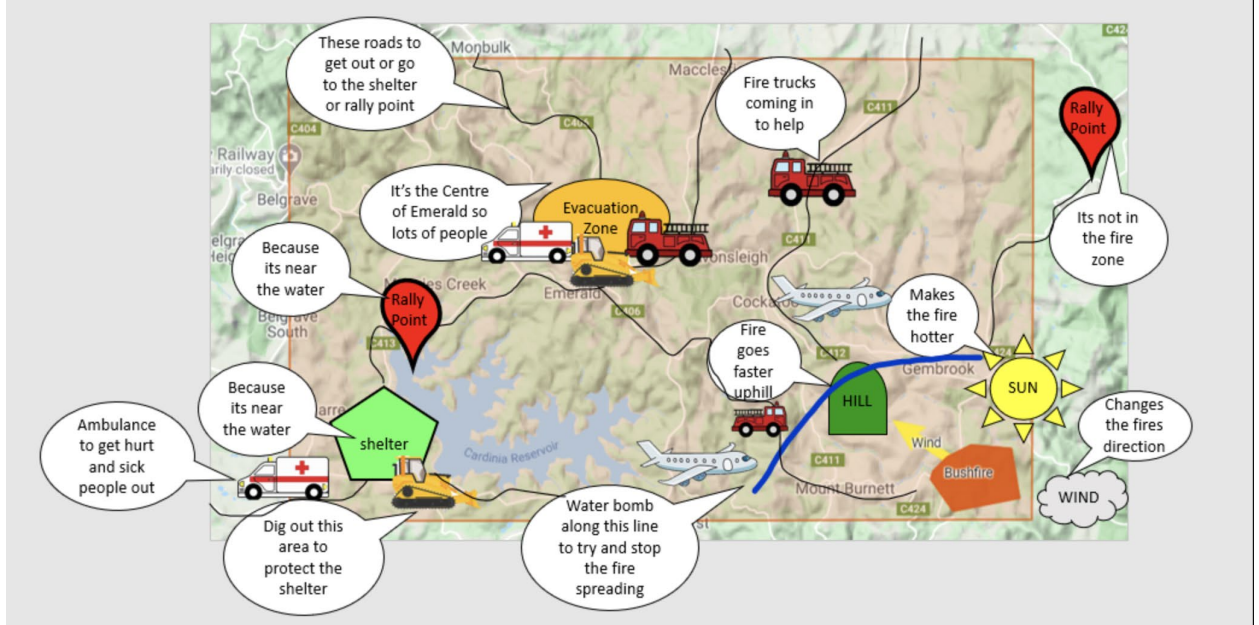
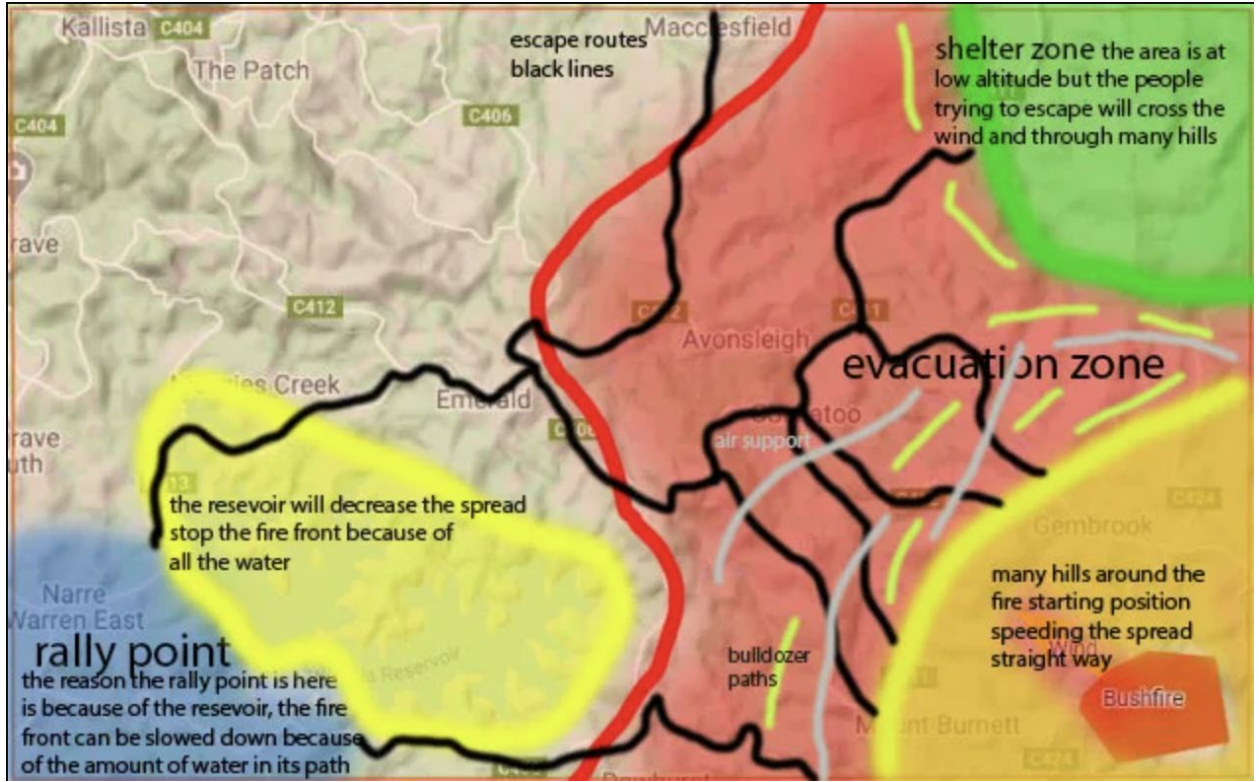
This example is just to show you the format we are looking for, it is not a good example of where you should place evacuation areas, routes, etc. Your poster should be more thought out and correct the mistakes in our example. Feel free to use whatever software you would like and get creative!



Now create your own and post it to the Padlet on the Student Projects page on our Lesson Plan website!

Example Student Projects





Appendix E: Video Resources

Introduction Video: <https://youtu.be/dmoMV-jQsas>

Unit 1 Map Activity Video: <https://youtu.be/V5x5Zhsjj4w>

Unit 2 Fire Dynamics Video: <https://youtu.be/BMRmCGiE8lw>

Unit 3 AnyHazard Bushfire Simulations: <https://youtu.be/n5MMeTJRQAE>

Unit 3 AnyHazard Evacuation and Response: <https://youtu.be/IKLrOc1TLHY>