Saving Endangered Species

Year 3-4 STEM Teaching Guide

Healesville Sanctuary

ZOOS VICTORIA

Zoos Victoria's STEM Design Challenge is a unique education program that helps students find solutions to complex problems by using their STEM knowledge and skills.

The team at Healesville Sanctuary have two big challenges to solve:

1. Keepers need to monitor the health of the Tasmanian Devil before release into the wild
2. Recovery Team scientists need to protect the Brush-tailed Rock-wallaby from predators.

This STEM Teaching Guide will help Year 3-4 students find solutions to these big and real-world challenges. They will develop their STEM skills and knowledge through an engineering framework called Design Thinking.

Here's how the STEM Design Challenge works, using Design Thinking as a learning and teaching tool:

1 UNDERSTAND the challenge

Book an excursion to Healesville Sanctuary .

You will be given a special itinerary for your day, which includes a workshop with a STEM educator and a guide on how to conduct research in the Sanctuary.

2 IDEATE possible solutions

Back at school, your students will brainstorm ideas and choose one to test.

Form teams of up to six students. Brainstorm a list of ideas that will solve one of the big challenges. Each team then needs to choose one idea to prototype and test.

3 PROTOTYPE an idea

Your students will bring their ideas to life.

Students may need to do further research. Then it is time to create a prototype of their idea using their STEM skills. They could use recycled materials from home, items from your art room or any technology available to build their prototype. See the FAQS on Page 3 to find out more about prototypes.

4 TEST & REFINE a prototype

Your students will share their prototypes with an audience to test and refine their ideas.

Your students can present their prototypes to their peers, another year level or an expert from outside your school.

You can also enter your students' prototypes in the STEM Design Challenge competition (optional).

Frequently Asked Questions

How do I fit Saving Endangered Species into my curriculum?

There are many ways to teach STEM. The STEM Design Challenge will help you use a transdisciplinary approach - students apply knowledge and skills from two or more learning areas by undertaking real-world problems or projects.

How long does the program run for?

You choose. Some teachers use this programas the centre of whole-term unit. Others use it as part of a special program that runs for 1-3 weeks. This Teaching Guide will help you walk your students through each stage of Design Thinking so you can move at your own pace.

What is a prototype? What have other schools done?

A prototype represents an idea. Prototypes can be 3D models that are 'tested and refined' by getting feedback from other people. Prototypes can also be in the form of something that can be physically tested.

Do I need special materials or a STEM lab for the prototypes?

Not at all. Just like people who work in STEM, students can use any of the materials available to them to create their prototype e.g. recycled materials from home, items from the art room, computers/technology.

How many prototypes should my class make?

If you want to participate in the STEM Design Challenge competition, you'll need to assign teams of up to **six students**.

This makes the Design Thinking and Project-Based Learning process easier to teach. If your students want to work on a whole-class prototype, split them into small groups to build the different parts.

What support is provided to help me teach this program?

This Teaching Guide has activities to help you teach each stage of Design Thinking. The Design Brief will kick off learning and outline expectations. The links on the Research page include videos and websites. Your Healesville Sanctuary educator will also be able answer student questions. You are also welcome to use the Judging Criteria as part of your assessment.

What are the links to the Victorian Curriculum?

Year 3-4 Science	**Science knowledge helps people to understand the effects of their actions (VCSSU056)** Students will learn how Recovery Team scientists evaluate human and environmental impact on endangered animals.
Year 3-4 Science	**Different living things have different life cycles and depend on each other and the environment to survive (VCSSU058)** Students will learn about what environmental conditions help animals thrive in the wild.
Year 3-4 Design and Technologies	**Generate, develop, and communicate design ideas and decisions using appropriate technical terms and graphical representation techniques (VCDSCD029)** Students will use Design Thinking to generate, grow and test their ideas for animal conservation.
Year 3-4 Mathematics	**Make models of three-dimensional objects and describe key features (VCMMG142)** Back in the classroom, students will demonstrate their solutions through 3D prototypes.
Year 3-4 Critical and Creative Thinking	**Investigate a range of problem-solving strategies, including brainstorming, identifying, comparing and selecting options, and developing and testing hypotheses (VCCCTM020)** Students will learn how to use each stage of Design Thinking to develop their own creative solutions – Understand, Ideate, Prototype, Test and Refine.

About Design Thinking

Design Thinking is a framework used by an engineering framework that is used to bring an idea to life. The following pages contain ideas and activities on how to teach each stage of Design Thinking. Many thanks to the good folks at IDEO.org who provide a free online Design Kit. IDEO uses human-centered design to improve the lives of people living in poverty.

Find out more at www.designkit.org.

1 UNDERSTAND the challenge

Bring your students to Healesville Sanctuary to undertake research.

You will be given a special itinerary for your day, which includes a workshop with a STEM educator and a guide on how to conduct research in the Sanctuary.

Here are some activities to help you teach the 'Understand' stage of Design Thinking:

Read the Design Brief

+ Engineers and designers use a 'Design Brief' to guide the design process. We've create a brief *(see page 6)* to help your class with their projects.

Look at the Judging Criteria or Co-Create Assessment

+ If your students would like to enter the STEM Design Challenge competition, read through the Judging Criteria *(see page 8)*. This Criteria can also be used part of your assessment. Alternatively, you could co-create an assessment rubric together with your students so that everyone understands what is expected.
+ You might like to set up a way for students to record their learning journey e.g. learning journal, video, exercise book

Research

+ Before or after your excursion, decide on the student teams. If you want to enter the STEM Design Challenge competition, you will need to have teams of up to **six students**.
+ Encourage students to find their 'why'. Why do they think this problem will be interesting to solve? How might solving this problem help them? Help animals? Help Zoos Victoria?
+ Use the Research Guide (*see page 9)* to help your students develop their understanding of endangered animals.

We recommend you wait until your Healesville Sanctuary visit before students choose which challenge they want to focus on.

Saving Endangered Species – Design Brief

1 UNDERSTAND the challenge.

There are two users you are designing for - keepers and Recovery Team scientists:

1. Keepers need to monitor the health of the Tasmanian Devil before release into the wild.
Tasmanian Devils are bred at Healesville Sanctuary and released in Tasmania. Keepers need to minimise human contact so that these animals have the best chance of survival in the wild. Keepers need to monitor Tasmanian Devil's health by:

- Identifying the animal by scanning the microchip that has been placed in it's neck
- Weighing the animal to check if its getting the right amount of food
- Taking a photograph to check its body for any health issues

2. Recovery Team scientists need to protect the Brush-tailed Rock-wallaby from predators.
Recovery Team scientists work out in the wild to protect Brush-tailed Rock-wallabies. They conduct research and work with other people to improve this animal's habitat, population size and quality of life. The survival of the Rock-wallaby is threatened by feral cats and foxes. Scientists are looking for solutions to protect the Rock-wallaby against these predators.

2 IDEATE possible solutions

Once you've chosen one of the challenges from the list above and done some research, it's time to think of solutions. Imagine and brainstorm your ideas. Choose one that you'd like to prototype and test.

3 PROTOTYPE an idea

Choose one of your ideas and create a prototype.

A prototype allows you to show your idea to other people. Your prototype can be a 3D model or diorama, or you can make a prototype that can be tested in a real-life situation.

4 TEST & REFINE a prototype

Test your prototype by explaining it to other people. You can show other students, parents or local experts like council park workers, scientists or even veterinarians.

Your audience should provide feedback so you can improve your prototype.
You might also be able to test your prototype in a real-life situation.

About the Competition

You are also welcome to enter Zoos Victoria's STEM Design Challenge competition.
To enter, teams of up to six students need to submit a video of 2 minutes or less that explains their prototype and their learning. Check out Zoos Victoria's website for the details.

Thanks for helping to solve the challenge of saving endangered animals!

Saving Endangered Species - Research Guide

While at the Sanctuary

Step 1. Practice quiet scientific observation skills to gather information. Watch the animal, look at its enclosure and read any signage.

Step 2. Share what people have learnt about the animal.

Step 3. 'Understand' discussion questions:
- What ecosystem does this animal live in?
- What features does this animal have?
- How does this animal survive in the wild?
- What makes this animal interesting?
- What threats might this animal face?
- Does understanding this animal help us design solutions for the Tasmanian Devil or Brush-tailed Rock Wallaby?

Animal Research at School

Here are some online resources to help with your research:

Websites
Zoos Victoria - Tasmanian Devil
www.zoo.org.au/fighting-extinction/local-threatened-species/tasmanian-devil/

Zoos Victoria - Brush-tailed Rock-wallaby
www.zoo.org.au/fighting-extinction/local-threatened-species/brush-tailed-rock-wallaby-southern-population/

The Guardian - Tasmanian Devils to be Released Back on to Mainland
www.theguardian.com/environment/2013/aug/23/tasmanian-devils-release-onto-mainland

Zoos Victoria YouTube Videos
Tasmanian Devils - https://youtu.be/n3_G9M2sup0

Zoos Victoria - Three Devils Heading to Tasmania - https://youtu.be/SgamSs1Pq8g

Act Wild for Tassie Devils - https://youtu.be/SdIMBZBtZeY

Katniss the Tassie Devil Mum - https://youtu.be/dNM3DHWU7aY

Saving Endangered Species – Judging Criteria

This judging criteria will be used for the STEM Design Challenge compeition.

Judging Criteria	1 Point	2 Points	3 Points	4 Points
1. UNDERSTAND What is the challenge and who is the user?	Neither the challenge nor the user was described.	The challenge *or* the needs of the user was described.	Both the challenge and the needs of the user were described.	The challenge and the needs of the user were described, including personal insights that showed deep thinking.
2. IDEATE What were your ideas and how did you decide which one to prototype?	The process of ideation was not described.	Limited description of the process of ideation.	The process of ideation was described, along with a few ideas.	The process of ideation was described, including how a decision was reached on what idea to prototype.
3. PROTOTYPE How did you create your prototype and how will it help the user solve the challenge?	The prototype was not complete.	The process of creating the prototype *or* how it works was described.	Both the process of creating the prototype and how it works was described.	Both the process of creating the prototype and how how it works was described in detail e.g. material, safety
4. TEST AND REFINE How did you test your prototype and what modifications did/could you make?	No testing or refining of prototype was described.	The testing *or* the refinement of the prototype was described.	Both the testing and the refinement of the prototype was desribed.	Both the testing and the refinement of the prototype was described, including detailed description of modifications.
5. BONUS POINTS will be given for the following: - Description of how STEM knowledge and skills were applied - Demonstration of creative thinking - Demonstration of team work - Suitability of prototype for the user - Sustainability of materials used				

2 IDEATE possible solutions

Your students will generate a list of solutions and choose one to test.

Your students now need to brainstorm a list of ideas that will solve one of the big challenges. They will then choose one of their ideas to prototype and test.

Here are some activities to help you teach the Ideate stage of Design Thinking:

Brainstorm and Generate Ideas

1 Everyone should feel like they can share their idea openly.

2 Come up with wild ideas that don't factor in any limitations.

3 Get creative brains going through drawing and post-it notes.

4 Go for quantity – the goal isn't a perfect idea, it's lots of ideas to choose from!

+ Brainstorm – www.designkit.org/methods/1
+ Download Your Learning – www.designkit.org/methods/12
+ How Might We – www.designkit.org/methods/3

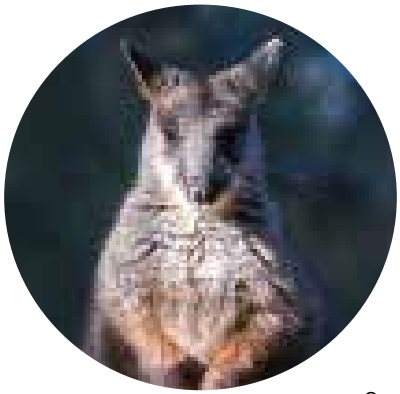
Decide on an Idea

Groups decide which idea has the greatest potential in the time-frame they have available to create their prototype:

+ Gut Check – www.designkit.org/methods/42
+ Find Themes – www.designkit.org/methods/5
+ Bundle Your Ideas – www.designkit.org/methods/30
+ Top Five – www.designkit.org/methods/15

Design the Prototypes

+ Groups could do a rough sketch/design of their prototype before they start building. They could use storyboards, models, sketched designs or scrappy mock-ups.
+ Students should seek feedback from other groups during this stage.



3 PROTOTYPE an idea

Your students will generate a list of solutions and choose one to test.

A prototype represents an idea. For example, a 3D model can show an idea and be 'tested and refined' by getting feedback from other people. A prototype can also be in the form of something that can be physically tested.

Here are some activities to help you teach the Prototype stage of Design Thinking:

Plan a Road Map

Once they've chosen an idea to prototype our students may need to do further research. They may also like to plan out their design and how they'll stay on track:

+ Plan a Roadmap – www.designkit.org/methods/7

Create the Prototypes

Ask students to focus on the challenge, the user and the functionality of their idea:

+ Your school's art room may have some supplies to help with this process.

+ Use recycled materials from home or from a company like Reverse Art Truck.

+ Encourage 'quick fails' where students try different ideas and quickly assess if the idea will work.

Decide on a Presentation

Students can practice how they will present their prototype to others. They might do a speech, a performance, animation or create interesting signage.

If they want to enter the STEM Design Challenge competition, they need to create a video of 2 minutes or less (refer to the Judging Criteria for more information).

+ Choose a Pilot to practice on – www.designkit.org/methods/8

4 TEST AND REFINE a prototype

Your students will share their prototypes with an audience to test and refine their ideas.

Your students can present their prototypes to their peers, another year level or an expert from outside your school. They can also submit a video entry into Zoos Victoria's STEM Design Challenge competition.

Here are some activities to help you teach the Test and Refine stage of Design Thinking:

Present the Prototypes

+ Students should share their prototype to explain how it would work. They might do a speech, a presentation, a performance or create interesting signage.

They may also consider creating a video for the STEM Design Competition. See the Judging Criteria on Page 8.

Get Feedback

+ Students should receive feedback about their prototype from their audience. This will allow them to expand their design and their thinking.

+ Get Feedback – www.designkit.org/methods/57

Refine the Design

+ Once students have received feedback, it is ideal to give them some time to refine their design. This stage of Design Thinking shows students that the engineering process doesn't stop after they've presented an idea. Designs get modified over time so that a better solution can be reached.

+ Integrate Feedback and Iterate – www.designkit.org/methods/4

Thanks for participating in Zoos Victoria's STEM Design Challenge.

For more information visit
www.zoo.org.au/education/