EXHIBIT DESIGN FOR A MODERN ZOO

Stage 3 - Science & Technology, Mathematics
Stage 4 - Science, Mandatory Technology, Mathematics
Stage 5 – Science, Design & Technology, Mathematics

LION PRIDE LANDS photo by Rick Stevens

Modern zoos are conservation, education and research facilities that support wildlife conservation both on-site and in the wild. Modern exhibits must ensure they meet the needs of both the animals, staff and visitors.

Throughout this project, you will be guided through the design and production process to develop a new exhibit for the Zoo.

During the Exhibit Design workshop led by a Taronga teacher at the Zoo, you will learn how exhibits are designed to support animal needs and allow them to display their natural behaviours. You will learn about and consider animal welfare and enrichment, visitor engagement and interpretation, zookeeper safety, as well as sustainable design principles.

Back at school, you will tackle the Identify and Define, Researching and Planning, Producing and Implementing, and Testing and Evaluating phases of the design and production process. To begin you will define your chosen animal and consider:

How does a modern zoo exhibit meet the needs of both animals and people?

Before embarking on this journey, you will need an understanding of these mathematical concepts: area & perimeter, volume & capacity, scale, diameter and these Science concepts: adaptations.

Name: _____

Class: _____

TARONGA ZOO SYDNEY
TARONGA WESTERN PLAINS ZOO DUBBO
For the Wild

INTRODUCTION

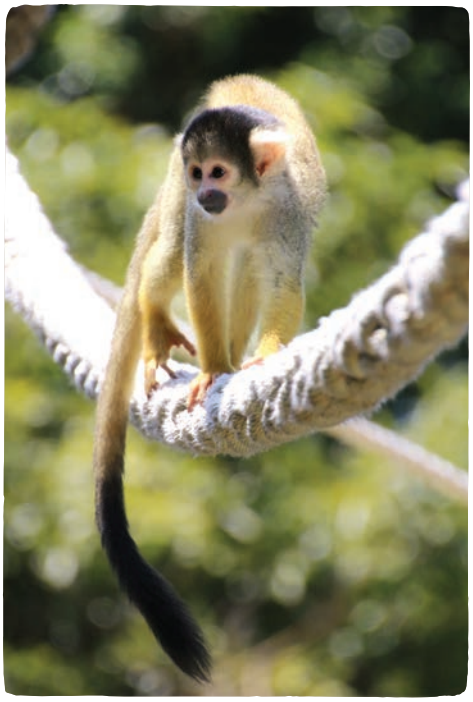
PURPOSE

Taronga Zoo wants to expand its facilities to hold one additional animal. This will be a stand-alone exhibit and you are required to design this facility. In order to meet the animal's needs, your facility must adhere to:

- The Taronga Conservation Society Australia Animal Welfare Charter
- State legislative exhibit requirements (see websites below)
- Animal husbandry requirements
- Workplace Health and Safety requirements
- The needs of the visitors viewing the facility
- The call to action to achieve positive behaviour change for wildlife

Inquiry question - How does a modern zoo exhibit meet the needs of both animals and people?

This project would be ideally undertaken in groups.



SQUIRREL MONKEY by Paul Fahy

DESIGN *and* PRODUCTION PROCESS

The design and production process is a method that provides a solution-based approach to solving problems. This lesson sequence will follow the steps involved in the process to design an exhibit for Taronga Zoo.

Identify & Define

(Empathise and focus your question by articulating the problem you want to solve)

Research & Plan

(Develop a deep understanding of the challenge and brainstorm creative solutions)

Producing & Implementing

(Design/build a representation of all or parts of your solution)

Testing & Evaluating

(Share your prototype for feedback)

LINKS: dpi.nsw.gov.au | animalwelfarestandards.net.au

TARONGA ZOO SYDNEY

TARONGA WESTERN PLAINS ZOO DUBBO

For the Wild

IDENTIFY AND DEFINE

At school – before the zoo

ROLE OF *the* MODERN ZOO

Zoos have existed since the mid-18th Century, but over time the design of zoo exhibits has changed to reflect the values and understandings of society, particularly in the field of Science.

Modern zoos endeavour to be leaders in conservation. Their ethos is to protect wildlife and build a sustainable future for people and wildlife. This is done through education, transformational guest experiences, caring for wildlife and participating in wildlife conservation initiatives that ensure long-term security of wildlife in sustainable ecosystems and habitats.

SPECIES *in* OUR CARE

Taronga cares for approx. 4,500 animals from over 300 species, many of which are threatened or critically endangered. Taronga participates in several conservation initiatives which demonstrate positive impact for wildlife, habitats and communities. Examples of this are breeding and research programs, such as the Animal Gene Storage Resource Centre of Australia, located at both Taronga Zoo and Taronga Western Plains Zoo, which includes a "Frozen Zoo" of genetic material. This program aims to develop techniques in the collection, preservation and storage of genetic material. This work is important for endangered and vulnerable species.

All species in our care have a clear role that contributes to conservation or education outcomes.

Empathise - Conduct research in order to develop your knowledge about your inquiry question.

THREE 'ROLES' OF SPECIES *at* TARONGA

1. Conservation Recovery – species for which Taronga is taking a leading role in supporting species recovery for which there is a direct contribution to the long-term survival of the species in natural ecosystems and habitats. Conservation Recovery species will have associated partnered conservation programs in range-states. Programs may function as breed-for-release, population insurance, head start, genetic supplementation, temporary rescue, demographic manipulation, assisted colonisation or ecological replacement.
2. Conservation Advocacy – those species that inspire and create a connection between zoo guests and wildlife; They can create understanding of and deliver conservation messages, they have capacity to drive guest and community action behind conservation actions, they create learning opportunities in wildlife conservation, conservation science and animal welfare.
3. Conservation Science & Research - those species play an active role in a research program which enhances wildlife conservation through the study of ecology, behaviour, nutrition, wildlife health, population management or population dynamics and viability.

REPRODUCTIVE LAB, DUBBO by Rick Stevens

CASE STUDY

The Southern Corroboree Frog (a Conservation Recovery Species)

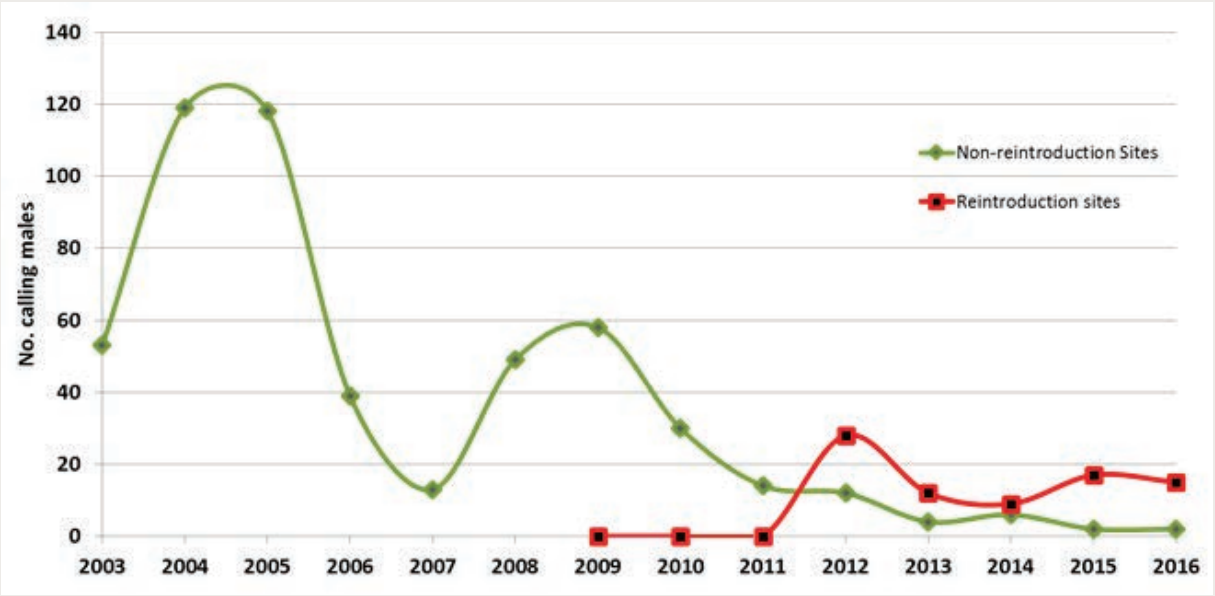
The Corroboree Frog is considered a conservation recovery species at Taronga Zoo.

Taronga, in collaboration with other partners, is heavily involved in the breeding and release of Southern Corroboree Frogs through the National Recovery Program. This program involves breeding frogs in our breeding units that contain computerised temperature and water filtration systems. They are set up with dual thermostats and alarms to ensure the temperature stays within the optimal range. One of these breeding units can be seen next to Reptile World at Taronga Zoo, Sydney.

Population Numbers

Use the graph below to examine population numbers of the Southern Corroboree Frog and the need for zoo breeding programs.

The most reliable monitoring technique is to survey the number of breeding males. The breeding males reliably respond with their threat call when researchers shout near their sphagnum nests and the calls can be easily counted. In 2009, the first Corroboree Frog eggs were reintroduced back into the wild. The frogs that survived from these eggs became sexually mature and started being recorded as breeding males in 2012.



The graph shows the number of Southern Corroboree Frog males recorded in annual surveys from 2003- 2016. Source: corroboreefrog.org.au

Photo above: SOUTHERN CORROBOREE FROG by Lorinda Taylor

QUESTIONS

1. **How many calling male Southern Corroboree Frogs were surveyed in 2003?** _____

2. **Describe the changes in the population since 2003.** _____

   _____

3. **In what years was the Southern Corroboree Frog's population at its highest?** _____

4. **Predict what would have happened to the population if there had been no intervention.** _____

   _____

5. **When were the first eggs reintroduced into the wild?** _____

6. **How long did it take for the eggs to become sexually mature breeding males?** _____

7. **How many breeding males were surveyed in the re-introduced site in 2016?** _____

8. **Why do you think there were less calling males surveyed in 2016 than in 2012?** _____

   _____

ANIMAL WELFARE CHARTER

When designing zoo exhibits, Taronga aims to recreate (as closely as possible) the animal's natural environment, taking into consideration their behavioural and physiological needs. It is vital that dignity and respect are considered. Therefore species specific research is so important.

An exhibit should provide visitors with a better understanding of the relationship between animals, the environment and themselves.

THE 5 W'S

Understanding the role of the Zoo

Before visiting the Zoo, use the information on the previous page and your own research to develop an understanding of the role of a modern zoo. (Hint – visit www.taronga.org.au and look at their conservation status)

WHY	WHERE	WHEN	WHAT	WHO
Why does Taronga Zoo exist?	Where is Taronga Zoo and Taronga Western Plains Zoo located and how does that influence what exhibits are found at each location?	When did Taronga Zoo Sydney and Taronga Western Plains Zoo first open and when did they have new major exhibits been developed?	What types of animals are kept in the Zoo? How will they inspire action and change people's attitudes and behaviours?	Who's need must be considered when designing an exhibit?

APPLYING MATHS *and* SCIENCE SKILLS

At school – before the zoo

BUILDING UP YOUR MATHEMATICAL SKILLS

In order to design your own exhibit, you will need to understand certain mathematical skills. Tick off the concepts that you know you can confidently use to solve a problem and show someone else how to use:

- ◯ Area & Perimeter
- ◯ Volume & Capacity
- ◯ Diameter
- ◯ Scale

For any concepts you are not sure about, speak to your teacher and see if they can do a lesson on these for the class!

You are now going to put these skills to work and solve the following problems!

Area and Perimeter

Area = length x width

Perimeter = add up all the sides

1. **Use your knowledge of how to calculate area and perimeter to design correct exhibits at http://mrnussbaum.com/zoo/**

2. **Find the measurements of your desk, classroom and another space around the school and write the measurements below:**

Object	Length (cm)	Width (cm)	Perimeter (cm)	Area (cm^2)
Desk				
Classroom				
Space around school				

3. **Explain the difference between the area of a shape and the perimeter of a shape**_____

_____

_____

Scale

Practice your knowledge of this by drawing scaled down versions of your desk and classroom that you have measured.

Write the ratio underneath the drawing.

The ratio of the length in a drawing (or model) to the length on the real thing.

Volume and Capacity

1. Calculate the missing values in the table below:

Volume = length x width x height
(How much space an object takes up)

Capacity = How much can fill an object, measured in mL

	Length (cm)	Width (cm)	Height (cm)	Volume (cm^3)
A	7cm	8cm	3cm	
B	5cm	6cm		210cm^3
C	9cm		2cm	90cm^3
D		4cm	5cm	80cm^3
E	9cm	6cm	4cm	
F	11cm	3cm	5cm	
G	13cm		3cm	468cm^3

2. **How might you find the volume of an irregular object like a seal?**

_____

_____

_____

_____

_____

_____

3. **Solve these capacity word problems:**

a. **The capacity of the echidna mix was 250mL but as zookeeper Suzie was walking, she tripped and spilled 70mL. How many mL are left for the echidna?**

b. **A budgie drinks 3mL of water every day.**
If he has drunk 72mL, how many days has it been?

c. **It costs $12 for every 4L of water to fill the tank for the seals.**
If the tank has a volume of 300m^3, how much will it cost to fill the tank?

Top to bottom: AUSTRALIAN SEA LION by Paul Fahy, ECHIDNA PUGGLE by Paul Fahy, BUDGERIGAR by Webandi via Pixabay, AUSTRALIAN SEA LION by Lorinda Taylor

Diameter

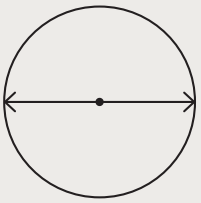
The ratio of the length in a drawing (or model) to the length on the real thing.

Practice your knowledge of this by drawing scaled down versions of your desk and classroom that you have measured. Write the ratio underneath the drawing.

1. Measure and record the diameter of these circles:

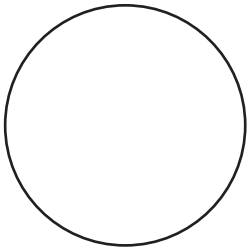
The distance from one point of a circle through the centre to another point on the circle.

The diameter is also twice the radius.



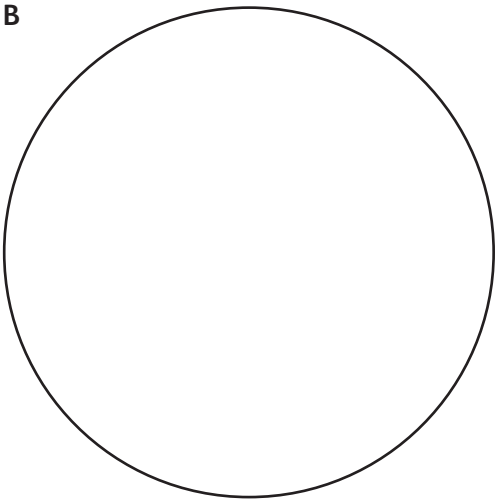
Diameter

A



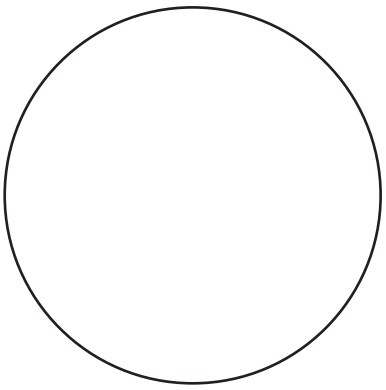
D= _____ cm

B



D= _____ cm

C



D= _____ cm

SCIENCE

Adaptations

Adaptations are features an organism possesses that helps it survive in its environment. They can be:

- Structural - a physical feature of an organism's body that helps it to survive in its environment.
- Behavioural – the way an organism acts that helps it to survive in its environment.

1. For each adaptations listed below, identify if it is a structural or behavioural adaptation.

Animal	Adaptation	Structural or Behavioural
Polar Bear	White fur	
Lion	Males roar when threatened by another male	
Peacock	To attract a mate, male peacocks fan out their tail feathers and shake them to catch the female's attention	
Gorillas	Large canine teeth	

2. **For the animals below, identify what their natural habitat is and label adaptations of the animal (both physical and behavioural) that help it to survive in those conditions. The first one has been done for you.**

SHORT-BEAKED ECHIDNA

Habitat: *Most Australian habitats, from deserts to rainforests and alpine mountains.*

KOALA

Habitat: _____

Top to bottom: ECHIDNA PUGGLE by Paul Fahy, YOUNG KOALA by Paul Fahy

GREEN TREE FROG

Habitat: _____

DIAMOND PYTHON

Habitat: _____

Top to bottom: GIANT GREEN TREE-FROG by Paul Fahy, DIAMOND PYTHON by Doug Beckers via Flickr

RESEARCHING

At the zoo

ETHOGRAMS

It is important to understand an animal's behaviour so you can design an exhibit to meet its needs. An ethogram is a tool used to observe and record an animal's behaviour. Choose one animal to undertake an ethogram on.

Watch the animal for 5 minutes and for all animals in the exhibit, list all the observed behaviours.

Date: _____

Weather: _____

Species: _____

Start Time: _____ **End Time:** _____

Write all your observed behaviours from the first activity in the top row of the table below. The first one has been done for you.

Watch your animal for 10 minutes in total.

During each minute, record whether a behaviour was observed during that minute by placing a tick in the table.

Only tick a behaviour once each minute.

When 10 minutes has passed, tally up all the times you saw each behaviour.

Start Time: _____

End Time: _____

Time (minutes)	*Out of sight*								
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
Totals									

Back at school - **graph the data you have collected** in a column graph. Don't forget to add a title and label your axis.

In what proportion of observations did you see each behaviour?

e.g. if you saw Resting in 5 of the 10 observations 5/10 = 1/2 = 50 %

Behaviour	Proportion

RESEARCH

While at the Zoo (as you visit exhibits before and after your workshop), **take notes and photographs associated with the following elements of exhibit design.**

Suggested exhibits to visit: Penguins, Sumatran Tigers, Savannah, Blue Mountains Bushwalk Aviary, Cotton-Top Tamarins, Chimpanzees, Southern Cassowary.

Exhibit Features

Exhibit:				
Is the exhibit built in a way that the animal is clearly visible for guests?	Yes ◯ No ◯	Yes ◯ No ◯	Yes ◯ No ◯	Yes ◯ No ◯
Is there clear signage?	Yes ◯ No ◯	Yes ◯ No ◯	Yes ◯ No ◯	Yes ◯ No ◯
Is the scientific name, common name, distribution map and photo of the animal visible?	Yes ◯ No ◯	Yes ◯ No ◯	Yes ◯ No ◯	Yes ◯ No ◯
Is there enrichment in the exhibit?	Yes ◯ No ◯	Yes ◯ No ◯	Yes ◯ No ◯	Yes ◯ No ◯
Single or mixed species exhibit?	Single ◯ Mixed ◯	Single ◯ Mixed ◯	Single ◯ Mixed ◯	Single ◯ Mixed ◯
What is the barrier type that contains the animals in the exhibit?	Wet Moat ◯ Dry Moat ◯ Glass ◯ Mesh/Netting ◯ Electrified wires ◯	Wet Moat ◯ Dry Moat ◯ Glass ◯ Mesh/Netting ◯ Electrified wires ◯	Wet Moat ◯ Dry Moat ◯ Glass ◯ Mesh/Netting ◯ Electrified wires ◯	Wet Moat ◯ Dry Moat ◯ Glass ◯ Mesh/Netting ◯ Electrified wires ◯
Is there access for the animal to be out of view from the public?	Yes ◯ No ◯	Yes ◯ No ◯	Yes ◯ No ◯	Yes ◯ No ◯
Is there access for the zookeepers?	Yes ◯ No ◯	Yes ◯ No ◯	Yes ◯ No ◯	Yes ◯ No ◯
Record the different types of furniture you see in the exhibit.				

Exhibit Assessment

Choose one exhibit to look at in detail.

Complete the exhibit assessment below.

Name of exhibit: _____

Species present: _____

What environment is being created and how has this been achieved?

Describe some of the structural and behavioural adaptations of the animal/s in the exhibit.

What exhibit features cater specifically to the animal (food, water, privacy, enrichment, activity etc)?

List the materials that have been used in the construction of the exhibit.

Describe the barrier type that contains the animals in the exhibit.

What design elements enable visitors to create a deep connection with the animal/s?

How does the signage increase understanding and change people's attitudes and behaviours?

How does the exhibit ensure the zookeeper's safety?

Describe one aspect of the exhibit that needs improving and how you would improve it.

RESEARCHING *and* PLANNING

Back at School

CHOSEN ANIMAL

It is important that you have a good understanding of your chosen animal to create a suitable exhibit. As part of your design and production process, it is a legislative requirement that your exhibit has at minimum a basic sign which includes the animals' common name, scientific name, distribution map and photo.

The following research will assist with creating a sign. Remember to use multiple sources to gather the information below.

Chosen animal/s: _____

Scientific name: _____

Country: _____

Habitat: _____

Adaptations: _____

Dietary requirements: _____

Sketch your animal with labelled adaptations:

Conservation Status (IUCN Red List iucnredlist.org): _____

Current threats: _____

_____

_____

The role of your chosen animal at Taronga Zoo: _____

Different exhibits are designed with different target audiences in mind.
For example, Backyard to Bush at Taronga Zoo is purpose built for young children.

Name your target audience: _____

Minimum exhibit size as per legislative requirements (surface area, volume, height etc): _____

_____

EXHIBIT

Features

You need to make sure that your exhibit has these features.

Work through the table and provide examples of the specific features that you will include in your exhibit.

Feature	Occurrence	Examples from your plan
Is the exhibit built in a way that the animal is clearly visible for guests?	Yes ◯ No ◯	
Is there clear signage?	Yes ◯ No ◯	
Is the scientific name, common name, distribution map and photo of the animal visible?	Yes ◯ No ◯	
Is there enrichment in the exhibit?	Yes ◯ No ◯	
Single or mixed species exhibit?	Single ◯ Mixed ◯	
What is the barrier type that contains the animals in the exhibit?	Wet Moat ◯ Dry Moat ◯ Glass ◯ Mesh/Netting ◯ Electrified wires ◯	
Is there access for the animal to be out of view from the public?	Yes ◯ No ◯	
Is there access for the zookeepers?	Yes ◯ No ◯	
Record the different types of furniture you will have in your exhibit.		

Sketch

Sketch the top view of your proposed exhibit below.

Use the checklist to ensure you have included all necessary features.

Checklist

Use the checklist below to ensure you are meeting both the needs of the animal and people with your design.

Needs of the animal:

- The exhibit reflects the animal's natural habitat
- The exhibit replicates the animal's natural social grouping (e.g. solitary or group animal etc)
- The exhibit provides the animal with enough space – as per the legislative requirements
- There are sufficient hiding areas if the animal requires privacy
- The exhibit has sleeping facilities for the animal
- There is food and water readily available in the exhibit
- The animal's activity level is met with sufficient enrichment items

Needs of the staff:

- The exhibit is secure
- The exhibit is easy to access for maintenance, cleaning, feeding, etc
- The exhibit is easy to clean
- Zookeepers can easily view the animals to do health checks
- The exhibit has an off limits area with holding facilities

Needs of the visitors:

- There is a clear view of the animal
- The exhibit is pleasing to look at
- The exhibit caters for all, i.e. young, wheelchair bound, etc
- The exhibit is safe for the public
- There is educational signage

FEEDBACK

Speedback – A Rotational Feedback Activity

This activity will require one person in your group to be the 'expert' on your plan and exhibit. This person will be required to stay at your station to deliver a short 1-minute pitch to other groups about your exhibit, what aspects you have chosen and why. After the 1-minute pitch, the group who have listened offer 2 stars and a wish (2 things that have been done well and 1 suggestion that you might like to change).

The rest of the group members will rotate around to hear everyone else's project pitches and provide them with feedback.

At the end of this activity, your group will have received positive feedback from your peers and some feedback with ideas that you might like to consider. You need to read through the feedback and apply AT LEAST one of the changes to your project.

Integrate Feedback

Things you need to consider:

1. **According to your feedback, what do you think is most important to making your exhibit a success?**

2. **How might you improve your prototype?**

3. **What features will you change?**

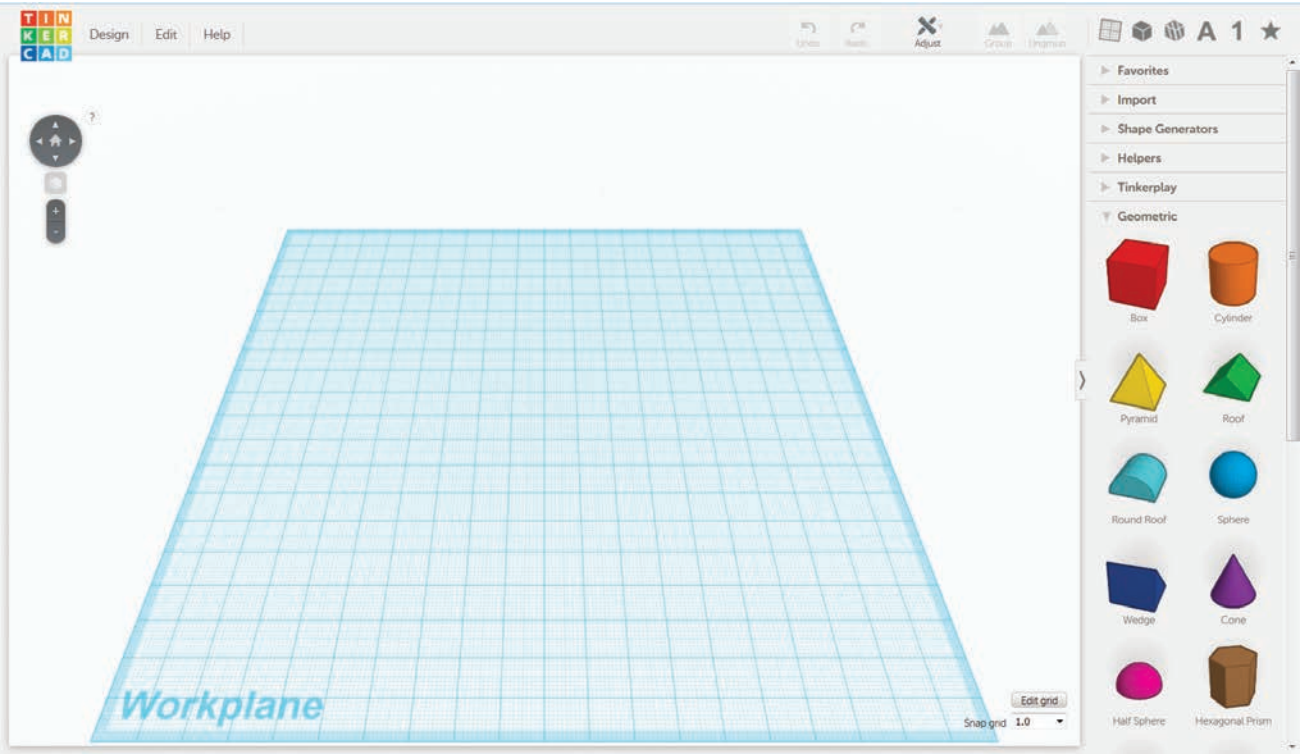
PRODUCING *and* IMPLEMENTING

Final Product

Choose the sketch that your group will take to the prototyping phase.

Your prototype needs to incorporate the key elements of your design (see exhibit checklist above) and can take the form of a:

- Digital model (e.g. using Google SketchUp, Tinkercad)
- Physical 3D model
- Physical 2D model



The Pitch

Your group needs to create a pitch for your final design.

Tell a brief and engaging story, focusing on the most important aspects of your design. What inspired your idea and how does it respond to the needs of animals and people? Ensure you outline what resources you will need to create the exhibit.

FINAL REFLECTION

Name:

1. **Evaluate your contribution to team tasks.**

SELF-ASSESSMENT

	Always (5)	Frequently (4)	Sometimes (3)	Rarely (2)	Never (1)
I contributed to my team work	○	○	○	○	○
I was on task every lesson	○	○	○	○	○
I maintained a positive attitude to my work	○	○	○	○	○
I completed the tasks	○	○	○	○	○
I helped my group to solve problems	○	○	○	○	○
I listened respectfully to what my team had to say	○	○	○	○	○

2. **Evaluate your team as a whole and individual team members.**
   This peer assessment task is to be completed individually and is for your teacher.

PEER-ASSESSMENT

	Always (5)	Frequently (4)	Sometimes (3)	Rarely (2)	Never (1)
My team worked well together	○	○	○	○	○
My team was on task every lesson	○	○	○	○	○
My team had a positive attitude	○	○	○	○	○
My team completed the tasks	○	○	○	○	○
My team displayed problem solving skills	○	○	○	○	○
My team listened respectfully to each other and incorporated many ideas into the plan	○	○	○	○	○

3. **How I thought my team members worked:** (Give them a rating of 1-5 in each box, 5 is the highest possible)

Member Name	Communication	On Task Behaviours	Positive Attitude	Problem Solving Skills	Overall Contribution to the Task

4. **What skills do feel you have developed while undertaking this design project?**

5. **What did you enjoy most and least about undertaking this project?**