

SCIENCE FAIR CENTRAL

Maker Corner Activity



BUILDING BRIDGES FOR WILDLIFE

Grades 6-8

MAKE. CREATE. EXPLORE.

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Vehicle collisions with wildlife are costly and dangerous for animals and for people.

Overview

Students will learn about how innovative bridges and wildlife crossings are being built for animals to ensure that they can safely navigate across and through human-made structures as they migrate or look for food, space, and mates. Students will form groups and each group will be assigned a target species of animal from various parts of the world that is threatened by development such as roads and highways. Groups will take on the roles of ecologists, engineers, and architects to design a bridge that is appropriate to solve this problem for their target species. Finally, groups will use provided resources to build prototype models of their bridges and present these models to their peers.

This activity focuses on the **Defining the Problem, Designing Solutions,** and **Creating or Prototyping** stages of the Engineering Design Cycle.

Engineering Design Cycle

- **Defining the Problem**
- **Designing Solutions**
- **Creating or Prototyping**
- Refining or Improving
- Communicating Results

Objectives

Students will be able to:

Examine how man-made structures can disrupt wildlife migration patterns and the cost of accidents for both animals and people

Research the best designs and strategies to encourage animals to use wildlife crossings

Design and create a blueprint and 3-D prototype model of a wildlife bridge and present their model to their peers



Are there ways that we can we help animals to safely cross roads?

Materials

Materials such as these should be made available to students. Groups will determine the materials and quantities they need.

- Hot glue gun and glue sticks
- Gorilla glue
- Craft sticks
- Cardboard sheets
- Artificial grass (turf)
- Gravel
- Potting soil
- Poultry netting
- Rope
- Cotton twine
- Duct tape

Have you ever wondered . . .

Why the did the chicken (or deer, or bear) cross the road?

Perhaps it was because they had no other choice! Wild animals are constantly on the move in search of food, territory, and mates, and when a road or highway is built it can separate them from these resources. Animals, many of which are endangered or threatened, have to find a way to cross it - and unfortunately this often ends with fatal and expensive results. Vehicle collisions with wildlife are costly and dangerous for both the animals and for people. Are there ways that we can help animals to safely navigate over or across the ever-expanding network of highways to find the important resources they need?



**Wild animals are constantly on the move
in search of food, territory, and mates.**



Make connections!

How does this connect to students?

Have you ever been in a car where a deer or some other animal has attempted to cross right in front of you? Wildlife crossings on busy highways are dangerous and costly for both people and animals. The cost of human-animal collisions in the U.S. costs millions of dollars in damage to vehicles. They can sadly result in injury or death for both humans and many species of animals, many of which are threatened or endangered.

How does this connect to careers?

Ecologist—Ecologists study various factors that affect the environment, in particular the ecosystem, or the relationship between organisms and their surroundings. They seek to sustain ecological health, and conserve wildlife and their habitats.

Civil Engineer—Civil engineers conceive, design, build, supervise, operate, construct, and maintain infrastructure projects and systems in the public and private sector, including roads, buildings, airports, tunnels, dams, bridges, and systems for water supply and sewage treatment.

Landscape Architect—Landscape Architects work with the man-made and natural environment to create wildlife habitats, innovative spaces, install sustainable infrastructure and thriving communities. Landscape Architects work in urban and rural landscapes and require the use of design, technical skills, management, ecology, problem solving and innovation across multiple projects and tasks.

How does this connect to our world?

Animals need to move around every day to try to find food, water, shelter, and mates. Highways and roadways fragment the open space that wildlife needs to travel through. This can prevent animals from being able to meet their daily needs or can result in a loss of millions of animals each year due to deadly collisions with cars and trucks. Thankfully, people around the world are now creating solutions that allow animals to safely cross over or under roads. They are engineering and building wildlife bridges and crossings which have the potential to save both money and lives, and help people and animals coexist safely.



Blueprint for Discovery

During Class:

1. **Begin by displaying the image below** on the overhead classroom screen:



Ask students to imagine that they are a deer that is looking for food and the only way to find it is to safely navigate across this highway. Do they see any potential problems with this scenario? What are some possible outcomes - would you as a deer attempt to cross the highway? Or, would you avoid the highway and take your chances at not finding enough food?

Allow students to share their answers with the whole group.

2. Explain to students that this is a picture of the 101 freeway in Los Angeles, California, and that the 101 was recognized as one of the worst highways in California for wildlife-traffic collisions in 2017. The worst highway, Interstate 280 in the San Francisco area had 386 collisions (that's more than 1 per day) in 2016, resulting in an estimated cost of \$875,000 in damage and cleanup!

How can we help to avoid these deadly types of interactions between wildlife and traffic, but still give wildlife the opportunity and ability to move freely in their search for food, territory, and mates?



3. Show students the following video clip to introduce a potential solution to this problem - wildlife crossings that have proven to be successful in Banff National Park, Canada.

<https://www.youtube.com/watch?v=ND0D3bVbM7Y>

4. Explain to students that for this activity, they will be working in teams to design and create a prototype model of a wildlife crossing or bridge that will allow for the safe passage of a particular species, just as the design teams did in the ARC competition in the video.

5. Ask students to form teams of 3 or 4. Give each group one ARC Design Challenge Card. This card will introduce the team to their design challenge - this includes the problem they need to solve and the species that they will be focusing their bridge design on.

6. Assign each group member one of the following roles:

a) The Ecologist - this person will be responsible for doing research to learn about their species natural habitat, behavior, and what features may be encourage their species to use the wildlife crossing their group designs.

b) The Engineer - this person will be in charge of determining which type of bridge would be most appropriate to build (a suspension bridge? an arch bridge?) and will lead the construction of the prototype model.

c) The Architect - this person will work with the engineer to create the design or the bridge or crossing. They will create a blueprint that will be used by the engineer to build a prototype model.

d) The Landscape Architect - this person will be the expert on the aesthetics of your bridge. What natural features, such as plants, rocks, or water features will be included in your design? They will add these features to the wildlife crossing blueprint and work with the engineer to determine how the features will be represented in the prototype model.

* a group of three people can combine the roles of architect and landscape architect.

**Teacher can provide the following link to the groups to help them look at different types of bridges:

<http://www.historyofbridges.com/facts-about-bridges/types-of-bridges/>

7. Give groups time to begin researching, designing, and building their wildlife crossing prototype model. As the groups work, they should use the ARC Design Challenge sheets - this includes the Species Research Sheet and Blueprint tips to help guide their work.



8. Once they have completed their research and the blueprint, **ask groups to use the provided materials to help them construct their 3-D prototype model** of their wildlife crossing.

9. To complete this challenge, each group will **present their model wildlife bridge to the class**. They should introduce their problem and each group member should explain their contribution to the finished product. They should explain how their wildlife crossing has been designed and created specifically to help their target species safely navigate over roads and highways.

Take Action

As an extension, students could make design competition submission videos that would present their bridges to a committee as if they were actually participating in an ARC design competition.

Students could also explore ways that wildlife bridges could be used in their community for local species. The class could work together to create a simple wildlife crossing (such as a rope or suspension bridge for squirrels over a road) and use a trail cam to determine if any species are using this bridge.

As an extension of mathematics and physics, students could further refine their models to calculate the costs of their bridges and look for ways to make them more efficient. They could also test the weight-bearing properties of their models to see if they would hold weight.

National Standards

Science

Next Generation Science Standards

MS-ESS3-3

Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment

MS-ETS1-4 Engineering v

Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

MS-LS2-5

Evaluate competing design solutions for maintaining biodiversity and ecosystem services.



HS-LS2-7 Ecosystems: Interactions, Energy, and Dynamics

Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*

Technology Education

Next Generation Science Standards and **International Technology and Engineering Educators Association**

Students will develop an understanding of Design. This includes knowing about:

- Attributes of design.
- Engineering design.
- The role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

Students will develop abilities for a technological world. This includes becoming able to:

- Apply the design process.
 - Use and maintain technological products and systems.
 - Assess the impact of products and systems.
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**Mathematical
Practice** **Common Core**

**English
Language Arts** **Common Core**



References and Helpful Links

- https://www.fhwa.dot.gov/environment/critter_crossings/overview.cfm
- <https://www.scpr.org/news/2017/09/08/75425/study-details-worst-ca-highways-for-animal-collisi/>
- <https://defenders.org/florida-panther/reducing-panther-deaths-roads>
- <https://www.worldwildlife.org/species/bornean-orangutan>
- <http://ncf-india.org/projects/towards-wildlife-friendly-roads>
- http://tucson.com/news/local/why-the-desert-bighorn-sheep-crossed-the-road/article_e4534060-73a4-11e5-8a98-c7ad99006751.html
- <http://www.dailymail.co.uk/news/article-1351475/Its-trunk-road-Elephants-use-underpass-links-wildernesses-time.html>
- <http://www.abc.net.au/news/2017-04-30/critically-endangered-wa-possum-could-be-wiped-out-in-20-years/8482970>



ARC DESIGN CHALLENGE CARD 1

TARGET SPECIES:

Florida Panther, *Puma concolor coryi*



WHERE: Florida, US

PROBLEM: The Florida panther is a critically endangered species in the United States. It is believed that there may be just 80-100 panthers left in the wild, and in 2014 there were 25 Florida panthers killed in collisions with vehicles on highways. For this shy and rarely seen cat, the expansion and widening of south Florida highways has increased the fragmentation of their shrinking habitat, making it more difficult and more dangerous for panthers to find new territory and the few mates that still survive.

ARC DESIGN CHALLENGE CARD 2

TARGET SPECIES:

Bornean Orangutan, *Pongo pygmaeus*



WHERE: Borneo

PROBLEM: As human development increases in Borneo and the need for large-scale plantation crops such as palm oil is on the rise globally, the rainforest habitat of the orangutan is becoming increasingly fragmented. Deforestation and farming practices have removed natural tree crossings that help orangutans navigate over rivers and other structures, making travel for orangutans increasingly difficult. Bornean orangutan populations have declined by more than 50% over the past 60 years, and the species' habitat has been reduced by at least 55% over the past 20 years.



ARC DESIGN CHALLENGE CARD 3

TARGET SPECIES:

Lion-tailed Macaque, *Macaca silenus*



WHERE: India

PROBLEM: Lion-tailed macaques live in the canopy of the rainforests of the Western Ghats in India. They use the tops of the interconnected trees to move around and find food and mates. As roads widen and tourism and industry increase in these areas of India, the natural canopy habitat is increasingly disrupted for these primates and other animals. This means that the macaques must cross the roads on foot, rather than in the safety of the trees, leading to an increase in fatal vehicle collisions for this critically endangered species of primate.

ARC DESIGN CHALLENGE CARD 4

TARGET SPECIES:

Desert Bighorn Sheep, *Ovis canadensis nelsoni*



WHERE: Arizona, US

PROBLEM: Widening highways through the Arizona desert has created huge problems for large migratory animals, like desert Bighorn sheep, a fragile species who has only recently begun to come back from the brink of extinction. The bighorn sheep need to travel across these highways to find mates and maintain a healthy genetic population, as well as to find sources of food and water. With sleepy 2-lane roads now being transformed into large 4 and 6-lane highways, the sheep are becoming increasingly involved in collisions with cars and trucks as they cross to find new territory and resources.



ARC DESIGN CHALLENGE CARD 5

TARGET SPECIES:

African Elephant



WHERE: Kenya, Africa

PROBLEM: In their search for resources such as food, water, and mates, elephants can travel up to 50 miles in a single day. In all of this walking, it is inevitable that elephants will have to cross roads and highways in a developing country like Kenya. While hitting an elephant with your car sounds like it may come out in the elephant's favor, elephants can stop traffic and cause delays on the road. And while collisions aren't necessarily the biggest threat to elephants, the fragmentation of their habitat is. When roadways isolate elephant populations from each other, it can decrease the genetic diversity of herds by preventing breeding with other populations, and cut them off from important food and water resources.

ARC DESIGN CHALLENGE CARD 6

TARGET SPECIES:

Western Ringtail Possum, *Pseudocheirus peregrinus occidentalis*



WHERE: Southern Australia

PROBLEM: The western ringtail possum is a critically endangered species in Australia that scientists believe could be gone forever in as soon as 20 years. Habitat loss due to human development has contributed to this quickly shrinking population. Vehicles have increasingly become one of the major threats to the little marsupials as they try to cross roads and highways to reach the now fragmented pockets of natural habitat in their search for resources and mates.

Species Research Sheet

Species Name: _____

Species Information:

a. In detail, describe the natural habitat of your species.

b. Does your species travel by land? Does it live in the trees?

c. Is your species solitary, does it live alone? Does it live in a family group or herd?

d. When is your species most active - in the day or night?

e. What does your species eat? Is it a predator or a prey animal?

f. Describe any unique behaviors that your species exhibits.

g. What are some things that should be taken into account about your species and their lifestyle and challenges when designing your bridge?



Wildlife Bridge Blueprint Instructions

Use this graph paper to draw your bridge blueprint. Try to draw things to scale as much as possible - this will make the construction easier for your engineer.

