The Tech for Global Good

Save the Species Design Challenge

RED KNOTS

The Tech for Global Good

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Introduction

The Tech for Global Good

The Tech for Global Good is an initiative that will create the next generation of innovators ready to tackle the toughest challenges facing our planet.

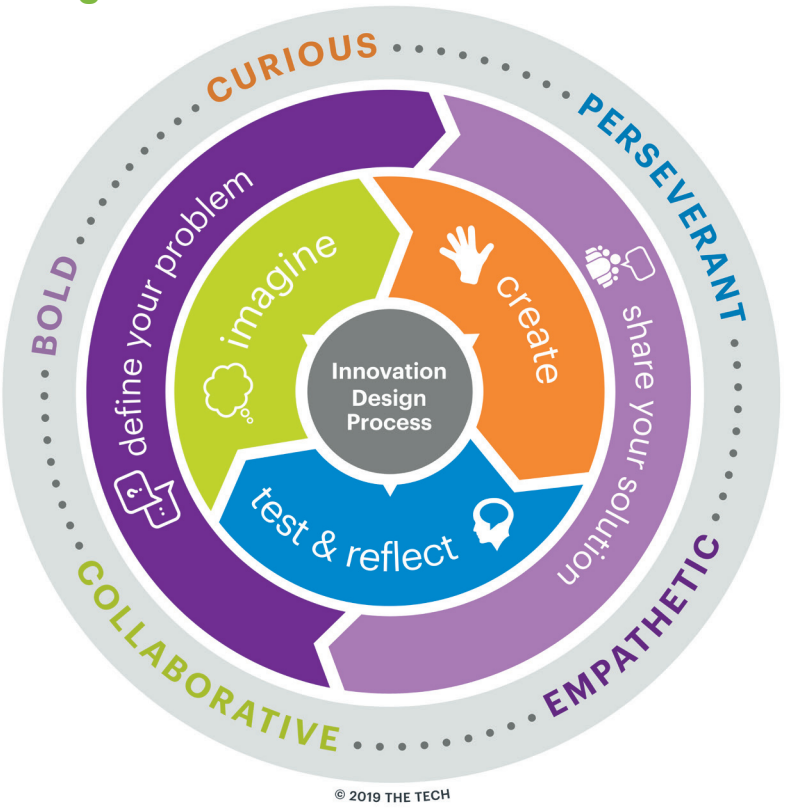
Smart Parks

Smart Parks combines conservation with innovation and technology to protect some of the world's most threatened animal populations.

Wild Me

Wild Me uses machine learning and artificial intelligence to track animal populations in the fight against species extinction.

Innovation Design Process



Design Challenge Scenario

You and your team run an animal conservation foundation that develops innovative technology and policy plans to help save endangered and threatened animals. Four communities around the world have reached out to you for help. Your team will use your skills as communicators, researchers, collaborators and creative problem-solvers to assist one of these communities in developing plans to help create more sustainable environments for animals and humans.

1. Research the problem:

- Understand the design challenge.
- Read the background material.

2. Brainstorm:

- Write each idea (in text, an image, or both) on a sticky note and put it on the board.
- Be creative! Think of as many wild ideas as possible.
- Develop questions and search out answers.

3. Create a solution:

- Each member shares their sticky notes and posts them on the board.
- Pick someone to group similar ideas.
- Label the categories.
- Work together to add more ideas.
- Each team member ranks their favorite ideas (1-5).
- As a team, choose a solution to focus on.

4. Refine your solution:

- Get feedback from peers on your solution.
- Edit your solution and improve how it addresses the problems your team is focusing on.

5. Design a project and presentation:

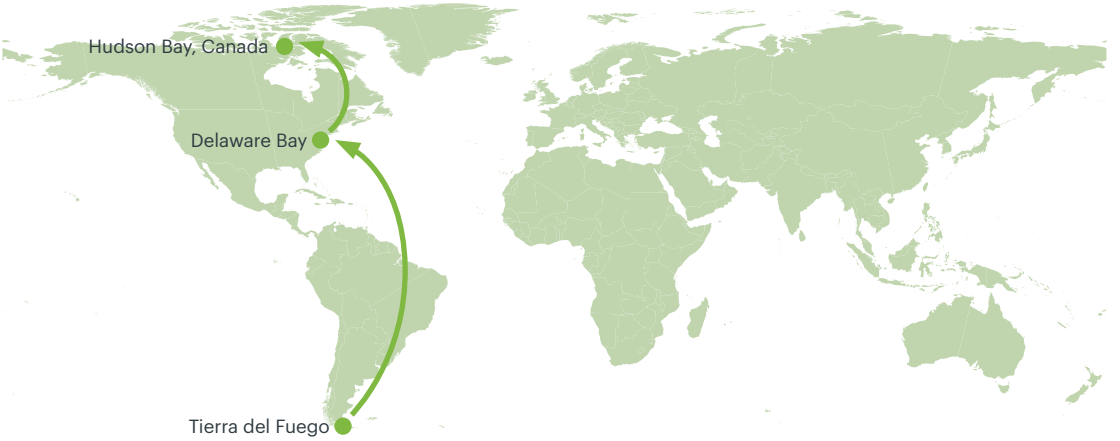
- Get feedback on your solution from others.
- Please show:
  - The specific problem your team is going to address.
  - Your team's solution for this problem.
  - A story of how someone is impacted by your work.

Designing a Solution for the Rufa Red Knot

in the Delaware Bay in Delaware and New Jersey, U.S.

Problem

You and your team run an animal conservation foundation. Community members who work with rufa red knots have asked your team to develop plans for helping to conserve this animal population.



Share with your team a couple things you already know about migratory birds.

Your team is working directly with the U.S. Fish and Wildlife Service to innovate in migratory bird conservation. As a company, your team has the ability to create policy and new technologies to help maintain and protect the rufa red knot (calidris canutus rufa) during their stop in Delaware Bay.

On the following pages, you will receive more information about the challenges we face in protecting the red knot. Think about these different issues to help inspire your solution. It is fine to design solutions that require collaboration with other organizations and governments, or that create new technologies or innovate with existing ones.

What will you do to create a change in Delaware Bay that will ripple out into the world?

Background Information

Migratory birds travel thousands of miles and live in many habitats spanning states, countries, and sometimes continents. Changes in their numbers or movements can help scientists learn about the health of the environment at their different stopovers.

There are multiple threats that migratory bird species face throughout the year. Some of the issues include:

- Starvation due to inadequate food supplies
    - Acidification of oceans decreases the size of mollusk shells and their overall population
    - Human consumption of red knot food sources
- Predators
- Disease
- Pollution of their feeding grounds
- Natural disasters
- Loss of habitats to human development and rising sea levels

Rufa Red Knots

Calidris canutus rufa, also known as the rufa red knot, is a migratory bird that travels as a flock between the Arctic at the northern tip of North America and Tierra del Fuego at the southern tip of South America. This is an annual journey of 9,300 miles. In January 2017, the annual red knot count in Tierra del Fuego yielded 13,127 birds, but the following January, only 9,840 were counted. Scientists began to look for possible reasons for such a significant loss.

One Red Knot Stopover, Delaware Bay

This is a stop that requires impeccable timing as the birds must show up at the same time as the horseshoe crabs arrive in the bay to spawn. Horseshoe crabs can lay up 120,000 eggs each, which are a rich protein source that the red knots eat to fatten up before heading to their Arctic breeding grounds. In May 2017, there were lower water temperatures that delayed the crabs. Some scientists think that there are simply fewer horseshoe crabs overall, which led to the collapse in red knot numbers.

Not only are horseshoe crabs a source of red knot food, but they are also useful to humans. Horseshoe crabs have been used by humans as bait to catch other marine life like eels and whelk. The blood of these crabs contains amebocytes, which are used to detect bacterial toxins. This is how labs make sure that vaccines, insulin, and IV antibiotics are safe to use. Currently, biomedical companies bleed horseshoe crabs and return them to the water alive. It is believed that between 5% and 30% of these crabs do not survive and even more do not breed for at least another season. Also, no one knows exactly how many horseshoe crabs are taken to be bled by various biomedical companies every year.

Currently red knots are protected in the following ways:

- Listed as a threatened species
- Limits are placed on using horseshoe crabs as bait for commercial fishing
- Limits on accessing the beaches during the horseshoe crab spawning season

Rufa Red Knot Migration

While there are other locations that the red knot may stop at, these locations below are the main stopovers for the majority of the birds.

Place	Spring Migration (from)	Goal	Threats
Tierra del Fuego, Argentina & Chile	Mid-February	• Avoid a cold winter • Gain weight	• Tierra del Fuego has strong winds and tidal surges. • Predators and birds of prey. • Beach tourism interrupts the birds' feeding. • Shrinking mollusk and clam size as a result of acidification of the oceans threatens the red knot's diet of mollusks, clams, worms, and insects. • Hunting in parts of South America can also threaten the birds as they rest and refuel on their migration north.

Delaware Bay, Delaware and New Jersey, U.S.	Mid- to late May	• Gain weight (Red knots lose half their weight during migration from Tierra del Fuego to Delaware Bay.)	• Red knot's main source of food during the spring migration is horseshoe crab eggs, which help them gain weight quickly during the two-week stopover on their way to the Canadian Arctic.
			  • Horseshoe crabs enter Delaware Bay in May or June during the highest tide to lay eggs (around the full or new moon).
			  • Red knots must arrive at a time when they overlap the horseshoe crab spawning season.
			  • Red knots travel as a flock, so there needs to be enough food to feed the whole flock for better survival.

Canadian Arctic	Early June to late June	• Arrive with enough weight to attract a mate, build a nest, lay eggs, and hatch chicks	• Changes in climate make weather patterns less predictable.
			  • A snowstorm can destroy eggs.
			  • Warmer temperatures can mean predators like foxes are able to travel further north, eating the red knot eggs.
			• Decreasing population numbers make finding a mate more challenging.

Hudson Bay, Canada	Late June	• Arrive with chicks to gain weight for flight back down to Delaware Bay and then to Tierra del Fuego	• Shrinking mollusk and clam size as a result of acidification of the oceans threatens the red knot's diet of mollusks, clams, worms, and insects.

Perspectives on the Issue

Tourist

My husband and I booked a trip of a lifetime down to the southern tip of Chile and then took a ship to see Antarctica. For a time we stayed in this area of Patagonia called Tierra del Fuego and it was absolutely beautiful. We would leave the hotel and walk down to the shore along the beach every morning. There is a huge flock of birds down there every morning and they would fly out in front of us, it was amazing to see all the birds in flight at once. One day this guy with binoculars told us we shouldn't walk along the beach while the birds are there because it stops them from eating and they need to eat to build up energy for their long migration back up north. Is it really that big of a deal that we interrupt their eating for three minutes as we walk by in the morning?

Technology

- Apps that identify and teach about different species of birds.

Organizations

- National Audubon Society tracks different species of birds, provides general information, and helps work on projects to save species.

Opinions

- Tourism provides money and resources to different locations. Keeping tourists happy is far more important than the minor disruptions it causes for the wildlife of that area.
- Teaching tourists about local wildlife could be part of the experience. Showing tourists the picturesque settings and how they are populated by diverse and unique species will add to the wonder of the trip and lead to greater care of native species.

International Approaches

- New Jersey Division of Fish and Wildlife closes part or all of certain beaches to humans during the red knot stopover and horseshoe crab spawning.

Climatologist

The red knots move between two dramatically extreme areas of weather and both are being affected by climate change. In the last decade, we have seen a difference in the red knot migration pattern and timing. Furthermore, the warming of the Delaware Bay waters is interfering with the delicate timing of the red knot and horseshoe crab arrivals. These changes are indicators of the rapid shifts in climate over a short period of time. What can I do to help the public understand the impact of climate change on every aspect of life on Earth?

Technology

- Seasonal bird counts with data collection on caught birds.
- ***Nanotags*** are attached to a bird's legs to get GPS data on their travel routes.
- Geolocators attached to a bird's leg record data twice a day, but that data can only be retrieved if the bird is caught again and the geolocator is removed.
- The data gathered from nanotags and geolocators help conservationists focus their efforts.

Organizations

- Audubon Society provides information on the red knot species and conservation efforts.
- U.S. Fish and Wildlife Services lists the red knot as a protected species.

Opinions

- "Birds of May" documentary about red knots explains the need to protect them.
- Protecting this species is important in studying the changing climate and coastal health.

Twitter: ***#redknot #conservation***

International Approaches

- A 2016 research article published in *Science* titled "Body shrinkage due to Arctic warming reduces red knot fitness in tropical wintering range" explains how changes in red knot size are illustrating climate change. This research addresses the red knot species that travels across Africa and Europe.

LAL Manufacturer

I do important work at my company to collect horseshoe crab blood to make licensed amebocyte lysate (LAL). The LAL we make is vital in detecting bacterial pathogens in medicines like insulin, vaccines, and IV medications like antibiotics. We are helping to protect humans everywhere. To do this, we collect and harvest 30% of a horseshoe crab's blood. We've done studies in our labs that prove the crabs recover this blood volume within a week and very few, if any, of the crabs die in our labs. Our company only needs about 50,000 to 80,000 crabs to make the LAL that we will sell to pharmaceutical companies. After we take the blood we need, we release the horseshoe crabs back into the bay. We are good corporate citizens and do our best to keep horseshoe crabs alive and healthy. Some people claim that we are abusing this resource and interfering with their reproduction, but so what if some of the crabs don't reproduce again. Isn't human health and safety far more important?

Technology

- National University of Singapore has created Factor C out of yeast to detect bacterial enzymes, calling this product ***PyroGene***.
- ***Hyglos***, a German company, is currently working on a synthetic bacterial enzyme detector.

Organizations

- University of New Hampshire and Plymouth State University attached accelerometers to female horseshoe crabs and found out that they move slower and sometimes do not return to their breeding ground after they have been bled.

Opinions

- Some people think that there should be licenses issued to pharmaceutical companies, and governmental oversight put in place to protect the horseshoe crab and the red knot.
- Pharmaceutical companies are using horseshoe crabs to save human lives, which are relatively more important than the extinction of the red knot.

Twitter: ***#horseshoecrab #pharmaceuticals***

International Approaches

- ***Fundación Inalafquen*** in Argentina created a social media campaign to encourage people to stay away from the red knots, especially on their beach feeding grounds.
- There are three other species of horseshoe crabs found in China, Japan, and the southern part of Borneo. Horseshoe crabs are a protected species in China.

From Your Reading

Below are some questions to help you process what you read

- What are some problems that affect red knot populations?

- What questions do you have based on your reading?

Brainstorm Notes

Problem

- Why is this a problem?
- What other problems does it remind you of?
- Often larger problems need to be broken down into smaller pieces. What part(s) of this problem does your team want to address?

Solution

- How could you combine these ideas to create a new solution?
- What ideas do you have that are nothing like what you have researched? (Wild ideas are welcome!)
- Who will help your team solve this problem? Which organizations, governments, etc.?
- How do these ideas help solve the problem?
- What is needed to implement or enforce your solution?

Impact

Pick one of the following identities:

- A birdwatcher
- A doctor that provides vaccines and prescribes insulin
- High school student

Based on one of the above identities, think about how they will be impacted by your team's solution to this problem.

- How will this person's life change because of your solution?
- What would they think or say about your solution?
- How will this change impact someone with a similar identity that lives 2,000 miles away?

Listen and Help

	Team Presenting	Audience
3 min	**Present their design solution.**	Silently listen. Take notes.
3 min	**Respond to clarifying questions.**	**Ask clarifying questions.**
2 min	Silently listen. Take notes.	**Provide feedback.**

Listen and Help Notes

Feedback *from* the other team	Notes *for* the other team

Design a Project and Presentation!

Your conservation team will need to create a presentation to share your plan with the community, including:

- The problem your team has identified and addressed.
- Your team's solution for this problem.
- A story of how your solution will impact one person in the community (for example, a birdwatcher, doctor, or high school student).

Remember your project can include any tools that are useful. Like a ...

Business plan

Advertising campaign

Demo of potential device

Slideshow

Infographic

Notes

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