WELCOME
The Tech for Global Good Design Challenge

RED KNOTS
Introduction

Terms to know:

**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.

Innovation Design Process
Design Challenge
You and your team run an animal conservation foundation based out of San Jose that develops innovative technology and policy plans to help save endangered and threatened animals. Your team will use your skills as communicators, researchers, collaborators and creative problem-solvers to assist governments and 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. Brainstorming:
   - Write each idea (text/image/both) on a sticky note and put it on the whiteboard.
   - 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.
   - Group similar ideas.
   - Choose a few ideas to focus on or combine into your team’s solution.

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.
     - Story of how someone is impacted by your work.

What do you already know about migratory birds?
Draw or write about your ideas (complete sentences are not necessary).
Designing a solution for the rufa red knot (Calidris canutus rufa), in the Delaware Bay (Delaware and New Jersey, United States of America)

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 red knot populations during their stop in Delaware Bay.

On the following pages you will receive more information about the challenges in protecting the red knot. Think about the different issues presented to help inspire your solution. As a company it is okay to design solutions where you collaborate with other organizations and governments, and where you can create new or innovate on current technologies. What will you do to create a change in Delaware Bay that will ripple out into the world?

Changing Ecosystems

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

Migration of the rufa red knot

*Some red knots will stopover in other locations, however for the main flock these are the main stopovers.

<table>
<thead>
<tr>
<th>Place</th>
<th>Spring Migration (from)</th>
<th>Goal</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tierra del Fuego, Argentina &amp; Chile</td>
<td>Mid February</td>
<td>• Avoid a cold winter</td>
<td>• Tierra del Fuego has strong winds and tidal surges.</td>
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<tr>
<td></td>
<td></td>
<td>• Gain weight</td>
<td>• Predators - Birds of prey.</td>
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<td></td>
<td></td>
<td></td>
<td>• Local resorts bring people to the beach who interrupt the birds from eating.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>• Diet high in mollusks, clams, worms and insects. Mollusk and clam size appears to be shrinking due to acidification of the oceans.</td>
</tr>
</tbody>
</table>
Focus on one stopover of the red knot, 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 and some scientists think there are fewer crabs in total, which led to the collapse in red knot numbers.

Horseshoe crabs provide food to red knots and 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 that we can use to detect bacterial toxins, which helps make sure 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 the various biomedical companies every year.

What is currently being done to protect red knots:

- 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

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| Delaware Bay, Delaware & New Jersey, USA | Mid to late May | • Gain weight  
• Red knots lose half their weight during migration from Tierra del Fuego to Delaware Bay | • Main source of food for the red knot during the spring migration is horseshoe crab eggs, which help them gain weight quickly during the two week stopover on the 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 knot 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 traveling farther north and eating red knot eggs.  
• Decreasing population numbers overall making 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 | • Diet high in mollusks, clams, worms, and insects. Mollusk and clam size appears to be shrinking due to acidification of the oceans. |
### Perspectives on the Issue

<table>
<thead>
<tr>
<th>Persona</th>
<th>Technology</th>
<th>Organizations</th>
<th>Opinions</th>
<th>International Approaches</th>
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</table>
| LAL Manufacturer         | • 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. | • 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. | • Some people think that there should be licenses issued to pharmaceutical companies and governmental oversight to protect the horseshoe crab and the red knot.  
                           |                                                                 | • Pharmaceutical companies are using horseshoe crabs to save human lives, compared to that the extinction of the red knot seems unimportant. | • Fundación Inalafquen in Argentina created a social media campaign to encourage people to leave the red knots alone.  
                           |                                                                 | • 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. | |

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 they 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. Now 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?
### Persona

**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

- There are 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 close part or all of certain beaches to humans during the red knot stopover and horseshoe crab spawning.

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### 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 migration pattern and timing of the red knot migration. Furthermore, warming of the waters in the Delaware Bay are 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.

### Audubon Society

- Audubon Society provides a lot of 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 and the need to protect them.
- Protecting this species is important in studying the changing climate and coastal health.
- Twitter: #redknot #conservation

### 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.
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 region(s) are we going to focus on?
- 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

STEP 1
Team A presents their design solution.  3 min
• Team B cannot speak.
• Team B can take notes.

Team B writes questions.  1 min
• Quiet minute for thinking.

Team B asks clarifying questions.  2 min
• Team A can answer.
• Team A can take notes.

Team B provides feedback.  2 min
• Team A should take notes.

STEP 2
Team B presents their design solution.  3 min
• Team A cannot speak.
• Team A can take notes.

Team A writes questions.  1 min
• Quiet minute of thinking.

Team A asks clarifying questions.  2 min
• Team B can answer.
• Team B can take notes.

Team A provides feedback.  2 min
• Team B should take notes.

Sharing Our Solution

Our solution
• The problem as we see it is:

• Our solution is to:

• We plan to tell a story about how our solution helped this person:

Requesting/Focusing Feedback
• Was the part about ____________________________

is easy for you to understand?
- We want feedback on specifically does it?

- What is your favorite part of our solution?

- What is part of our solution that you think needs work?

**Giving Feedback to Other Team**

- What problem are you solving? Is it:

- Who will benefit from this solution?

- Can you explain how will help solve this problem?

- A question I have about your design solution is:

- One thing I like about your solution is:

- I think it is important that you include:

- I wonder what would happen if:

- I heard you say:
Design a Project and Presentation!

Pick a project:
• Business plan
• Advertising campaign
• Demo of potential device
• Slideshow
• Infographic

Project and presentation:
• Describe a focused problem
• Explain a solution to this problem
• Show how your solution will impact one person (birdwatcher, doctor or high school student)

Notes