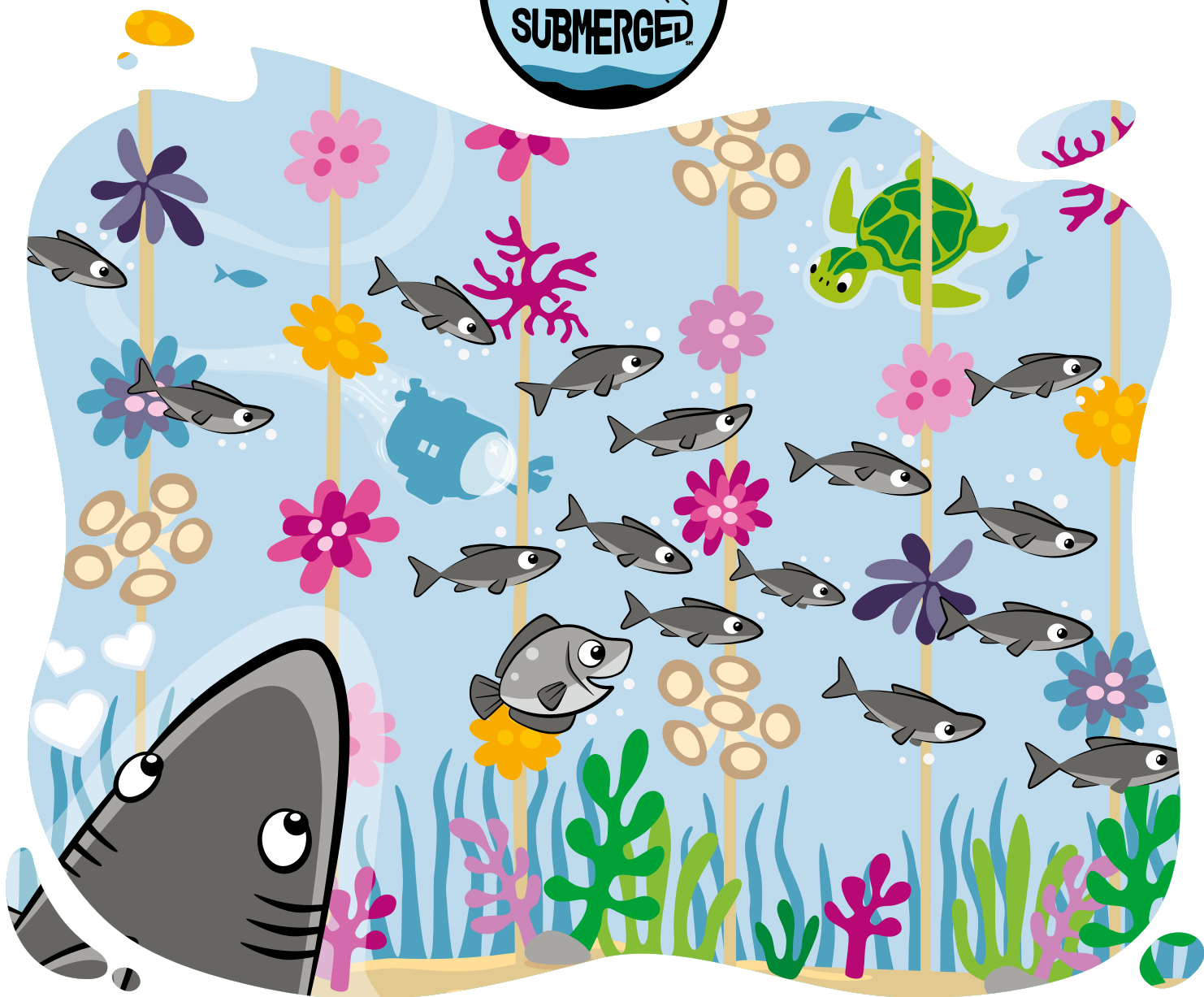


**FIRST
LEGO
LEAGUE**

EXPLORE

ENGINEERING NOTEBOOK





FIRST® LEGO® LEAGUE GLOBAL SPONSORS

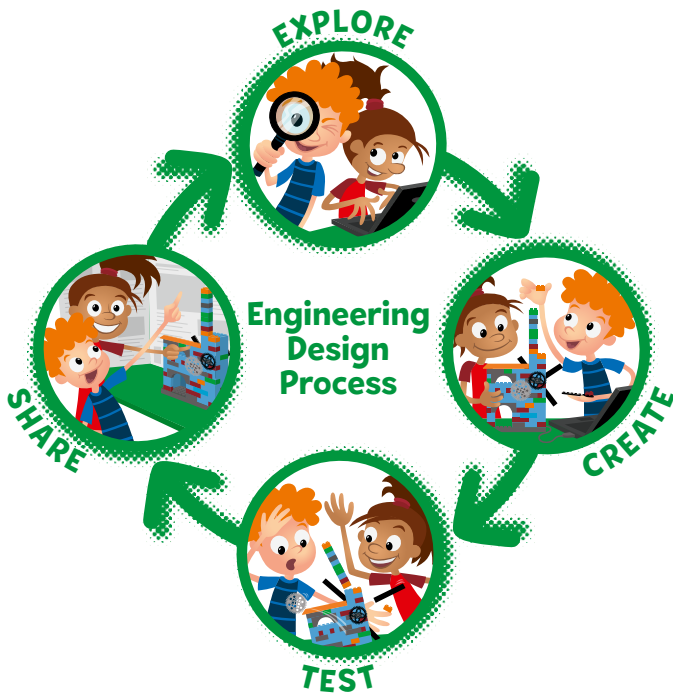


The LEGO Foundation

Welcome!

Team Members:

1.	4.
2.	5.
3.	6.

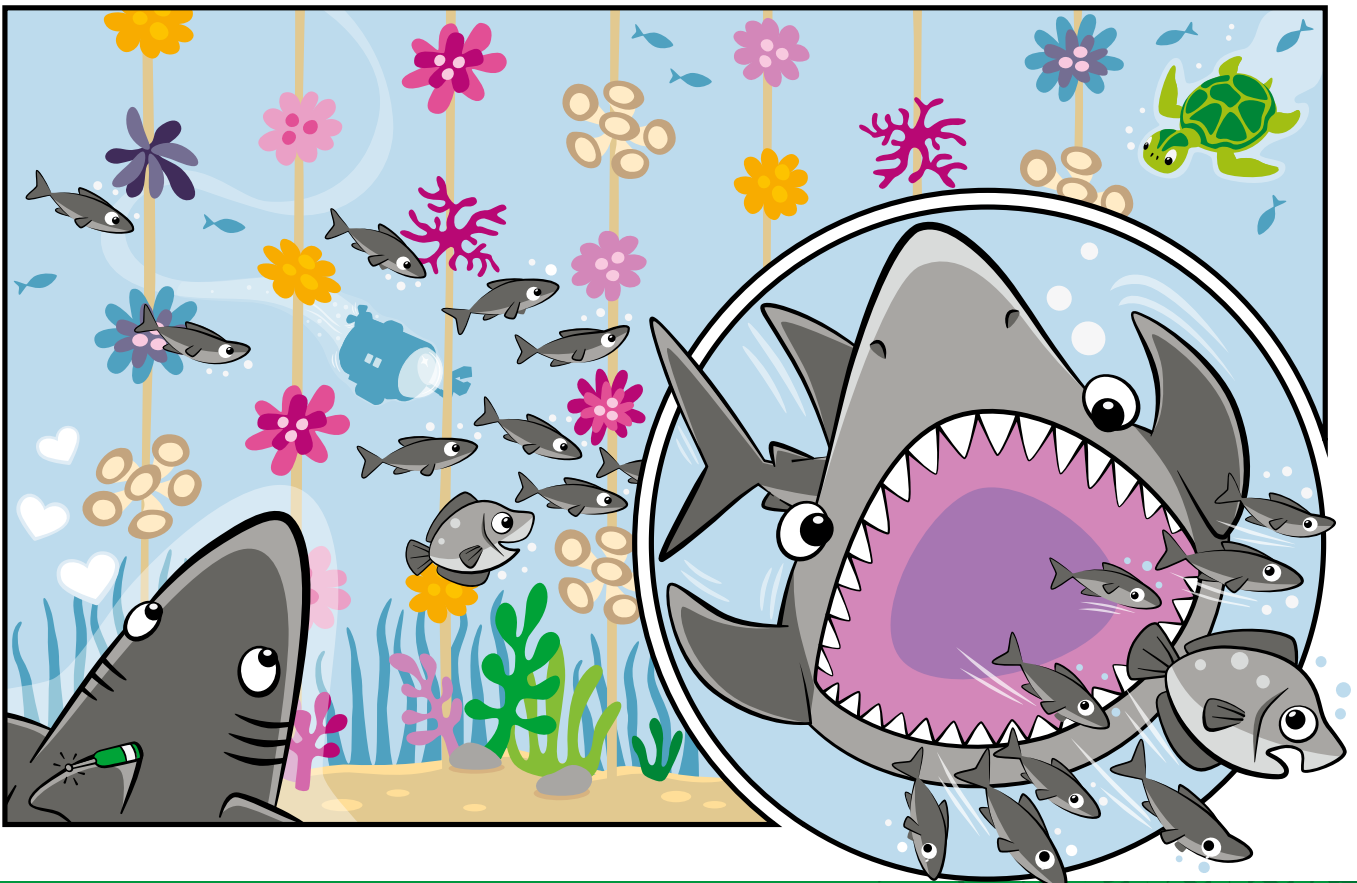
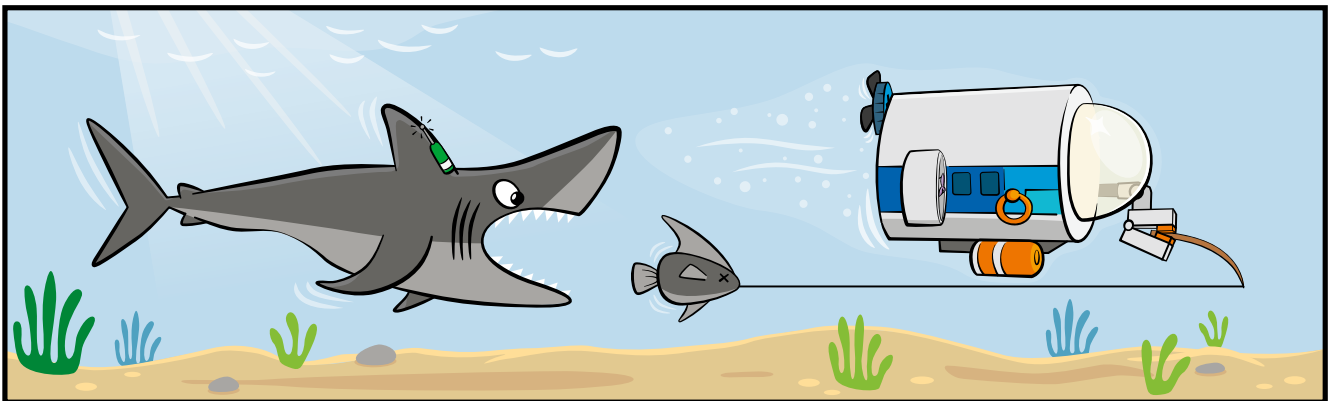
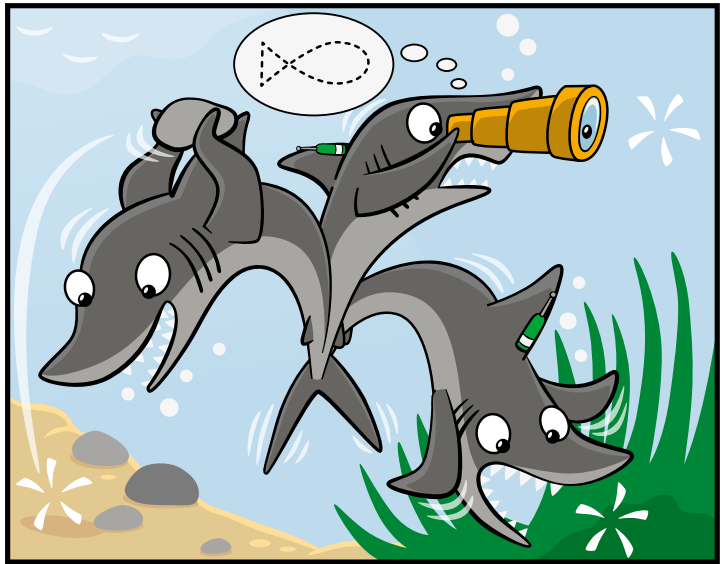
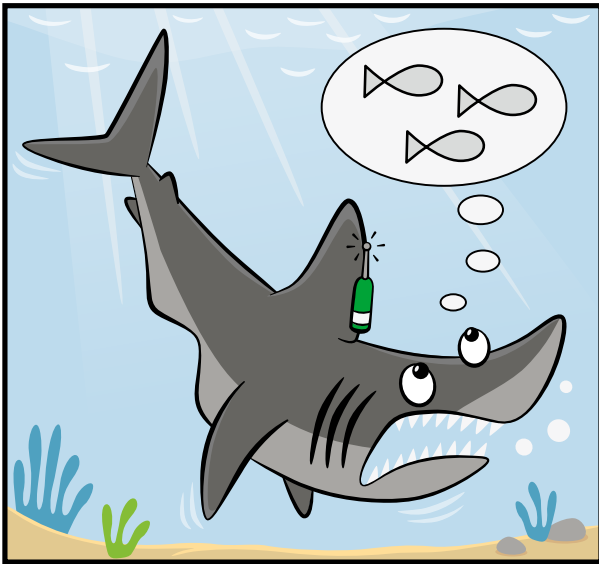


Together with your teammates, you will:

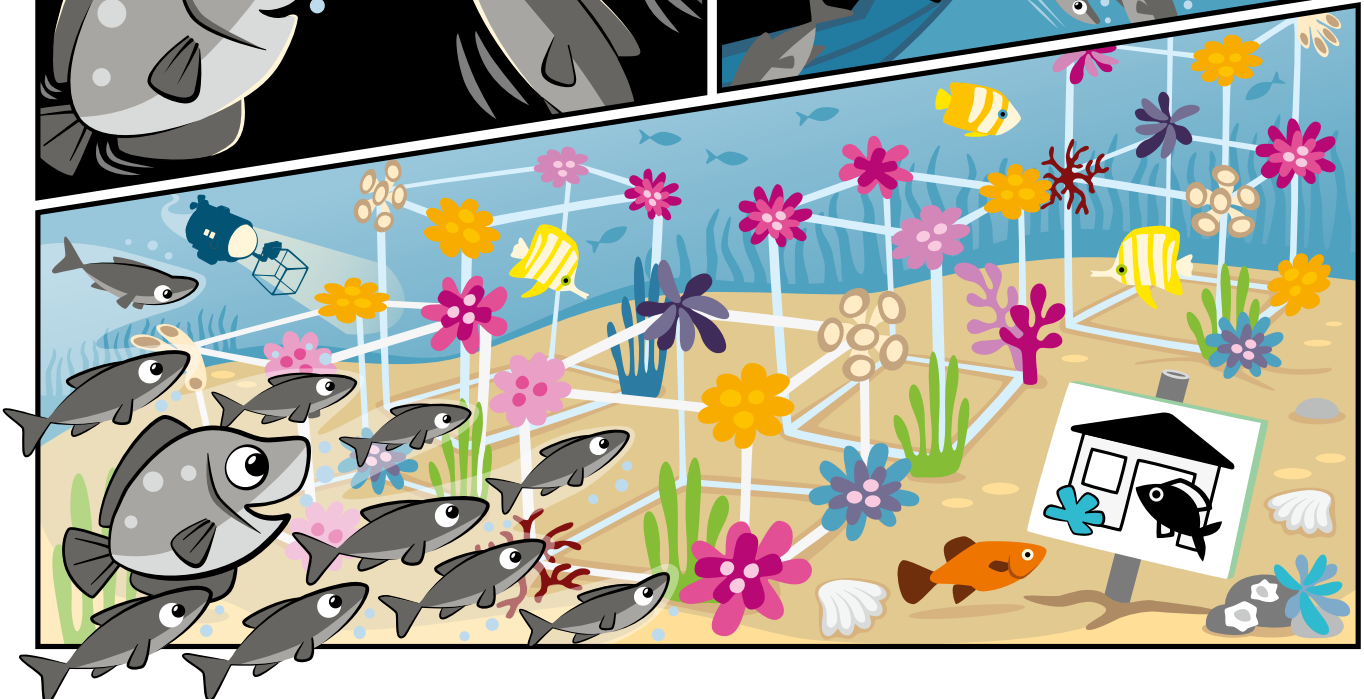
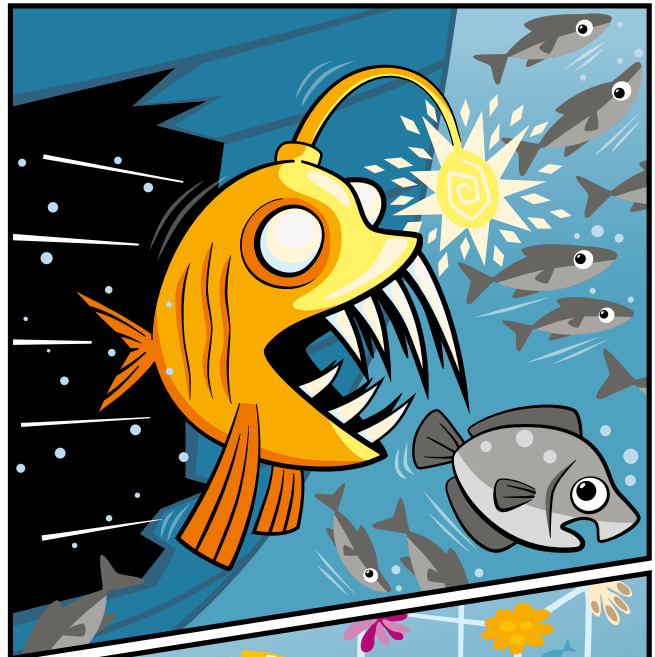
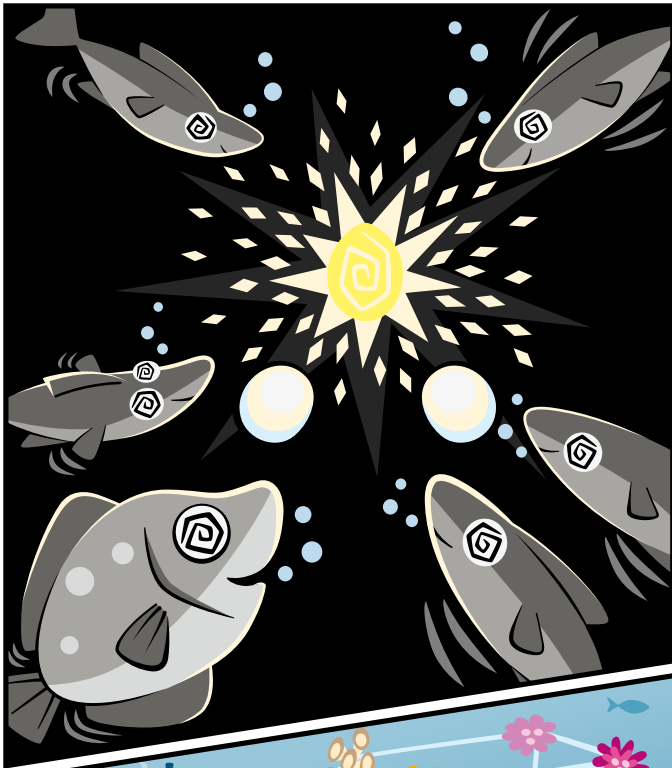
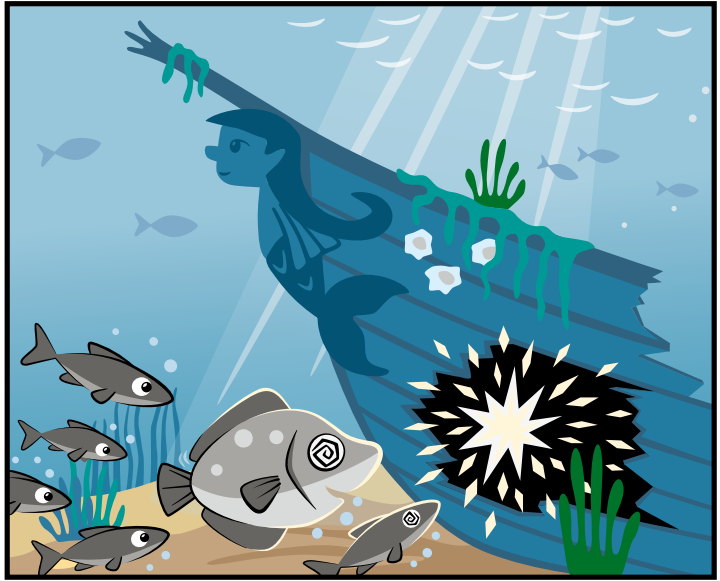
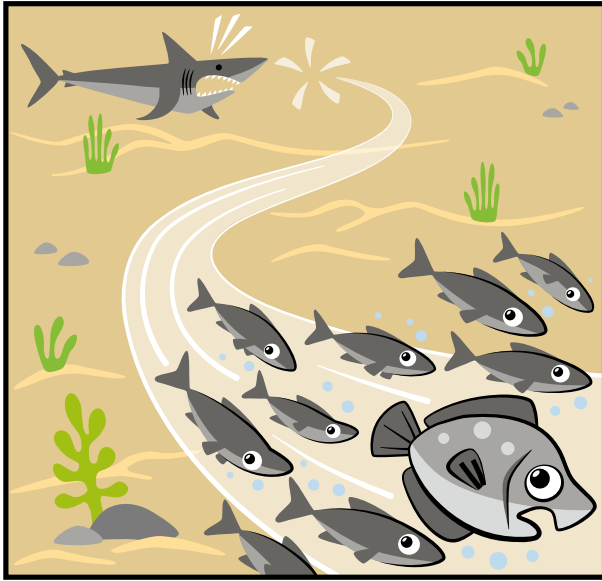
- Discover real-world challenges and opportunities in this season's theme.
- Create a team model and program it to make part of it move.
- Test and improve your program and model changes.
- Track your work in the *Engineering Notebook*.
- Make a team poster that reflects your team's journey.
- Share your model and poster with reviewers at an Explore festival.
- Celebrate your accomplishments with family and other teams at the festival.



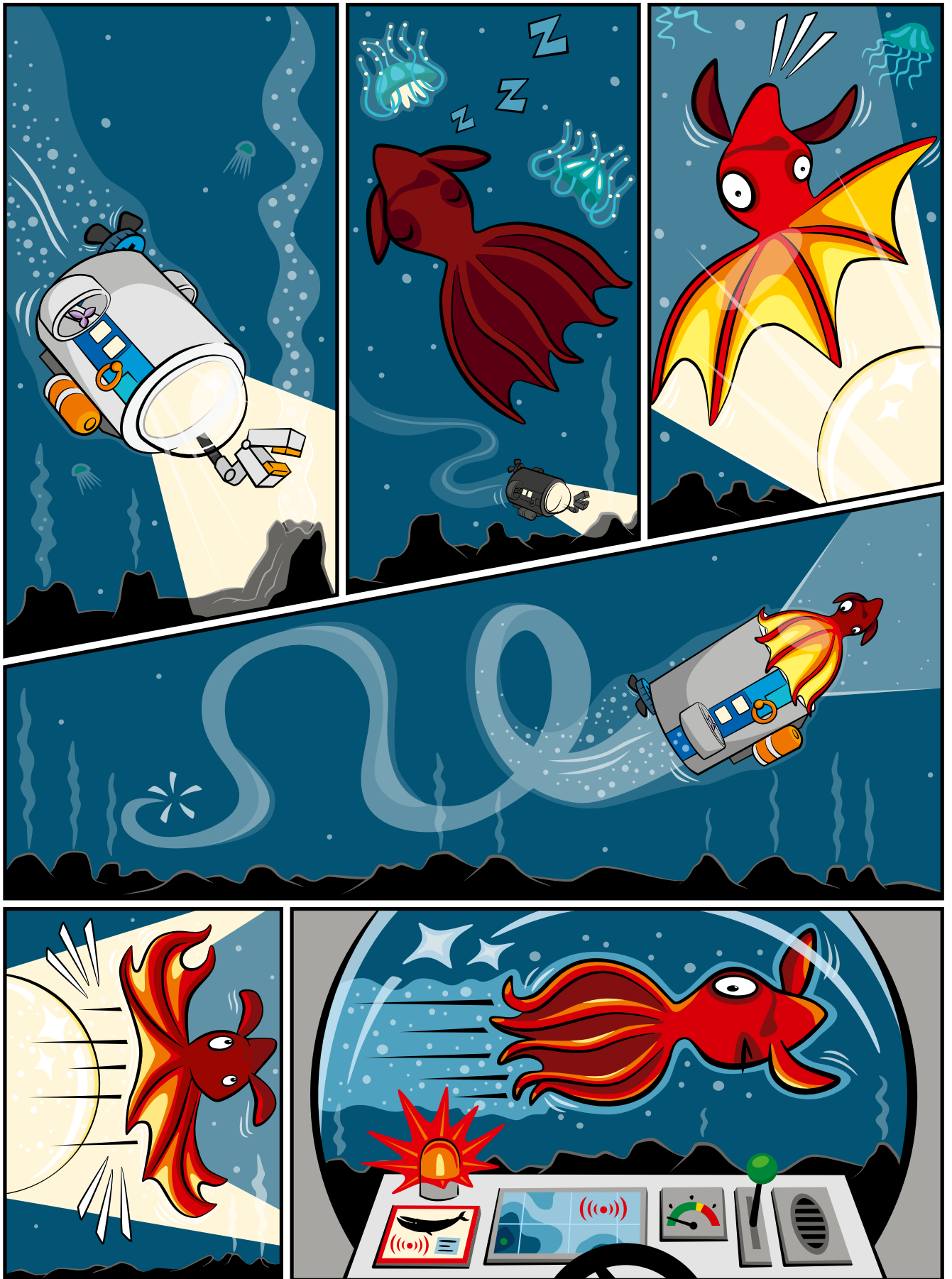
Explore Story



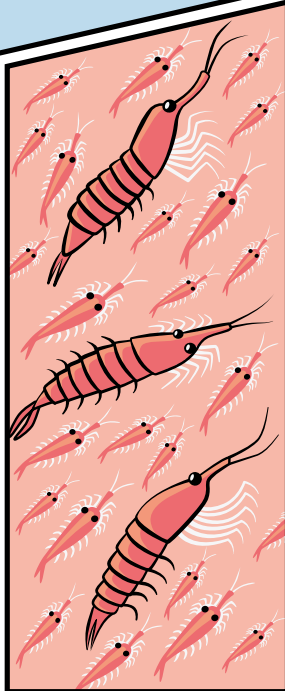
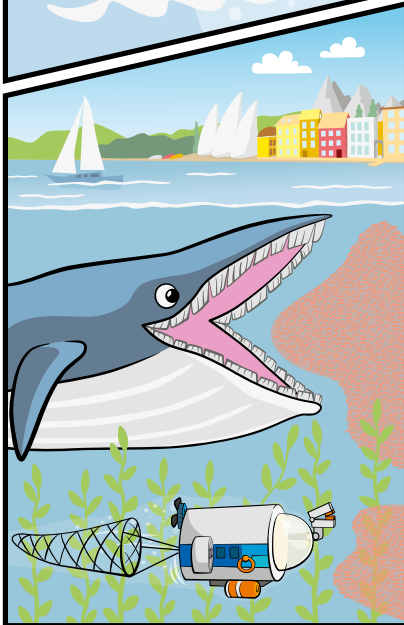
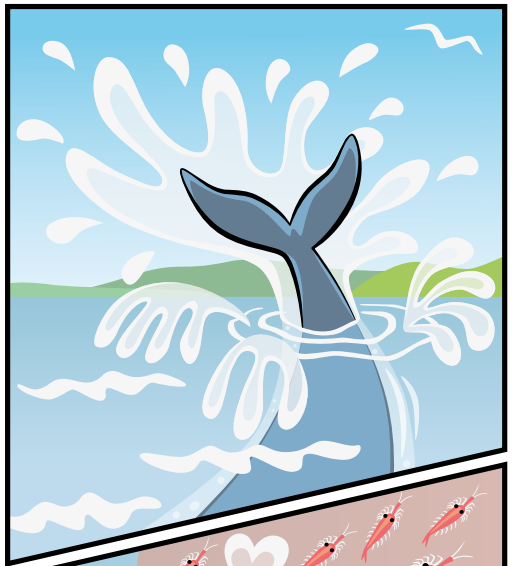
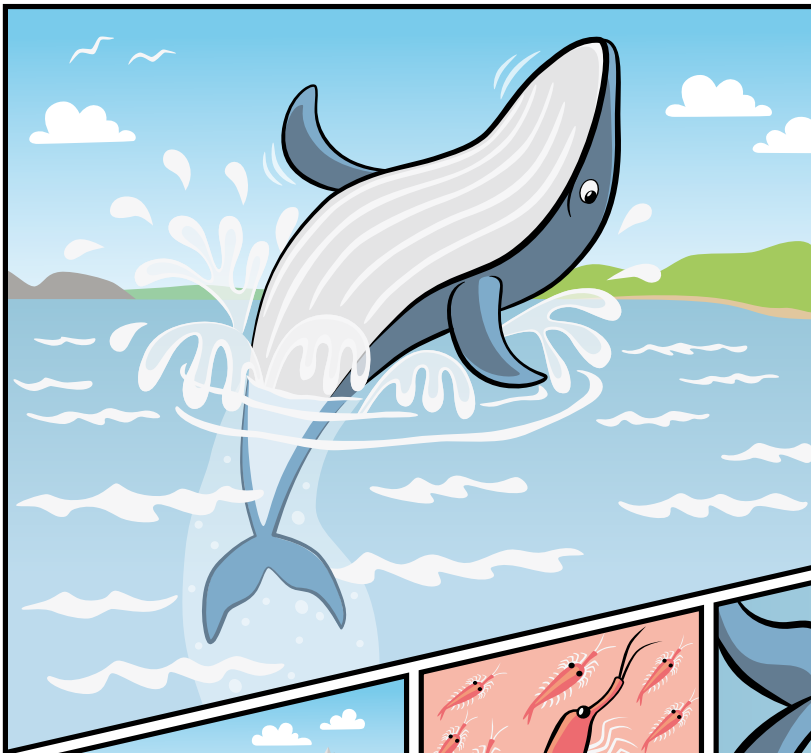
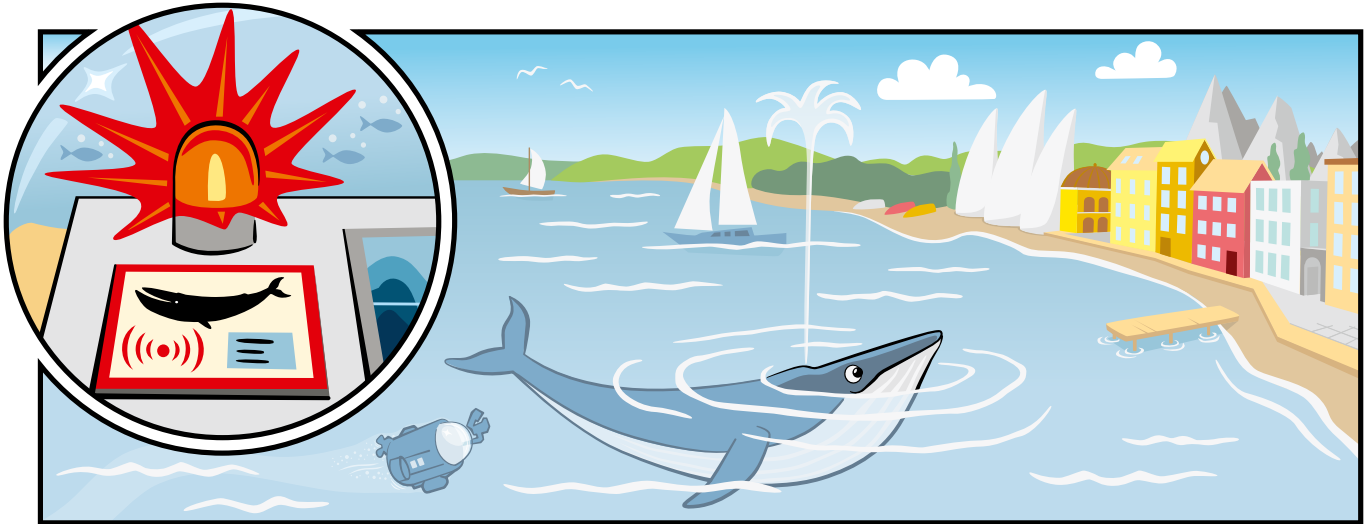
Explore Story



Explore Story



Explore Story



Team Progress

Come back to these pages throughout your season to update your team's goals and your own and to share your progress.

My goals for this season are...

**START
HERE!**

So far, I have learned...
I want to learn more about...

What has been
the most surprising
thing you have
learned?

**HALFWAY
THERE!**

I am proud of my team because we...

**FESTIVAL
TIME!**

What is your favorite
feature of your team
model?

Core Values

Draw or write an example of your team using each Core Value when directed in the sessions.

You will develop new skills as you work together.

DISCOVERY

We explore new skills and ideas.

INCLUSION

We respect each other and embrace our differences.

INNOVATION

We use creativity and persistence to solve problems.

TEAMWORK

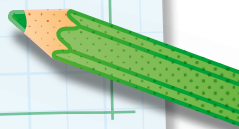
We are stronger when we work together.

IMPACT

We apply what we learn to improve our world.

FUN

We enjoy and celebrate what we do!



Session 1

Activity 1 Tasks

- Read the Explore story to learn about the SUBMERGEDSM theme.
- Talk about what you know about the oceans with your teammates.
- There are many ocean mysteries left to explore. Think about what part of the oceans you and your teammates would want to explore and hope to discover.
- List your questions about the ocean below.

Your team needs:

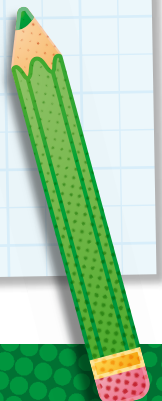


What did you learn from reading the Explore story?

What animals or objects did you recognize in the Explore story?

More than 80% of the ocean has never been mapped, explored, or even seen by humans!

What animals and objects do you want to learn more about?



Your team needs:



An autonomous underwater vehicle (AUV) is like a small submarine that doesn't need a person to drive it. A remotely operated vehicle (ROV) requires a person to drive it, and it is connected to the ship with cables.



Dive In!

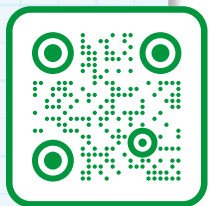
Activity 2 Tasks

- Build the submarine from the Explore set using Bags 1 and 2.
- Talk about the different parts of the submarine and what they might be used for.
- Think of something your submarine might discover in the ocean.
- Use the space below to draw your ideas.

Challenge

- Use the prototyping pieces to build animals, plants, or unknown object that your team wants to learn about.
- Share your ideas.

My ideas:



Scan me to see a video of the submarine model.

Session 2

Activity 1 Tasks

Sunlight Zone

- Build the coral reef and shark models using the pieces in Bag 4. Place them on the mat.
- These living things are found in the sunlight zone of the ocean.

Twilight Zone

- Build the sunken treasure and anglerfish models using the pieces in Bag 5. Place them on the mat.
- These things can be found in the twilight zone of the ocean.

Challenge

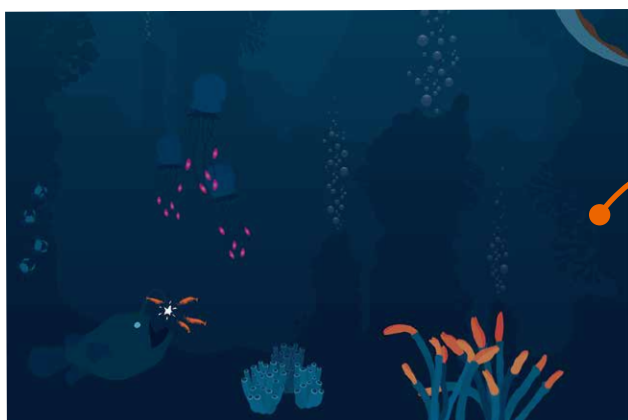
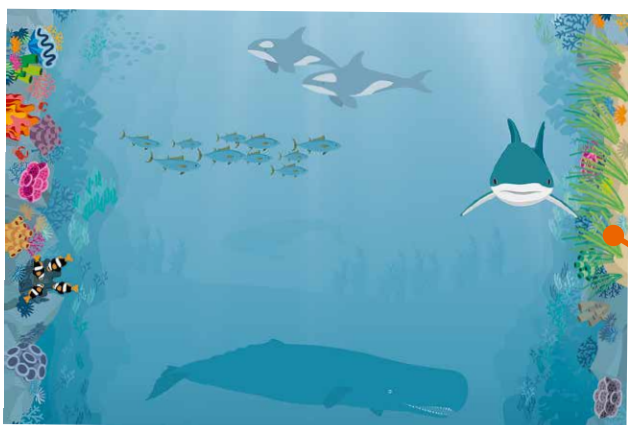
- Learn about the sunlight and twilight zone in the ocean. What makes them different?

Your team needs:



My ideas:

Your team needs:



Ocean Layers

Activity 2 Tasks

Abyssal Zone

- Build the two abyss models in Bag 6. Place them on the mat.
- These things can be found in the abyssal zone of the ocean.
- Learn about the abyssal zone. What does ocean life look like in this extreme environment?

Challenge

- Label the picture of the mat to show the different layers.
- Share what you learned about the ocean layers.

Label the ocean layer:

Session 3

Activity 1 Tasks

- Open the SPIKE™ Essential app. Complete your lesson.
- Make the model rotate at a different speed.
- Write your ideas below for how to change the program.
- Modify the program based on your ideas. Run your new program. See what happens.

Your team needs:



Your lesson:



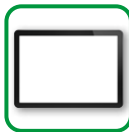
FIRST® LEGO® League
Explore Unit:
Lesson 1 (Boat Trip)



Write your ideas:

A large sheet of blue grid paper with a pencil at the bottom right. The paper has a light blue grid pattern and a series of white circles along the left edge, suggesting it's a spiral notebook page. A green pencil with a pink eraser is positioned at the bottom right corner of the page.

Your team needs:



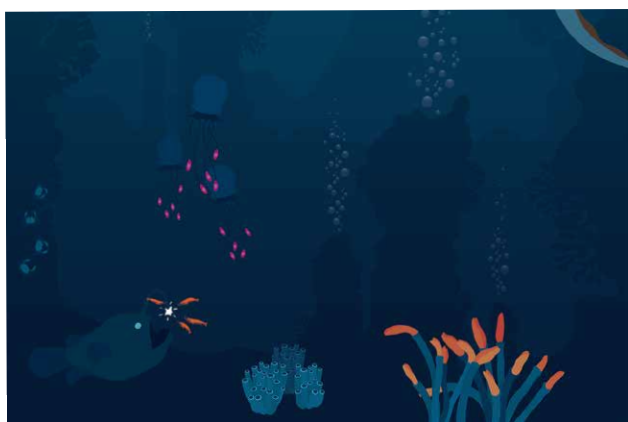
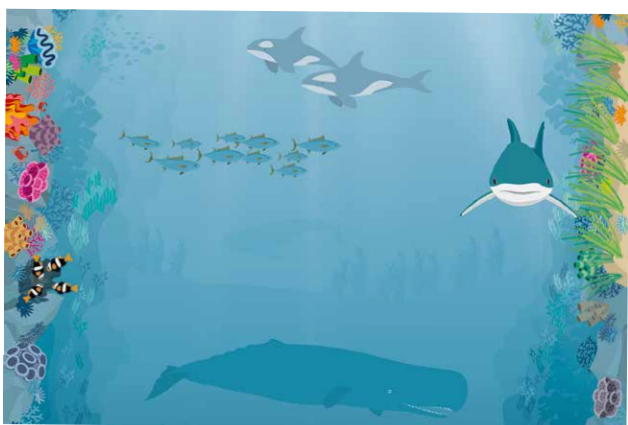
Sunlight Zone

Activity 2 Tasks

- Modify the boat model from the previous task so it represents your team. Will you need special tools or equipment?

Challenge

- Open the SPIKE™ Essential app.
- Change the program to launch your team boat in the sunlight zone. Try it out!



The sunlight zone receives light that warms the water and enables plants to grow.

CAREER CONNECTION

A marine biologist studies life in all parts of the ocean. There is a lot to observe and discover in the sunlight zone!

Find out more on [Page 30](#).



Session 4

Activity 1 Tasks

- Open the SPIKE™ Essential app. Complete your lesson.
- Code the model to flash a light when a team member approaches the sensor.
- Modify the program based on your ideas and test it out!

Challenge

- Code the model to display a different light pattern that is unique to your team.

Your team needs:



Your lesson:



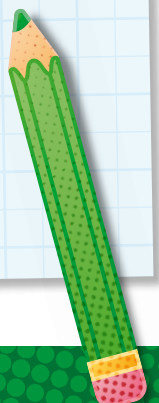
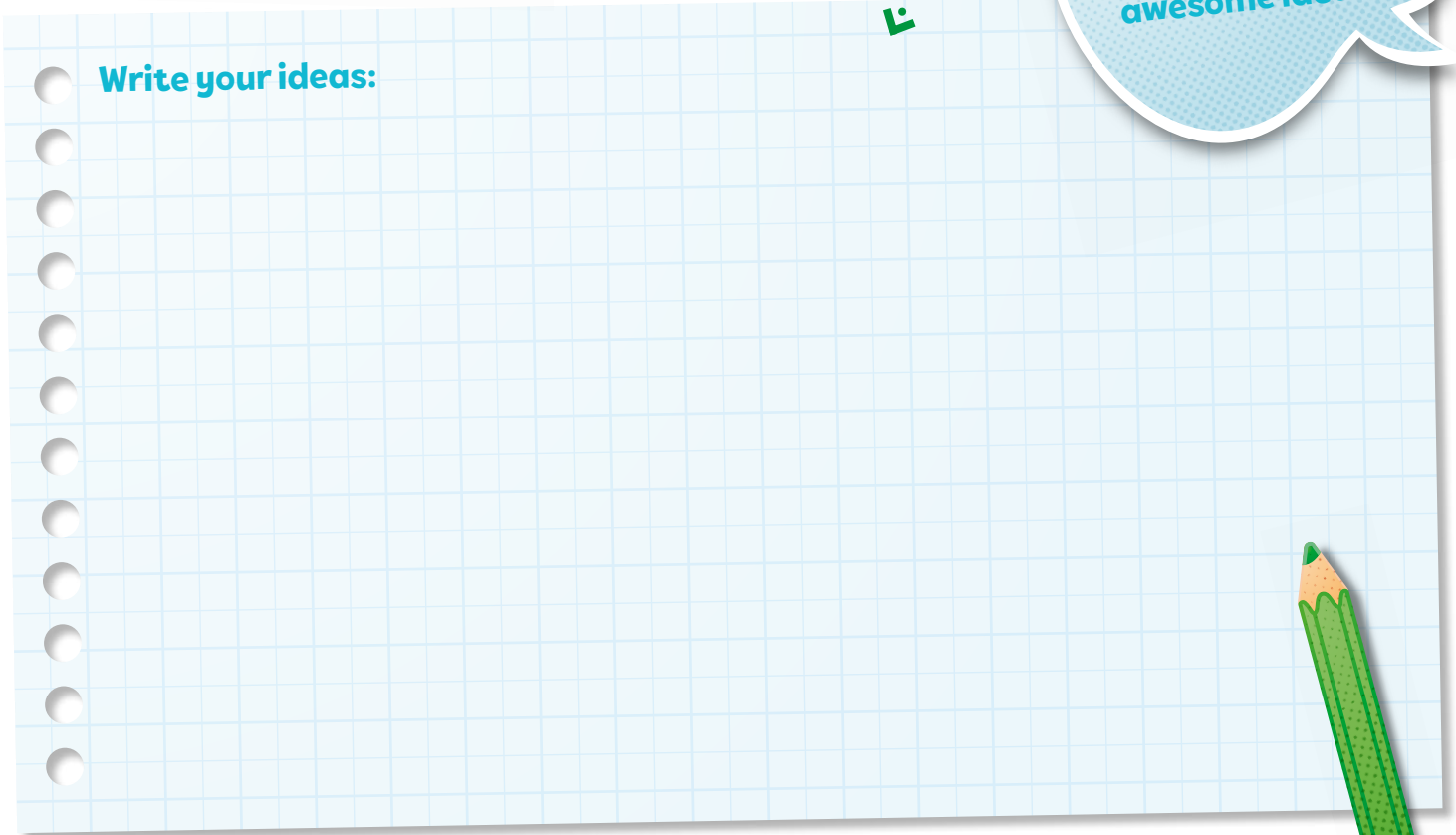
FIRST® LEGO® League
Explore Unit:
Lesson 2 (Animal Alarm)

Sensors can help scientists detect things that can't be seen with our eyes.

How could sensors help us explore the oceans?

Show how you include everyone's awesome ideas!

Write your ideas:



Your team needs:



Navigating underwater without any light can be tricky. Submarines must be able to control their speed to avoid colliding with objects.

Twilight Zone

Activity 2 Tasks

- Use the building instructions in Book 2 to attach the sensor, motor, and hub to the submarine from Session 1.
- Open the SPIKE™ Essential app. Try the program provided in Book 2 to motorize your model.

Challenge

- Change the program so that the submarine will do the following:
 - When the sensor detects a black or gray object, the propeller spins quickly to back away.
 - When the sensor detects a blue or yellow object, the propeller spins slowly to move in and get a closer look.
- Share what you built and explain how you coded the model.

My ideas:



CAREER CONNECTION

A marine archaeologist explores how humans have interacted with the oceans in the past. They can teach us a lot about the history of the oceans.

Learn more on [Page 30](#).

Session 5

Activity 1 Tasks

- Open the SPIKE™ Essential app. Complete your lesson.
- Next, code the model to move backward.
- Write your ideas for how to change the program below.
- Change the existing program based on your ideas. Test it out!

Challenge

- Modify the model so it represents a submarine. What can you add? What would you remove?

Your team needs:



Your lesson:



FIRST® LEGO® League
Explore Unit:
Lesson 3 (Arctic Ride)

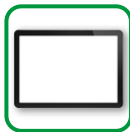
Submarines that travel to the deepest parts of the ocean need special equipment to navigate.

You may need to add lights to see in the dark or an arm attachment to pick up objects.

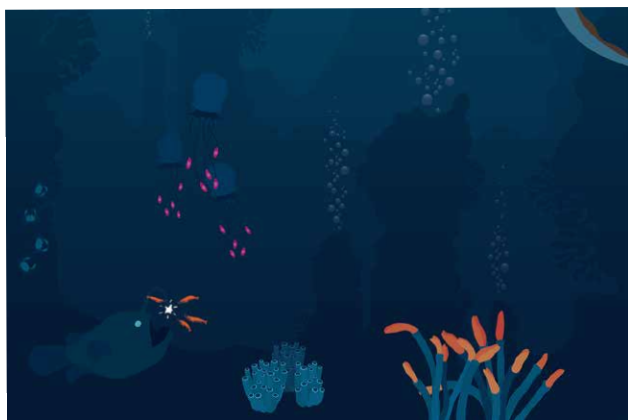
Draw what changes you made to the model:

A large sheet of blue graph paper with a pencil on the left and a red LEGO brick on the bottom right. A dotted line with a checkmark at the end points from the challenge section to the graph paper.

Your team needs:



There is so much to learn about the abyssal zone because its extreme environment is hard to reach!



Abyssal Zone

Activity 2 Tasks

- Modify the SPIKE model from the previous task so that it represents a submarine and can be driven.
- Open the SPIKE™ Essential app.
- Change the program so that the vehicle drives slowly on the mat.

Challenge

- Pick two spots on the mat the submarine should visit.
- Change the program for your vehicle to move between two icons.
- Share how you coded your submarine.



CAREER CONNECTION

Oceanographers are scientists that study all areas of the ocean. This could include mapping the seafloor or understanding how different living things survive there.

Discover more careers on Page 30.

Session 6

Activity 1 Tasks

- Imagine that your team discovers something strange while traveling through the ocean.
- Use the prototyping pieces to build a mysterious and unknown creature.

Challenge

- Write a summary of your new species below.
- Share your newly discovered species with others.

Your team needs:



You can share your new species on your team poster later.

New Species Found

Year:	Month:	Day:	Place:

What would you call it?

Where in the ocean was it discovered? What ocean layer?

What was it doing?

Was it alone or with other species?

Did you see more than one?

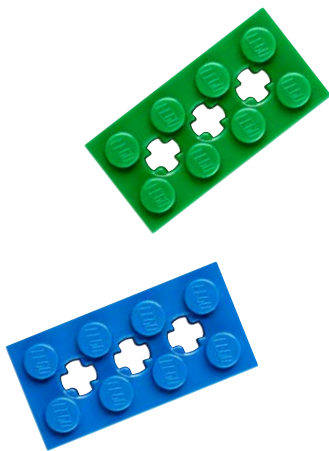
How big is it?

Will it get bigger?

What kind of habitat does it need?

What does it eat?

What else should everyone know about your discovery?



Your team needs:



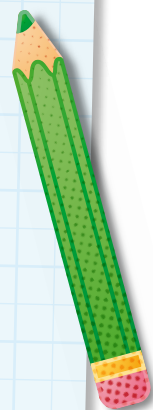
Artificial habitats are created by humans for many reasons. They can provide protection for fish and other small animals. They can also help protect a coast from erosion!

Deep Sea Discovery

Activity 2 Tasks

- Build an artificial habitat for the new species using the prototyping pieces.
- Draw your team's ideas for a habitat below.
- Think about what part of the ocean your creature is from and what protection it may need.
- Keep your creature in the artificial habitat to share in your team model later.

My ideas:



Session 7

Activity 1 Tasks

- Explore the ocean jobs on pages [30-31](#).
- Pick a job that interests you. Think about the different tools someone in that role might need to do their work.
- Write or draw your ideas below.

Challenge

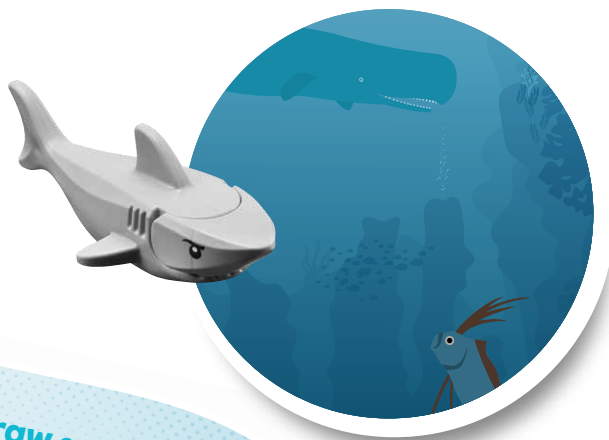
- Use the prototyping pieces to build a place where people can study the ocean.
- Build the tools or equipment the people might need.

Your team needs:



My ideas:

Your team needs:



Draw and label the parts of your exploration station on this scene from the Explore story.

Exploration Station

Activity 2 Tasks

- Think of a different job that explores or studies the ocean.
- Talk about what new tools or equipment the job might require.
- Change your model so it matches the job.
- Place your model on the mat.
- Talk about what you built.

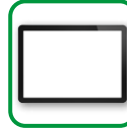


Sessions 8&9

Session Tasks

- Your team has learned a lot about the oceans!
- Design a team model that shows your team's ocean journey.
- Explore the list of required parts on the next page.
- Draw your team model design and label the required parts.
- Create your team model together. Use the mat and build the different parts of your ocean journey!

Your team needs:



Build a team model that shows the exploration station, an artificial habitat, and the ocean creature your team discovered!

Draw your team model on the mat:



Team Model

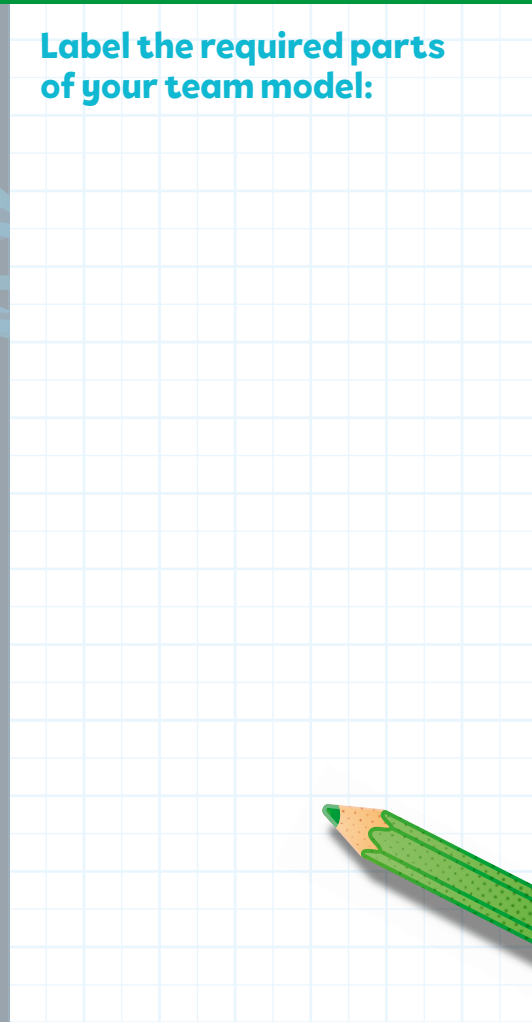
Build a team model that represents a unique way to share your team's ocean discoveries with others.

Requirements

- Include your exploration station, an artificial habitat, and an ocean creature.
- Include all models of the Explore set.
- Motorize any part of the team model.
- Use only LEGO® elements.
- Use the SUBMERGEDSM mat.
- Use LEGO coding.



Label the required parts of your team model:



Sessions 10&11

Session Tasks

- Find your poster board and art supplies.
- Brainstorm what to put on your poster.
- Use the next page as a draft for your ideas.
- Work together to create your team poster. Teamwork!
- Be creative. You can use words, drawings, and photos on your poster.

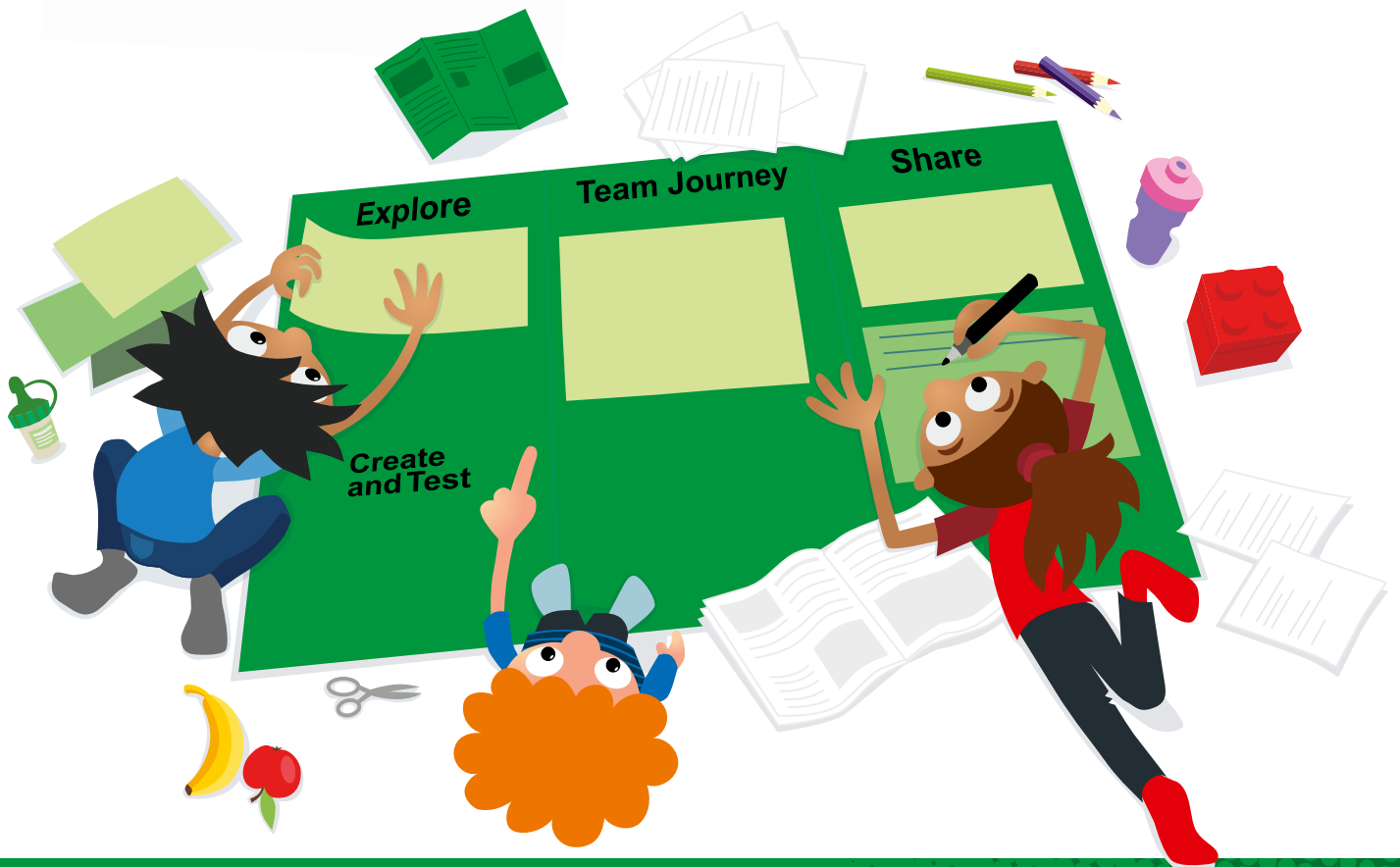
Your team needs:



**Congratulations
on all you have
learned!**

**Now, make a
team poster
to share
about it.**

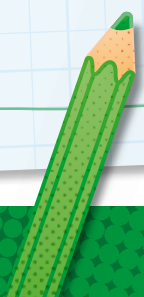
**Describe your team
journey throughout
the sessions.**



Team Poster

Here's your chance to capture ideas for your team poster.

Sample Topics: *Explore, Create, Test, Share, Core Values, Team Journey*



Session 12

Tasks

- Gather your completed team model and team poster.
- Talk about what your team would like to share at your event!
- Complete the next page to prepare for your event.
- Look over the reviewing sheet with your coach.
- Practice your presentation.
- Communicate what you have learned with others.

You will be taking part in a FIRST® LEGO® League Explore festival. Invite your family and friends to your special event!

Share what you have learned and how your team had fun!

Sample Festival Roles

I'm going to share what we explored.

I will describe the team model.

I will explain the program and how it motorizes the team model.

We will show how the poster captures our team journey!

I can reflect on how our team used Core Values.



Prepare for Event

Think about what you will share at the event.

- Can you describe your team model?
- Explain how your team used innovation and creativity to explore the oceans.

- What did you learn about the season challenge?
- How did you use Core Values?

- What part of your team model is motorized?
- How did you code your motorized part?

- What did you include in your team poster?
- How does the poster show your team journey?

Let's celebrate how well we all worked together! It is much more fun when everyone on the team is included.



Career Connections



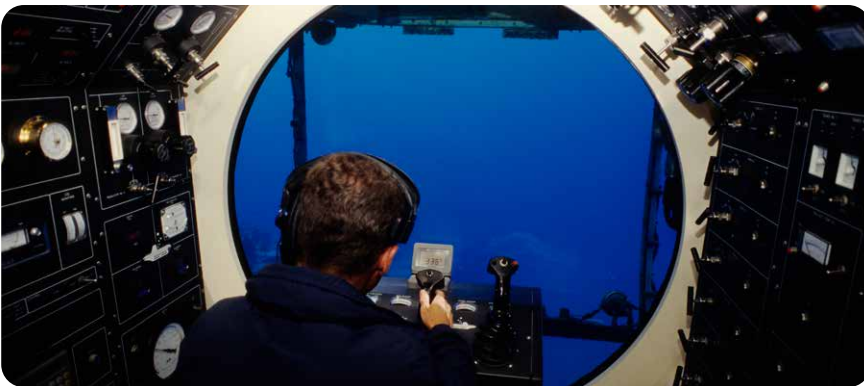
Marine Biologist

A marine biologist studies ocean ecosystems and ocean life. Their focus may be on large animals like whales and dolphins or small organisms like plankton and algae.



Oceanographer

Oceanographers study a wide range of ocean concepts. These scientists may research the seafloor, water chemistry, or coastal erosion and waves.



Submarine Pilot

A submarine pilot is responsible for driving underwater vehicles that may or may not have passengers. This specialized role requires training to ensure the safety of the passengers and the environment.

Exploration

(Recommend completing after Session 4)

Look at the jobs on these pages. Choose a job role, research it, and answer the questions.

- Explain the job. What are some of this job's daily tasks?
- What education or training is required?
- What is this job's yearly salary?
- What companies could people in this job work for?

Fields of Study

- Oceanography
- Marine Biology
- Coastal Management
- Marine Chemistry
- Geology
- Marine Technology
- Underwater Photography



Marine Geologist

A marine geologist studies the ocean floor. They may be interested in how the shoreline is affected by the ocean or how the seafloor has changed throughout Earth's history.



Underwater Photographer

Underwater photographers give people a chance to see what is beneath the ocean surface. This job requires specialized equipment and dive training.



Marine Educator

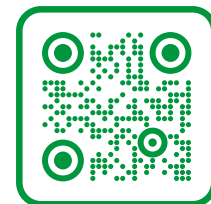
A marine educator teaches people about the oceans. This role may cover a wide range of ocean topics including history, science, ocean conservation, and more.

Reflection

(Recommend completing after Session 12)

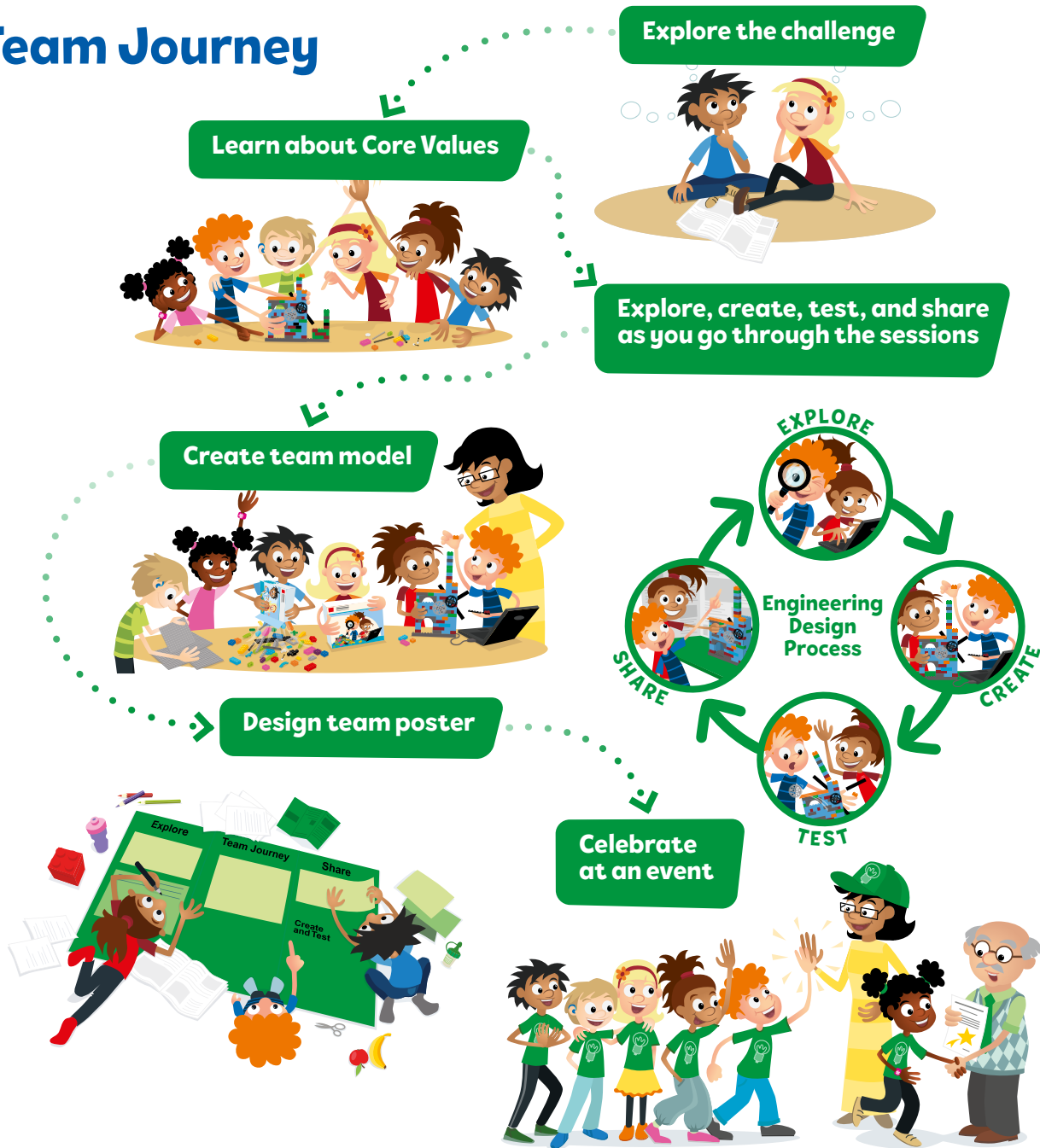
Look at the jobs on these pages. Think about these jobs and what interests you.

- What interests you about these jobs?
- What skills are needed in these jobs?
- Think about what other jobs relate to studying the oceans.
- Can you explore one of these careers for more information?



**Scan me for
career resources**

Team Journey



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