Ocean Discovery Camp
Platform: Fish are Friends!

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Overview: Fish are Friends

Science Discovery Focus: Explore and Wonder

Ocean Discovery Unit

Next Generation Science Standards:

K-ESS3-3 Earth and Human Activity: Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.

5-ESS3-1 Earth and Human Activity: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

LS4.D Biodiversity and Humans: Populations live in a variety of habitats and change in those habitat affects the organisms living there.

NGSS Alignment

Overarching Responsibilities of Team Lead:

- Classroom management & timing of lesson
- Execution of all lesson material in this curriculum
  - Regular – content that should be covered using language of your choice
  - (Parenthesis) – Teaching notes and actions
  - *Adaptation* – Way curriculum can be adapted for different grade levels
- Adapting curriculum up or down for grade level audience
- When transitioning from activity-to-activity use attention getters
- Lead discussions & ask guiding questions to get students thinking about science
- Use Belief and Science Discovery Process language during lesson
- Encourage participation from all students to create an inclusive environment
- Determine floor management with team BEFORE the start of the lesson
- **Always be thinking about ASC – Accountability-Safety-Communication**

Overarching Responsibilities of Assistant Team Lead:

- Remind students of mantra early and often:
- Mentor students during and in between activities
- Participate in any kinesthetic movements and/or writing or lab activities
- Ask students questions that help them to make their own discoveries
- Sit with students and model good listening behavior
- Sit or stand near any students struggling to pay attention
- **Always be thinking about ASC – Accountability-Safety-Communication.**

Fish are Friends Story

Internal

During Fish are Friends camp, students explore the incredible diversity of fish, including internal and external anatomy, morphology, management practices, and lifecycles. Students also build belief that science is something they can do, and a scientist is someone they can become.

On day one, students explore the pathway of a science leader by hearing from current Ocean Discovery participants, then they go on a "Fishy Adventure" through the canyon, searching for clues and solving a puzzle to win a prize. Throughout the day, students build a sense of community through teamwork and listening and sharing about their own ideas and experiences.

Over the next three days, students continue to explore the world of fish. One day, they investigate the internal and external anatomy of fish through a shark dissection, on another day, students explore fish morphology and how each body shape is adapted to help a fish survive within its habitat, and on another day, students learn how fish are a great source of protein and create a delicious fish recipe they get to taste and recipe card they can bring home to share with their family.

On their final day in the program, students make a difference by playing a game where they become fishermen and learn about the importance of fisheries management to protect fish populations and about future careers in fishery management.

Fish are Friends Story
External – Students

I am excited to continue my journey with Ocean Discovery Institute this summer by joining the Fish are Friends camp. Over the years, Ocean Discovery has helped me believe that science is something I can do, and a scientist is someone I can become.

On the first day of program, I enter the building and am greeted by remote controlled shark and fish balloons! So fun! I meet the Ocean Discovery staff and we watch a video about kids like me, who participate in Ocean Discovery programs. I learn that I am on the pathway to becoming a science leader – awesome! After that, we go on an adventure in the canyon searching for "fish" eggs that contain clues to the life cycle of a fish. My team works together to figure out the steps of the life cycle and when we do, we see the final clue. This clue revels the location of the golden egg and we can claim our reward! I learn a lot about how fish grow up – it's not an easy life. Throughout the day I get to know lots of new people and learn that I have a lot in common with my fellow science leaders. I'm excited to learn more about fish the rest of the week!

Over the next few days, I learn so much about fish. One day we learn about the inside and outside body parts of fish by doing a shark dissection – so cool! Did you know that sharks have livers filled with oil to help them float? Another day we learn how fish have different body shapes and these shapes help them live in different places. The best part? We go and check out the living fish in Ocean Discovery's big circle tank and look for those body shapes among the fish there! On another day, we become chef's and work together to prepare a fish recipe that we can share with our friends and family. It is yummy! Fish is a good source of protein so I'm going to ask my parents if we can cook my fish recipe for dinner one night this week!

On the last day of camp, we play a fun game where we are all fishermen. We get to fish and make money. Sadly, we take all the fish the first time we play so we can't earn any more money after that! Bummer. After talking about the experience, our teacher lets us play again and this time all the fishermen talk to each other to make sure we don't take too many fish. We do a good job, and there are fish for many rounds. We learn that there are people who monitor fish populations and make sure there are rules in place to protect fish populations all over the world. That could be a really great job!

I learned so much this summer! I can't wait until camp this fall!

Space and Activity Schedule

*to be updated by the Program Coordinator each year
** The kitchen will need to be utilized by the groups during "Fish & Nutrition" lesson so this should not be assigned as a "Home Base".
*** The Ocean Alcove and Circle Tank in the Plaza Del Sol will need to be utilized by the groups doing the "Fish Morphology" lesson so the Ocean Alcove should not be assigned as a home base.

	Monday	Tuesday	Wednesday	Thursday	Friday
Blue	Believe Alcove				Believe Alcove
Green	Eco-Lab				Eco-Lab
Orange	Sci-Tech Lab				Sci-Tech Lab
Red	Achievement Alcove				Achievement Alcove
Yellow	Plaza Del Sol				Plaza Del Sol

Day 1: Fish Are Friends

Goal: Students learn about the Pathway of a Science Leader and build a sense of belonging as they get to know their Ocean Discovery Family by engaging in an "fish egg hunt" and working as a team to solve puzzles while sharing about themselves and their experiences.

Technology:

- Large Smart Board with "OS Fish are Friends" PPT loaded to desktop
  - If a guest speaker joins - connect a speaker, microphone, microphone stand, and camera.
  - If a video will be shown - connect the speaker.
  - *PLAZA DEL SOL LAB ONLY* - connect the lavalier to speaker for team lead.

Supplies:

***For one group of 10 students – multiple all supply numbers based on the number of groups expected.**

Visual Materials:

- Large whiteboard + easel (1)
- Seed to Tree Science Leader Pathway video
  - Papi/Curriculum/CI New
- Ocean Poster (will be used every day of the program)
  - Made from a large piece of butcher paper with a drawing of the ocean.
- Labels for Ocean Poster
  - Laminated in a large font "Fish are Friends"
- Word Wall (will be used every day of the program)
  - A poster made from a large piece of butcher paper
  - "Word Wall" written in large letters
  - Laminated words in a large font:
    - Family – a group of people that care for you
    - Science Leader – a person who uses science to make our world a better place
    - Diversity – lots of different kinds
    - Fish – a vertebrate, that lives in the water, and has fins and scales
    - Vertebrate – an animal with a backbone

Supplies:

- Jarred fish (5)
- Fabric for armbands (1/student + 1/adult)
  - Different color for each team (2 teams/group = total of 10 colors)
- Remote control fish balloon (1)
- Remote control shark balloon (1)
- Small tank of helium (1)
- Set of Fish Facts (2)
  - Papi://Curriculum/CI New/OS Fish are Friends Camp/Materials for Fish are Friends Camp
- Wooden hollow eggs (12)

Commented [JLN1]: Lupita – new!

Commented [JLN2]: Lupita – new!

Commented [JLN3]: Something like this: https://www.amazon.com/Swimming-Infrared-Balloons-Decoration-ANTI-GRAVITY/dp/B095WG5S1P/ref=asc_df_B095WG5S1P/?tag=hyprod-20&linkCode=df0&hvadid=532544167582&hvpos=&hvnetw=g&hvrand=10338962417951107520&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=9011880&hvtargid=pla-1394093122755&psc=1

Commented [JLN4]: Something like this: https://www.amazon.com/Smile-Diary-Swimming-Decoration-Anti-Gravity/dp/B095WH2GVV/ref=asc_df_B095WH2GVV/?tag=hyprod-20&linkCode=df0&hvadid=532544167582&hvpos=&hvnetw=g&hvrand=10338962417951107520&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=9011880&hvtargid=pla-1392191369405&psc=1

Commented [JLN5]: If we want to go a more sustainable (not using plastic) but more expensive route (you would ultimately need 6 per group so if you have 5 groups you need 30 eggs). I found these (they could be painted by group color) (but there might be better and cheaper options: https://www.etsy.com/listing/1157883445/hollow-wood-eggs-wooden-easter-eggs-diy?gpla=1&gao=1&&utm_source=google&utm_medium=cpc&utm_campaign=shopping_us_a-craft_supplies_and_tools-patterns_and_how_to-kits&utm_custom1=_k_CjwKCAjwj42UBhAAEiwACIhADprRrdt3fhzhjKjAG_hnWs_BPqnURVawcbCpd8ZI3KrLBeN3_ustqBoCrqwQAvD_BwE_k_&utm_content=go_12569400892_126353648104_507394780987_pla-297994408538_c__1157883445_129152437&utm_custom2=12569400892&gclid=CjwKCAjwj42UBhAAEiwACIhADprRrdt3fhzhjKjAG_hnWs_BPqnURVawcbCpd8ZI3KrLBeN3_ustqBoCrqwQAvD_BwE

    - Each containing one Fish Fact inside
- Large gold hollow easter egg (1)
- "Ocean Discovery Institute – Fish are Friends Camp" sticker
- Signs for Signpost (1 set)
    - Papi://Curriculum/CI New/OS Fish are Friends Camp/Materials for Fish are Friends Camp
- Wooden Paint Sticks for Signposts (6)
- Leave No Trace Backpack (2)
    - Mini White board (4)

Student bins (1/student):

**To be created on the first day and used throughout the week.*

- Science notebook (1)
- Colored pencils (1 set)
- Pencil (2)
- Scissors (1)
- Pre-cut Fish Egg Outline (1)
    - Papi://Curriculum/CI New/OS Fish are Friends Camp/Materials for Fish are Friends Camp

Team Lead Teaching Bin (1/Team Lead):

**To be created on the first day and used throughout the week.*

- Painter tape (2)
- Scotch tape (2)
- Extra pencils (10)
- Dry erase markers (4)
- White board eraser (1)
- Spray bottle (1)

Commented [JLN6]: Perhaps: https://www.amazon.com/Amscan-Large-Gold-Easter-Inches/dp/B07M792SCP/ref=asc_df_B07M792SCP/?tag=hyprod-20&linkCode=df0&hvadid=270610367741&hvpos=&hvnetw=g&hvrand=10367749042726033236&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=9011880&hvtargid=pla-659450719199&psc=1

Commented [JLN7]: Stickers will need to be created by someone. ☺

Timing:

Time	Activity	Learning Cycle
9:45a – 9:55a	Introduction	Engagement
9:55a – 10:30a	Fish are Friends Challenge	Exploration & Guided Analysis
10:30a – 10:40a	Process Reflection	Reflection

Time	Activity	Learning Cycle
2:15p – 2:25p	Introduction	Engagement
2:25p – 3:00p	Fish are Friends Challenge	Exploration & Guided Analysis
3:00p – 3:10p	Process Reflection	Reflection

Set up

- Write daily agenda on white board and set on white board stand
- Set up technology & visuals:
  - Open "OS Fish are Friends" PPT slides and test links for the day.
    - Be sure to move past commercials for any videos.
    - Check sound on the Seed to Tree Science Leader Pathway video
  - Put up Word Wall Poster and set aside words for the day at instructor station.
  - Put up Ocean Poster.
- Place one jarred fish on each table.
- Prep student bins.
  - Create one bin per students and stock each bin with all supplies listed above.
- Inflate remote control fish and shark balloons and set them up in the Discovery Gallery.
  - Determine who will operate the balloons while students are arriving.
- For Fish are Friends Challenge:
  - Put "Search Here for Fish Egg #1" sign onto signpost.
    - Repeat above for Search Here signs #2-6.
  - Determine which color each team will be (this is the color "fish eggs" to search for).
  - Place one Fish Fact in each hallow egg (be sure you know which is Fish Fact #1, #2, #3, etc.)
  - Walk through canyon using Fish are Friends Challenge Map (see below).
    - At Fish Fact #1 location place the "Search Here for Fish Egg #1" signpost.
      - Hide an egg that contains Fish Fact #1 for each team nearby (consider difficulty of hiding based on age group).
    - Continue down the canyon and repeat the above for Fish Egg locations #2-6.
  - Place enough "Ocean Discovery Institute – Fish are Friends Camp" stickers into the golden egg so there are enough for one per student.
  - Place the golden egg under the golden Odi statue in the Watershed Plaza.
  - Place two mini white boards into each backpack.
    - These will be used as a hard surface on which students can put together the puzzle.

Assistant Team Lead Teaching Notes

- Help students to place words on the Word Wall.
- During Fish are Friends Adventure:
  - Make sure the team stays together as you travel from place to place.
  - Encourage students who are quiet to participate.
  - Gather all students around when an egg is found.
    - Depending on age level chose a student to read the Fish Fact or read it out loud yourself.
  - Encourage students to work together to put the puzzle together and solve the final clue. Potential questions:
    - Has anyone here every seen a gold Odi statue? Where?
  - Remember if you are the last group to grab the signposts as you return to the lab from the canyon.

Introduction

Orient students to schedule and space.

- Review daily agenda on the white board.
- Orient students to the space.
  - Water fountain and bathrooms
  - UPSTAIRS ONLY:
    - Highlight the Solar Trees. Be sure to cover:
      - Connection to name Plaza Del Sol
      - How sunlight is used to power the Living Lab which is a net-zero energy building.

Community Agreements.

- As scientists we all must agree to follow a certain set of expectations when we work together.
- At Ocean Discovery we believe everyone should Be Their Best Self.
  - (Show Community Agreements slide.)
- **To Be Your Best Self**, you should:
  - **Be curious!**
    - Ask questions, make observations, and share your thoughts and ideas.
  - **Be respectful!**
    - Respect people, living things, and the environment around you.
  - **Be safe!**
    - Take care of yourself and others.
- Ask students to give a silent thumbs up if they can agree to be their best self when working with Ocean Discovery.

Introduce Ocean Discovery Family.

- Potential questions include:
  - How many people have visited the Living Lab before? How many people are here for the first time?
  - How many of you have done an Ocean Discovery program before? What did you do?
  - Have any of you had Ocean Discovery in school? Where did you go? What did you do?

- Some of you may already be a part of the Ocean Discovery Family and some of you are new to the Ocean Discovery Family.
- Today everyone is a part of the Ocean Discovery family.
    - Our definition of a family is a group of people who care about you.
    - (Ask a student to place "Family" on word wall.)

<u>Goals for the day.</u>

- (Show Goals for the Day slide.)
- Today we will focus on three goals
    1) Getting to know your Ocean Discovery Family
    2) Learning about the Science Leader Pathway
    3) Learning about fish – who are our friends.
- Introduce Science Leader Pathway.
    - We believe that all students are science leaders.
    - Define <u>Science Leader</u> – a person who uses science to make our world a better place.
        - (Ask a student to place "Science Leader" on word wall.)
    - Science leaders who come from City Heights, like you, are especially important! We can create diversity in the science workforce and bring new ideas, perspectives, and experiences to our work.
        - Define diversity: having lots of different kinds.
        - In City Heights there are many people who are different races, religions, etc. We have a diversity of people and that's excellent for science!
        - (Ask a student to place "Diversity" on word wall.)
- Introduce Seed to Tree Science Leader Pathway video.
    - Ocean Discovery wants to support students who want to become science leaders, so we have many programs to help you on your pathway.
    - Watch a video that shows Ocean Discovery students in different places along their pathway to becoming science leaders.
        - (Show Seed to Tree Science Leader Pathway video.)
- Debrief Seed to Tree Science Leader Pathway video.
    - Potential questions include:
        - In what ways are you similar to the people in the video?
        - What did you see in the video that gets you excited?
        - How would you describe a science leader?
        - What questions do you have about becoming a science leader?
- How you can be a science leader.
    - Be a science leader today by:
        - Share what you learn
        - Raise your hand to answer questions
        - Make good decisions
    - Be a science leader in the future by:
        - mentor others
        - go to college
        - have a career in science

Fish are Friends Challenge

Preview the theme of the week

- We will be learning about fish.
- (Have students examine the jarred fish on their table.)
    - As a group try to come up with a description (e.g., they have fins, tails).
- Define fish: a vertebrate, that lives in the water, and has fins and scales.
    - (Ask a student to place "Fish" on word wall.)
    - Define vertebrate: an animal with a backbone.
    - (Ask a student to place "Vertebrate" on word wall.)
- Throughout this week we will learn all about fish! From the smallest fish in the deepest ocean to the largest fish in the open ocean – we will learn that fish are friends! Even the "scary" ones!

Introduce Fish are Friends Challenge

- We will start our exploration of fish today by going on a fishy challenge!
- The goal of the challenge is to learn some facts about the lifecycle of fish and work together as a team.
- During the challenge, we will journey through the canyon right outside.
    - (Show Canyon slide.)
- Whenever we see a signpost – we will need to stop and search for a "fish egg".
    - (Show Signpost and Fish Egg slide.)
    - The fish egg MUST be the color: _____ (whatever color your team has been assigned)
    - There will be TWO eggs at each location that are the same color. Each team will only take ONE.
- When we find a fish egg we will open it up as a team and read some fun fish facts.
- When we have found all the fish eggs – a total of six, we will need to put our facts together to create the lifecycle of a fish, and to reveal instructions to find the final clue.
- If we can figure out the final clue, we will each get to claim a reward.

Review expectations for Fish are Friends Challenge & Prep for Challenge

- Expectations:
    - (Show Expectations slide.)
    - We must stay together as a team as we travel through the canyon.
    - If we find an egg of another color- leave it where we found it.
    - Remember we are only taking ONE egg of our color.
    - When we find our team's egg at each location bring it to the Team Lead to be opened.
    - We will open all the eggs as a group.

Divide into Teams

- Divide your group into two teams.
    - One team will go with the Lead Instructor.
    - One team will go with the Assistant Lead Instructor.
- Give colored fabric ribbons to each student to wear.
    - The ribbons make us a team!
- Assigns someone to take be in charge of the leave-no-trace backpack.

Commented [JLN8]: Lupita when you have a moment can you take a picture of these and upload them to the slideshow (I've saved a space for them in the PowerPoint.

- The supply pack has the items you need to solve puzzles along the way.
- The leave-no-trace pack will be used to pick up clues and puzzles we are finished with to ensure we don't leave them in the canyon.

Begin Fish are Friends Challenge

- When students find an egg, assign one student to read the facts out loud to the group.
  - For K-2 students the adult will read the fish facts out loud to the group.
- Once students have found the golden egg under the Odi statue in the watershed plaza let each student take a sticker from the golden egg.
- Return to Introduction location for Process Reflection.

Debrief

- What did you learn about fish?

Process Reflection

Getting to know yourself and your Ocean Discovery Family

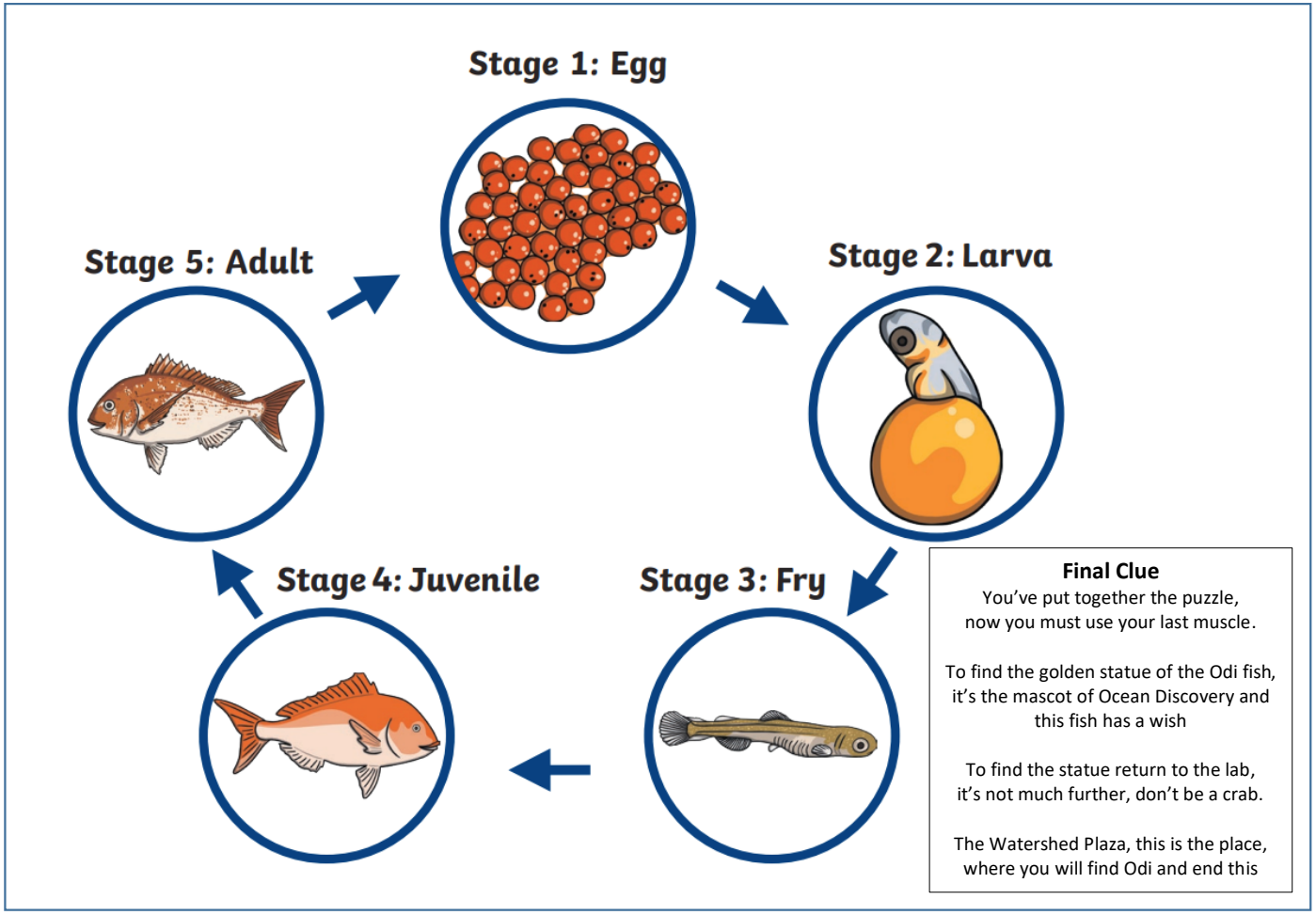
- Wait until you are reunited with your whole group before the process reflection.)
- (Have students take their chairs and form a circle.)
- (Ask a question, give 20-30 seconds of "think" time and then allow all students to answer.
  - (Start from different points in the circle so the same student doesn't start each time.)
- We are going to take a few minutes to get to know our Ocean Discovery Family a little bit more.
- I will ask a question, give you some time to think and then we will go around the circle and each of you will have a chance to answer.
- Questions:
  - What is your favorite animal?
  - What activity do you like to do outdoors with friends or family?
  - Do you think life as a fish would be easy or hard? Why?
  - Do you think it is important to learn science? Why or why not?

Uniqueness and Belonging

- Thank you all for sharing about yourselves.
- When listening to other Ocean Discovery Family members share their answers to the questions did you ever find:
  - That you had the same answer as someone else?
    - (Ask students to raise their hand if they had the same response as another.)
  - That your answer was different than everyone else?
    - (Ask students to raise their hand if they had a response that was different from everyone else.)
- Being a member of the Ocean Discovery family means that you have ideas and experiences that are sometimes similar to others and sometime completely unique and that is awesome! It's great to be part of a family that has similarities and differences!

Introduce Ocean Poster

- Introduce the theme of the week – Fish are Friends.
    - Throughout the week we will learn about fish adaptations, internal and external fish anatomy, fish body shapes, how we can cook fish, and how we can help make a difference in the world and keep fish populations healthy.
- All week we will use this drawing of the ocean and add to it as we add to our knowledge of fish.
    - (Ask a student to add the laminated words "Fish are Friends" to the poster.)
- Each day we will add something to this drawing.
    - Today each of us will add a Fish Egg to the poster with our name on it since today we searched for fish eggs and learned that most fish begin life as a tiny egg.
- (Have each student take a fish egg drawing and write their name on it.)
- (Have each student come up and tape their egg anywhere they want in the ocean.)
    - If time allows students can decorate their egg or you can work together as a group to draw the life cycle of a fish on the Ocean poster.
- Great job today science leaders! I will see you tomorrow to continue learning about fish!



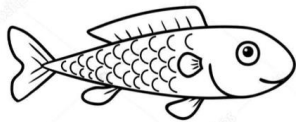
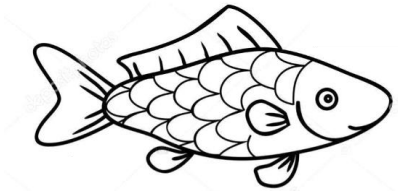
Final Clue

You've put together the puzzle,
now you must use your last muscle.

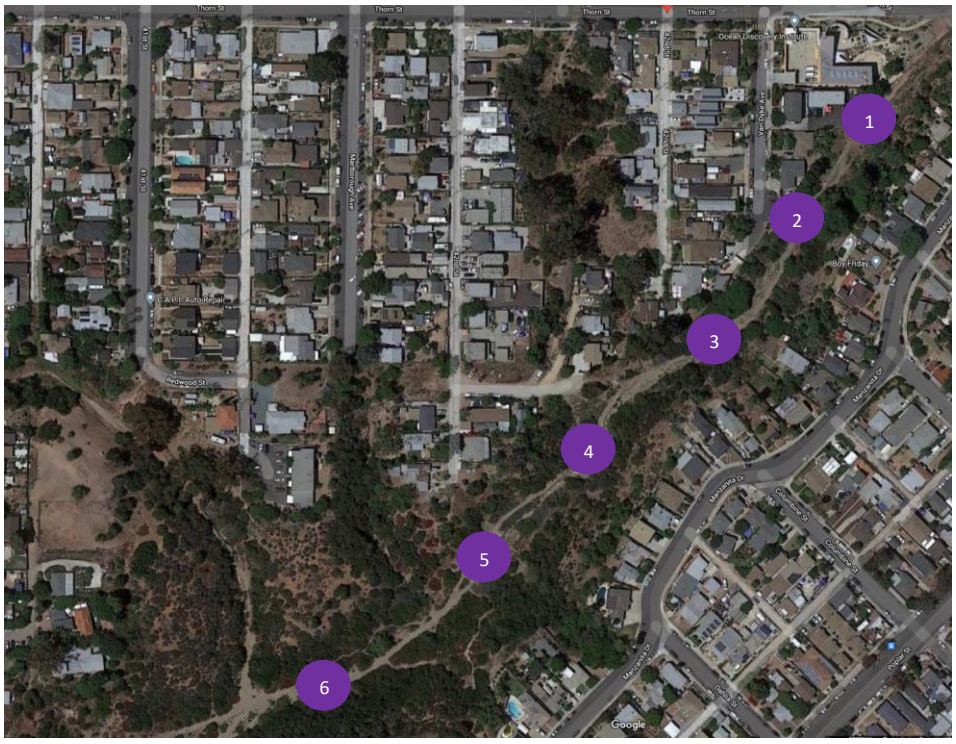
To find the golden statue of the Odi fish,
it's the mascot of Ocean Discovery and
this fish has a wish

To find the statue return to the lab,
it's not much further, don't be a crab.

The Watershed Plaza, this is the place,
where you will find Odi and end this

Fish Fact #1: All fish begin life as an egg. The egg only has a copy of the mother's genetic material. Female fish releases thousands to hundreds of thousands of eggs at a time. Not many of these eggs survive less that 5-25% depending on the species.  It's hard to be an egg!	Fish Fact #4 The fourth stage of life is called: Juvenile. During this time scales and fins grow. A juvenile fish looks a lot like and adult but is smaller and weaker. 	Fish Fact #3 The third stage of life is called: Fry. Fry have eaten all the yolk and are now very small fully formed fish. This is the time in a fish's life when it grows the most rapidly.  Fish fry are not French fries! Remember – fish are friends, not fries!
Fish Fact #5 The final stage of life is called: Adult Now the fish is fully grown and able to reproduce. A female fish can now lay eggs of her own and start the cycle again! 	Fish Fact #2: The second stage of life is called: Larvae. Larvae have their own source of food attached to their body- called the yolk sac. They feed off this yolk until they grow big enough to feed themselves. This phase can last 2-4 days.  A fish's eyes and mouth are still developing during the larvae stage. Weird but cool!	Fish Fact #6 Even though we looked at the life cycle of most fish, there are a few that are different. Some fish (several species of sharks) give birth to live young like people do! These types of fish begin as eggs but get food directly from the mother not from a yolk sac.  Fish can be different in their life cycles but remember: All fish are friends!

Fish are Friends Challenge Map



Feel free to lessen the distance between Fish Fact eggs with younger students or make the distance between greater with older students.

Day 2, 3, or 4: Internal & External Anatomy of Fish

Goal: Students will learn about the internal and external anatomy of fish through a shark dissection.

Technology:

- Large Smart Board with "OS Fish are Friends Camp" PPT loaded to desktop
- If a guest speaker joins - connect a speaker, microphone, microphone stand, and camera.
- If a video will be shown - connect the speaker.

Supplies:

***For one group of 10 students – multiple all supply numbers based on the number of groups expected.**

Visual Materials:

- Ocean Poster (1)
- Labels for Ocean Poster
  - Laminated in a large font "Sharks are Fish!" (1)
  - Large Laminated Shark Drawing Showing External Anatomy (1)
  - Large Laminated Shark Drawing Showing Internal Anatomy (1)
- Word Wall Poster
  - Laminated words:
    - Dissection - to cut open a plant or animal to study its internal body parts

Lab Materials:

- Butcher paper or other to cover tables
- Trash bags for shark disposal (2)
- Dogfish sharks for dissection (2-3)
  - Smaller sizes when possible, ideally some that are male and some female
- Box of gloves (1)
  - Size small for K – 5th
  - Size medium for 6th – 12th
- Dissection tools:
  - K – 2nd: Pointers (3)
  - 3rd – 5th: Pointers (3), scissors (3)
  - 6th – 12th: Pointers (3), scissors (3), scalpel (3)
- Team Lead dissection tools (1/Team Lead + 1/Assistant Team Lead)
  - Scissors (1), scalpel (1)
- Jarred fish (mix of cartilaginous and bony) (5)
- Sharpie (3)

Student Bins:

- Pre-cut shark outlines (1/student)
  - Papi://Curriculum/CI New/OS Fish are Friends Camp/Materials for Fish are Friends Camp

Timing:

Time	Activity	Learning Cycle
9:45a – 9:50a	Introduction	Engagement
9:50a – 10:05a	Science Leader Student Connection	
10:05a – 10:30a	Shark Dissection	Exploration and Guided Analysis
10:30a – 10:40a	Process Reflection	Reflection

Time	Activity	Learning Cycle
2:15p – 2:20p	Introduction	Engagement
2:20p – 2:35p	Science Leader Student Connection	
2:35p – 3:00p	Shark Dissection	Exploration and Guided Analysis
3:00p – 3:10p	Process Reflection	Reflection

Set Up

- Determine which tables Assistant Team Leads will work with during dissection.
- Write daily agenda on white board and set on white board stand
- Set up technology and test for Zoom call with scientist.
    - Check sound.
    - Check that the camera shows as many students as possible.
- Set up visual materials:
    - Open "Fish are Friends Camp" PPT slides and test links for the day.
        - Be sure to move past commercials for any videos.
    - Put up Word Wall Poster and set words for the day at instructor station.
    - Put up Ocean Poster.
- Cover all tables with butcher paper for dissection.
    - Make sure blue tape isn't showing.
- Open and rinse the sharks.
- Place sharks, dissection tools, and trash bags in the back of the lab.
- Place one jarred fish on each table.
- Prep student bins with:
    - a pair of gloves
    - a pre-cut shark outline

Assistant Team Lead Teaching Notes

- Help students to place words on the Word Wall and tape shark outlines to Ocean poster.
- During the Shark Dissection:
  - Pass out and collect animals.
  - Work with students at assigned tables. Potential question include:
    - What do you see/feel?
    - What might that help the shark to do?
    - What do want to know more about/what questions do you have?
- During the Process Reflection you have a **Mentoring opportunity**. Potential questions include:
  - What have you learned about fish so far?
  - What is one thing you have enjoyed doing at camp?
  - Can you think of a time today when you were doing science? What were you doing?

Introduction

Teacher Note: If you aren't familiar with the internal and external anatomy of a shark see Instructor Supplement below.

K-8th grade adaptations:

- One of the main ways to adapt this lesson is through vocabulary and more anatomy. Simpler vocabulary (K-2nd) will be used within the curriculum while more advanced vocabulary will be included in parenthesis (6-8th).

- Review daily agenda on the white board.
- Review the previous day using the Word Wall and Ocean poster. Potential questions include:
  - What did we learn about yesterday?
  - What are some things you have learned about fish so far?
- Today we will continue to learn about our friends' fish by doing a dissection.
  - Define dissection: to cut open a plant or animal to study its internal body parts.
    - (Ask a student to place "dissection" on the Word Wall.)
  - Why would we do a dissection?
    - We are want to learn more about a plant or animal.
    - Today we are going to dissect a shark to learn about the inside (internal) and the outside (external) body parts of fish.
    - Respect the shark you are dissecting as they are helping us to learn more about how the world works and to become science leaders.

Science Leader Student Connection

- Provide an overview of the Science Leader Student Connection portion of the program.
  - Each day will meet virtually with a science leader. This science leader is someone who believes that each of you can do science and be a science leader when you grow up!

- We will learn about their:
  - pathway to becoming a science leader,
  - their job, and
  - their passion for science and fish
- You will also have the opportunity to ask the scientist questions.
  - Brainstorm questions they could ask the scientists ahead of time.
  - Provide curiosity cubes as a backup. Students can ask one of these questions or their own question.

- Introduce Science Leader.
  - Tell the students who they are about to meet (scientist's name) a scientist who (describe what they do in 1-2 sentences).
  - (Connect Zoom Call).
  - (Welcome the Science Leader.)
  - (Conduct the interaction as one would an interview.)
    - Interview tips:
      - You may change the order or modify the questions based on the Science Leader's responses.
      - If a Science Leader is answering a question that may need to be wrapped up, you can move to the microphone which will signal them that you want to speak.
      - After the Science Leader answers a question, in a sentence or two, reaffirm the point they are making or acknowledge how it ties to the students' experience.
    - Interview questions (Asked by Team Lead.)
      - Can you please introduce yourself and tell us a little bit about your job and what you love about it? (2 minutes)
      - Tell us about your pathway to your current job. For example, what got you interested in science, your education, etc. (2 minutes)
      - Have you ever faced an obstacle or challenge in your life that you were able to turn into an opportunity? How did you do that? (2 minutes)
      - Students are exploring and investigating fish this week. Why do you think this work is important? (2 minutes)
    - Student questions:
      - Give two or three students the chance to ask questions.
      - Remind students of the questions they brainstormed earlier.
        - (Point to questions you wrote on the whiteboard.)
  - When time is up, thank the science leader for speaking with you and the students.
  - (Have students say "Thank you!" and all clap for the science leader.)
  - (Disconnect Zoom call.)

Shark Dissection

- <u>Introduction Bony v. Cartilaginous Fish</u>
  - There are a crazy variety of fish in the world. Fish come in many sizes, shapes, and colors.
    - (Show Fish slide.)
  - Often scientists like to group fish with similar characteristics together.
    - One grouping that scientists use is bony fish (Osteichthyes) vs. cartilaginous fish (Chondrichthyes).
    - While both types of fish have many similarities (fins, tails, mouth, etc.) one of the main differences is that bony fish – have a skeleton made of bones and cartilaginous fish have a skeleton made up of cartilage.
      - Describe cartilage (the flexible material that makes up your ears and tip of your nose) and bones (like the bones in your arms and legs).
    - (Show cartilaginous (Chondrichthyes) vs. bony (Osteichthyes) fish slide.)
      - Explain which fish are cartilaginous and which are bony.
      - Explain that most people do not realize that sharks are a type of fish (cartilaginous).
        - (Have a student add "Sharks are Fish!" to the Ocean poster.)
  - (Have students look at jarred fish on their table.)
    - Do you think this is a bony or a cartilaginous fish? Why?
    - (Go around the room and have students share about the fish on their table.)

- <u>Introduce Dissection:</u>
  - Take a closer look at fish through a shark dissection.
  - When we dissect, we are exploring and investigating to learn more.
  - Remind students during the dissection to be their best self:
    - Be curious: ask question, make observations, and share these with others.
    - Be safe: take care with dissection tools which can be sharp or pointy
    - Be respectful: the shark you are dissecting is helping us to learn more about how the world works and to become better scientists, so tread it respectfully.
  - Review potential reactions to dissection: Excited, nervous, etc.
    - Whatever you feel is appropriate.
    - You can take a quick break if you need to but try to hurry back so you don't miss too much exploring.
    - We never say "gross!", instead we day "Oooooohh science!"
  - (Explain how to use dissection tools based on grade level.)
    - K – 2nd: Pointers
    - 3rd – 5th: Pointers, scissors
    - 6th – 12th: Pointers, scissors, scalpel (only to be given to/used by students when an adult is at their table)
  - (Have student put on gloves from their box.)
    - Only one pair of gloves so don't take them off until we are done.
    - Do not touch yourself or others after you have touched the shark even with gloves on.

- <u>External Anatomy</u> (10 min):
  - Explain external shark exploration.
    - Students will have five minutes to explore the outside of the shark.

- They should look at it, touch it, and make some observations.
- Question: what do you think each of the different parts are and what do they do?

▪ (Pass out sharks.)
▪ (Pass out dissection tools.)
▪ (Give students five minutes to explore the shark.)

o Debrief external shark exploration
▪ (Show External Shark Anatomy slide.)
▪ Ask students about their observations and use these to lead into discussion and stories about SOME of the following internal anatomy features (choose a few students seem interested in):
- Senses for sensing predators and prey
  - Eyes/Ojos – for seeing
  - Nostrils/Fosa Nasal – for smell
  - Ampullae of Lorenzini – sense electromagnetic fields
- Mouth/Boca
- Gill slits/Hendiduras branquiales
- Dermal denticles/Dentículos dérmicos
- Tail fin/Aleta de la cola
- Fin spine
- Claspers

- <u>Internal Anatomy</u> (10 min):
  - (Team Lead should cue everyone that it is time to start the Internal Anatomy.)
  - Explain internal shark exploration.
    - Students will have five minutes to explore the inside of the shark.
      - They should look at it, touch it, and make some observations.
      - Question: what do you think each of the different parts are and what do they do?
  - (Show students how to cut open shark.)
    - K – 2nd: open for them
    - 3rd – 5th: Team Lead uses scalpel make two incisions and instructs students how to use scissors to connect the cuts.
    - 6th – 12th: instruct them how to use scalpel and scissors
  - (Pass out dissection equipment.)
    - (Give students five minutes to explore the shark.)
  - Debrief internal shark exploration
    - (Show Internal Shark Anatomy slide.)
    - *Teaching tip: As student name different parts – instructors can write these parts on butcher paper (in English and Spanish when appropriate) and students can place that part next to the writing.*
    - *Ask students about their observations* and use these to lead into discussion and stories about SOME of the following internal anatomy features (choose a few students seem interested in):
      - Heart/Corazón
      - Liver/Hígado

- Stomach/Estómago
- Intestines/ intestinos
- Based on the age of the students identify any pregnant females and cut open the egg to see the babies attached to their yolk sac/saco vitelino.
- Based on the age of the students cut open the stomach and see if there is undigested food.

- Clean-up
  - (Remove all sharks from tables)
  - (Place the sharks in a trash bag and then add a second bag for disposal.)
  - (Have all students remove and dispose of gloves.)
  - (Have students wash hands.)

Process Reflection

- Debrief Dissection:
  - Good job scientists! We learned a lot about some of our fishy friends- sharks!
  - (Have a student tape the "Large Laminated Shark Drawing Showing External Anatomy" on the Ocean Poster.)
    - Ask students to name different parts of the external anatomy they learned and draw arrows to those and label them with a sharpie.
  - (Have a student tape the "Large Laminated Shark Drawing Showing Internal Anatomy" on the Ocean Poster.)
    - Ask students to name different parts of the internal anatomy they learned and draw arrows to those and label them with a sharpie.

- Return to Ocean Poster
  - Ask students what we should add to our ocean poster? – Sharks!
  - Students can choose a shark outline from their bin.
    - Students should write their name on their shark.
    - Encourage students to label some of the parts on the shark and color their shark.
      - (K-2nd color only.)
    - (Give students time to work.)
    - (When a student is finished help them tape their shark to the Ocean Poster.)
    - Review the rest of the roadmap for the week.
- If time allows:
  - Do a think-pair-share: What was your favorite part of the dissection and why?
- Great job today scientists!

Day 2, 3, or 4: Fish Morphology

Goal: Students will learn about how different fish body shapes are adapted for different environments.

Technology:

- Large Smart Board with "OS Fish are Friends Camp" PPT loaded to desktop
  - If a guest speaker joins - connect a speaker, microphone, microphone stand, and camera.
  - If a video will be shown - connect the speaker.
  - *PLAZA DEL SOL LAB ONLY* - connect the lavalier to speaker for team lead.

Supplies:

***For one group of 10 students – multiple all supply numbers based on the number of groups expected.**

Visual Materials**:**

- Labels for Ocean Poster
- Laminated in a large font
  - Laminated words:
    - Morphology – how body shapes are adapted for different environments
- Word Wall Poster

Lab Materials:

- Morphology Activity Card set (5 sets):
  - K – 2nd grade
  - 3rd – 5th grade
  - 6th – 12th grade
    - Papi://Curriculum/CI New/OS Fish are Friends Camp/Materials for Fish are Friends Camp
- Laminated Morphology Cards (10)
  - Papi://Curriculum/CI New/OS Fish are Friends Camp/Materials for Fish are Friends Camp

Process Reflection:

- Pre-cut Fish and Shark Outlines (several different shapes/student)
  - Papi://Curriculum/CI New/OS Fish are Friends Camp/Materials for Fish are Friends Camp

Timing:

Time	Activity	Learning Cycle
9:45a – 9:50a	Introduction	Engagement
9:50a – 10:05a	Science Leader Student Connection	
10:05a – 10:30a	Fish Body Shapes Activity	Exploration and Guided Analysis
10:30a – 10:40a	Process Reflection	Reflection

Time	Activity	Learning Cycle
2:15p – 2:20p	Introduction	Engagement
2:20p – 2:35p	Science Leader Student Connection	
2:35p – 3:00p	Fish Body Shapes Activity	Exploration and Guided Analysis
3:00p – 3:10p	Process Reflection	Reflection

Set Up

- Write daily agenda on white board and set on white board stand
- Set up technology and test for Zoom call with scientist.
  - Check sound.
  - Check that the camera shows as many students as possible.
- Set up visual materials:
  - Open "OS Fish are Friends Camp" PPT slides and test links for the day.
    - Be sure to move past commercials for any videos.
  - Put up Word Wall Poster and set words for the day at instructor station.
  - Put up Ocean Poster.
- For Fish Body Shapes activity:
  - Turn on Ocean Alcove screens and load the below three websites to flip between:
    - Kelp Forest Cam: https://www.montereybayaquarium.org/animals/live-cams/kelp-forest-cam
    - Shark Cam: https://www.montereybayaquarium.org/animals/live-cams/open-sea-cam
    - Shark Cam: https://www.montereybayaquarium.org/animals/live-cams/shark-cam
  - Place a calculator at the front of the room to be used by the Assistant Instructor to get totals for each box on the data chart.
- Place several different pre-cut fish outlines in each student's bin.

Assistant Team Lead Teaching Notes

- Help students to place words on the Word Wall.
- For the Fish Body Shapes activity:
  - Help pass out "Morphology Activity" card sets.
  - Walk around and help students with the activity. Potential questions include:
    - What type of morphology do you think this fish has?
    - How do you think that body type might help this fish survive?
- During the Process Reflection you have a **Mentoring opportunity**. Potential questions:
  - Tell me about the fish you are building.
    - How does it's body shape help it to survive?
    - What kind of place do you think your fish might live based on its body?
  - Can you think of a time today when you were doing science? What were you doing?

Introduction

Teacher Note: If you aren't familiar with "Fish Morphology" see Instructor Supplement below.

- Review daily agenda on the white board.
- Review the previous day using the Word Wall and Ocean poster. Potential questions include:
  - What did we learn about yesterday?
  - What are some things you have learned about fish so far?
- Today we are going to do an activity to see how different fish body shapes are adapted for different environments. This is called morphology.
  - (Give a student the laminated word "morphology" to place on the Word Wall.)

Science Leader Student Connection

- Provide an overview of the Science Leader Student Connection portion of the program.
  - Each day will meet virtually with a science leader. This science leader is someone who believes that each of you can do science and be a science leader when you grow up!
  - We will learn about their:
    - pathway to becoming a science leader,
    - their job, and
    - their passion for science and fish
  - You will also have the opportunity to ask the scientist questions.
    - Brainstorm questions they could ask the scientists ahead of time.
    - Students can ask one of these questions or their own question.
- Introduce Science Leader.
  - Tell the students who they are about to meet (scientist's name) a scientist who (describe what they do in 1-2 sentences).
  - (Connect Zoom Call).
  - (Welcome the Science Leader.)
  - (Conduct the interaction as one would an interview.)
    - Interview tips:

- You may change the order or modify the questions based on the Science Leader's responses.
- If a Science Leader is answering a question that may need to be wrapped up, you can move to the microphone which will signal them that you want to speak.
- After the Science Leader answers a question, in a sentence or two, reaffirm the point they are making or acknowledge how it ties to the students' experience.

▪ Interview questions (Asked by Team Lead):
- Can you please introduce yourself and tell us a little bit about your job and what you love about it? (2 minutes)
- Tell us about your pathway to your current job. For example, what got you interested in science, your education, etc. (2 minutes)
- Have you ever faced an obstacle or challenge in your life that you were able to turn into an opportunity? How did you do that? (2 minutes)
- Students are exploring and investigating fish this week. Why do you think this work is important? (2 minutes)

▪ Student questions:
- Give two or three students the chance to ask questions.
- Remind students of the questions they brainstormed earlier.
  - (Point to questions you wrote on the whiteboard.)

- When time is up, thank the science leader for speaking with you and the students.
- (Have students say "Thank you!" and all clap for the science leader.)
- (Disconnect Zoom call.)

Fish Body Shapes Activity

- Introduction
  - There are a crazy variety of fish in the world. Fish come in many sizes, shapes, and colors.
    - (Show Fish slide.)
  - Today we are going to spend some time looking at how fish have different body shapes (morphology) and adaptations for living in different environments.
    - (Show Dolphin slide.)
    - Example: Dolphins have very streamlines bodies so that can travel through the water easily and can go long distances quickly – good for living along the coast or in the open ocean. Dolphins don't have a great body type for living in the kelp forest.

- Morphology Activity Expectations
  - Today you are going to look at some fish and think about their body shapes (morphology) and where they might live in the ocean based on those body shapes.
  - In a moment you will be given a set of cards.
    - Some cards will be pictures of fish and some cards will give descriptions of body shapes (morphology).
  - Your job will be to match up the fish with its morphology.
    - (Show Morphology Activity Example slide.)

- Ask students: Which body morphology fits which animal?
- How do curved paddle-shaped limbs help a sea turtle?
- How do long, powerful back legs help a grasshopper?

- (In the "Advanced Morphology Activity (6th – 12th grade)" set there are more fish pictures than morphology so some fish will fall under the same morphology.)
- (In both "Morphology Activity" sets fish can have multiple morphologies so there can be more than one correct answer.)
  - Ex. Angel fish: Body Shape: Compressed and Tail fin shape: Rounded.

- Morphology Activity
  - (Divide students into pair and give each pair a set of "Morphology Activity" cards.)
  - (Give students five minutes to work.)

- Debrief Morphology Activity
  - Ask students to share their answers to the activity with a focus on asking students how different morphologies could be beneficial based on where the fish lives. Potential questions:
    - Where does this animal live in the ocean?
    - How does this body shape help them exist in this location?
  - (See Morphology Information for potential answers.)

- Application of Morphology Activity
  - Now we will go and look at some living examples of fish and try to identify some of the body shapes we just learned about.
  - (Give each student a "Morphology Card" to help them identify body shapes.)
  - Take students to locations below and have them try to identify body shapes they have on their "Morphology Card" with living fish.
    - (Group 1: Take students to circle tank for ~5-7 minutes then rotate to the Ocean Alcove to look at Monterey Bay Live cams (Kelp Forest, Shark, and Open Ocean) for ~5-7 minutes.)
    - (Group 2: Look at Monterey Bay Live cams (Kelp Forest, Shark, and Open Ocean) on Ocean Alcove screen for ~5-7 minutes, then take students to circle tank for ~5-7 minutes.)

Process Reflection

- Return to Ocean Poster
  - Ask students what we should add to our ocean poster? – Fish with different body types!
  - Students will get to create their own fish using body parts in their bins.
    - Students can create any type of fish they want to can build one similar to something they saw today.
      - Students should write their name on their fish.
      - Encourage students talk about what kind of environment they think their fish might live in based on its body shape.

- (Give students time to work.)
  - If a student finishes early they can color another fish with a different body shape.
- Share Out
  - Ask 2-3 students to share the fish they created with the rest of the group. Ask the students to describe how their fish's body parts help it to survive.
- Students tape their fish to the Ocean poster.
- Review the rest of the roadmap for the week.
- Great job today scientists!

Fish Morphology Matches

Body Shape:

- **Flat and Thin (Depressed):**
  - Usually bottom dwellers - helpful because these fish can slide under the sand and hide.
  - Examples: Sole, Angel Shark, Sawtooth Shark
- **Compressed**:
  - Typically live in dense coverage areas (i.e., coral reefs, kelp forest, etc.)- similar to the "Flat and Thin" but fish swim normally and allows them to move through narrow spaces.
  - Examples: Angel fish, Pompano
- **Rod (long and thin):**
  - This long and thin body shape is hydrodynamic which means it is a fast swimmer, typically found in the open ocean or edge of kelp forest where there is lots of space to swim quickly.
  - Examples: Barracuda, Needlefish
- **Ribbon (long and snake-like) (Anguilliform):**
  - Habitat: -good for moving among rocks.
  - Examples: Eel
- **Torpedo/football shape (Fusiform):**
  - These types of fish can swim fast for a long time, typically lives in the open ocean.
  - Examples: Tune, Great White Shark

Appendage:

- **Elongated head or rostrum:**
  - This type of fish has a very wide head or beak-like projection that has many electromagnetic sensors for detecting prey hiding beneath the sand.
  - Examples: Hammerhead Shark, Sawtooth Shark

Tail Fin Shape:

- **"C – Shape" (Lunate):**
  - These types of fish have a tail shaped like a large "C", fish with this type of tail are some of the fastest in the ocean and can swim fast for long periods of time.
  - Examples: Great White, Pompano, Tuna, Sailfish
- **Rounded:**
  - These types of fish are usually slower swimmers but are more maneuverable between things like kelp or rocks.
  - Examples: Angelfish, Clownfish,

Day 2, 3, or 4: Fish and Nutrition

Goal: Students learn that fish is a healthy source of protein and how they can easily prepare fish for eating.

Technology:

- Large Smart Board with "OS Fish are Friends Camp" PPT loaded to desktop
  - Virtual guest speaker - connect a speaker, microphone, mic stand, and camera.
  - If a video will be shown - connect the speaker.
  - *PLAZA DEL SOL LAB ONLY* - connect the lavalier to speaker for team lead.

Supplies:

***For one group of 10 students – multiple all supply numbers based on the number of groups expected.**

Visual Materials:

- Ocean Poster (1)

Lab Materials:

- My Plate Poster + easel (1)
- Fish Machaca Recipe Card printed on card stock (1/student)
  - Papi://Curriculum/CI New/OS Fish are Friends Camp/Materials for Fish Are Friends Camp
- Laminated Station Direction cards
  - Papi://Curriculum/CI New/OS Fish are Friends Camp/Materials for Fish Are Friends Camp
    - Fish Station cards
    - Guacamole Station cards
    - Cooking Station cards
- Chef's knife (1)*
  - For staff only. For pre-prepping food.
- Non-stick pan (1)
- Wooden spoon (1)
- Latex gloves (1 pair/student)
  - Size small for K – 5th
  - Size medium for 6th – 12th
- Ingredients Machaca:
  - Tilapia filet (1)
  - Olive oil (2 Tbsp.)
  - Yellow onion (1/2 onion)
  - Tomato (2)
  - Salt (1/4 tsp.)
  - Black pepper (1/4 tsp.)
  - Cumin (1 tbsp)
  - Paprika (1 tbsp)
- Ingredients Guacamole:

- Avocados (2)
- Cilantro (1/4 cup)
- Lime (1)
- Salt (1/4 tsp.)
- Measuring spoons (2 sets)
- Measuring cups (1 set)
- Medium size bowl (3)
- Small bowl (1)
- Tupperware w/ lid (2)
- Fork (1)
- Spoon (2)
- Tortilla chips (1/4 bag)
- Dish soap (1)
- Sponge (2)
- Towels for drying (2)
- Cleaning spray bottle and rag (2)
- Broom (1)
- Dust pan (1)
- Food dicer (2)
- Metal hand juicer (1)
- Small paper sample cups (12)

Timing:

Time	Activity	Learning Cycle
9:45a – 9:50a	Introduction	Engagement
9:50a – 10:05a	Science Leader Student Connection	
10:05a – 10:35a	Nutrition and Cooking Lesson	Exploration and Guided Analysis
10:35a – 10:40a	Process Reflection	Reflection

Time	Activity	Learning Cycle
2:15p – 2:20p	Introduction	Engagement
2:20p – 2:35p	Science Leader Student Connection	
2:35p – 3:05p	Nutrition and Cooking Lesson	Exploration and Guided Analysis
3:05p – 3:10p	Process Reflection	Reflection

Commented [JLN9]: Something like this for safety? https://www.williams-sonoma.com/products/oxo-vegetable-chopper/?catalogId=79&sku=1939016&cm_ven=PLA&cm_cat=Google&cm_pla=Cooks%27%20Tools%20%3E%20Choppers&region_id=697020&cm_ite=1939016_14586774859&gclid=Cj0KCQjwm6KUBhC3ARIsACIwxBhFsmEzdx24xLXv10tvIORuD5pSK0s09rJSZTzko0n55yOGSXxxo3YaAsrnEALw_wcB

Commented [JLN10]: Something like this: https://www.target.com/p/zulay-kitchen-heavy-duty-stainless-steel-lemon-squeezer-silver/-/A-82254846?ref=tgt_adv_XS000000&AFID=google_pla_df_free_online&CPNG=storefront&adgroup=70-5

Commented [JLN11]: Something like this? https://responsibleproducts.com/products/2oz-compostable-portion-cup?currency=USD&variant=31664840212503&utm_medium=cpc&utm_source=google&utm_campaign=Google+Shopping&utm_source=shopping-ads&utm_campaign=&utm_agid=108404678370&utm_term=&creative=479515172310&device=c&placement=&gclid=Cj0KCQjwm6KUBhC3ARIsACIwxBgeXp3iWS8007yITiVvuq0Lufq78lewDcTyH60sV7fG4j-xNrmt3sQaAsbTEALw_wcB

Set Up

- Write daily agenda on white board and set on white board stand
- Set up technology and test for Zoom call with scientist.
  - Check sound.
  - Check that the camera shows as many students as possible.
- Set up visual materials:
  - Open "OS Fish are Friends Camp" PPT slides for the day.
  - Put up Word Wall Poster and set words for the day.
  - Put up Ocean poster.
- For Nutrition & Cooking Lesson activity:
  - Wipe down surfaces
  - Clean and sanitize all kitchen supplies
  - Peel and cut an onion in fourths - preserve half of the onion for another day.
  - Wash and dry tomatoes and cilantro.
  - Cut tomato into ¼ and place into a bowl in the fridge.
  - Cut lime in half.
  - Rinse and pat dry fish. Dice fish into 2-inch cubes, place in Tupperware, place in the fridge.
  - Cut 2 avocados in half (leave pit inside) place in sealed Tupperware in the fridge.
  - Cut bell pepper in half (leave seeds inside), place in the fridge.
  - Set up Fish Station:
    - Fish Station direction cards
    - All spices, sample cups, tortilla chips, small bowl, balance (to measure weight of fish) set of measuring spoons, paprika, cumin, salt, and pepper. May need small bowl for each spice.
    - Onion, tomatoes, bell pepper, food dicers, and three bowls
  - Set up Guacamole Station:
    - Guacamole Station direction cards
    - Fork, medium bowl, hand juice squeezer, cilantro, lime, butter knife food dicer, cutting board, salt, set of measuring spoons.
  - Set up Cooking station:
    - Cooking Station direction cards
    - Pan, oil, spatula

Assistant Team Lead Teaching Notes

- Help students to place words on the Word Wall.
- During the Nutrition & Cooking Lesson activity:
  - Monitor students for safe behavior.
  - Stay at the Dicing Station to monitor students using the food dicer.
  - Show students how to properly clean and dry dishes.
- During the Process Reflection, you have a **Mentoring opportunity**: Potential questions:
  - Do you think you might try cooking fish yourself or with your family?
  - Did you enjoy cooking today? Why or why not?
  - What have you learned about fish so far?
  - Can you think of a time today when you were doing science? What were you doing?

*****Instructor Note: Students will be consuming fish during this lesson. The Program Coordinator should communicate with you about student allergies.***

Introduction

- Review daily agenda on the white board.
- Review the previous day using the Word Wall and Ocean poster. Potential questions include:
    - What did we learn about yesterday?
    - What are some things you have learned about fish so far?
- Today we are going to learn about how fish can help support healthy bodies and how we they can be prepared to eat.

Science Leader Student Connection

- Provide an overview of the Science Leader Student Connection portion of the program.
    - Each day will meet virtually with a science leader. This science leader is someone who believes that each of you can do science and be a science leader when you grow up!
    - We will learn about their:
        - pathway to becoming a science leader,
        - their job, and
        - their passion for science and fish
    - You will also have the opportunity to ask the scientist questions.
        - Brainstorm questions they could ask the scientists ahead of time.
        - Students can ask one of these questions or their own question.
- Introduce Science Leader.
    - Tell the students who they are about to meet (scientist's name) a scientist who (describe what they do in 1-2 sentences).
    - (Connect Zoom Call).
    - (Welcome the Science Leader.)
    - (Conduct the interaction as one would an interview.)
        - Interview tips:
            - You may change the order or modify the questions based on the Science Leader's responses.
            - If a Science Leader is answering a question that may need to be wrapped up, you can move to the microphone which will signal them that you want to speak.
            - After the Science Leader answers a question, in a sentence or two, reaffirm the point they are making or acknowledge how it ties to the students' experience.
        - Interview questions (Asked by Team Lead):
            - Can you please introduce yourself and tell us a little bit about your job and what you love about it? (2 minutes)
            - Tell us about your pathway to your current job. For example, what got you interested in science, your education, etc. (2 minutes)
            - Have you ever faced an obstacle or challenge in your life that you were able to turn into an opportunity? How did you do that? (2 minutes)

- Students are exploring and investigating fish this week. Why do you think this work is important? (2 minutes)
- Student questions:
  - Give two or three students the chance to ask questions.
  - Remind students of the questions they brainstormed earlier.
    - (Point to questions you wrote on the whiteboard.)
- When time is up, thank the science leader for speaking with you and the students.
- (Have students say "Thank you!" and all clap for the science leader.)
- (Disconnect Zoom call.)

Nutrition and Cooking Lesson

- Nutrition:
  - Today we are going to talk about how Fish are Friends in helping all of us have healthy bodies.
  - Fish are a good source of protein.
    - (Show My Plate poster and point to protein.)
    - Protein is found throughout your body, in muscle, bone, skin, hair, etc.
    - Fish is the primary source of protein for ~3 billion people in the world.
      - Largest traded food commodity in the world.
  - Protein comes in many forms like meat (chicken, pork, beef, etc.), dairy (milk, cheese, etc.), beans, and fish!
  - Fish is a great way to get the daily protein you need because it is low in saturated fats, low in sodium, and contains vitamins and omega-3 fatty acids which are good for your heart!
  - We will have a cooking lesson today to learn a healthy and delicious way to prepare fish for eating.
  - Remind students to be their best self:
    - Be curious: ask questions.
    - Be respectful: be patient, always be looking for ways to help others.
    - Be safe: watch out for any sharp blades, be very careful of hot items like the stove (even after it has been shut off), always walk.
  - You will each be assigned to a station and a role at that station.
    - When you get to your station the tools and directions will be there.
    - Follow the directions carefully

- Cooking lesson:
  - (Walk your group to the kitchen.)
  - (Have all students wash their hands0
  - (Have all students put on food prep gloves.)
    - Remind students not to touch their faces or anything else while wearing the gloves.
  - Fish Station: Measure out fish and spices, cut bell peppers and onions using vegetable chopper**– Monitored by Assistant Team Lead.**
    - Student 1– Measure out ½ pound of fish
    - Student 2 – chop ½ onion
    - Student 3 – remove all seeds and stem of bell pepper

  - Student 4 – Cut bell pepper into chopper
  - Student 5 – Measure 1 tablespoon of cumin, measure 1 tablespoon of paprika
  - Student 6 – Measure ¼ teaspoon of salt & ¼ teaspoon of pepper
  - (Can wait until the cooking starts) Student 7 – lay out 20 small paper cups & Student 8 – place 2 tortilla chips into each cup
- Guacamole Station: Make guacamole **– Monitored by Team Lead.**
  - Student 1 & 2: Scoop avocado out into a bowl
  - Student 2: Scoop out second avocado out into a bowl
  - Student 3&4: Chop 1 piece of tomato in the chopper
  - Student 5: Chop 1 piece of onion inside the chopper
  - Student 6: Squeeze half of a lime into the avocado bowl. Repeat for the other half
  - Student 7: pluck off cilantro leaves & place onto cutting board
  - Student 8: use butter knife to cut cilantro leaves into small pieces
  - Student 9: measure 2 teaspoons of salt
  - Student 10: mix it all up!
- Cooking Station:
  - (Gather all students around stove.)
  - Remind students to be their best self:
    - Be curious: Ask questions.
    - Be respectful: switch places from time to time with someone to allow them to see better.
    - Be safe: Hand away from the stove top, do not reach over the stove, etc.
  - (Ask students questions as they work to prep the fish.)
- Cooking:
  - Team Lead:
    - Explain that while we are cooking we will also start doing dishes so that we have a clean kitchen when we are done.
    - Let students know that everyone will help with dishes.
  - Assistant Team Lead:
    - ****STUDENTS DO NOT CLEAN THE FOOD DICERS.**
    - Take three students to dish area and have them clean AND dry:
      - Dishes from Dicing Station & Guacamole Station
      - Once complete have them return to the cooking area.
  - Team Lead: Turn on stove to medium heat.
  - Student 1: Measure olive oil into pan.
    - Potential questions:
      - Why do we put oil in the pan? – prevent sticking
      - Why do we give the oil time to heat up? – if you don't allow oil to heat up it will quickly be absorbed in one place by whatever you put into the pan and won't work to prevent sticking anymore.
  - Student 2: Place onions and bell pepper into pan and move around with wooden spoon.
    - Potential questions:
      - What is this called in cooking? – sautéing
      - How do we know when onions are ready? – get slightly soft and look transparent.

- Team Lead:
  - Show students the diced fish.
  - Tell the students what kind it is and if they can find it at their local market.
  - Explain that we purchased it as a filet without the skin attached but that fish can be bought in many forms.
  - Explain that we diced up the fish with a knife into small cubes.
- Student 3: Once the onions look a bit translucent, add the pieces of fish and mix all together
- Assistant Team Lead:
  - Take three different students to dish area and have them clean AND dry:
    - Any dishes that are no longer being used.
    - Allow students to return to cooking area when this is done or when food is being eaten.
- Student 4: Pour in all the spices to machacha and stir into onions, bell pepper and fish.
  - Encourage this student to break up the fish a bit using the edge of the wooden spoon.
- Team Lead:
  - Once fish is cooked through turn off the heat.
  - Scrap the machacha into a clean plastic bowl.
- Student 5: Take a spoon and place a scoop of machacha on each tortilla chip.
- Student 6: Follow student 6 and place a spoonful of guacamole on top of machacha.

- Eating
  - ****BE AWARE OF STUDENTS WITH ALLERGIES** (The Program Coordinator should communicate food allergies on Day 1.)
  - Have each student take a sample container and eat.
  - If there is left over machacha and guacamole divide it among the students.

- Cleaning:
  - Assistant Team Lead:
    - Take the final students who haven't done dishes to dish area and have them clean AND dry:
      - All remaining dishes (except the food dicers).
  - Team Lead:
    - Give a rag and spray bottle to two students to wipe off all tables.
    - Give a broom and dustpan to two students to sweep the kitchen area.

Process Reflection

- Debrief:
  - (Return to you Introduction space for Debrief.)
  - Ask students about their experience.
    - Did you enjoy the fish?
    - Did you enjoy cooking? Why or why not?
    - Do you think you would want to make this recipe with your family?

- If you would like to try this recipe at home with family or friends, you have this recipe located in your journal, you can take the next couple of minutes to decorate your recipe card.

Fish Machaca Recipe

- 2 Tbsp. oil
- 1 Filet of tilapia or fish of your choice cut into 6-8 strips
- 1Tbsp. Cumin
- 1Tbsp. Paprika
- ¼ tsp. Salt
- ¼ tsp. Pepper
- ½ Cup of diced onion
- 1 Cup of chopped tomatoes

Directions: Heat oil in a pan over medium heat. Add onion, tomatoes, salt, and pepper. Sauté until onions are translucent. Add in fish and sprinkle everything with cumin and paprika. Stir to combine. Break up fish using a spatula until fish is shredded. Once fish is cooked through take off the heat and serve in taco shells or with chips.

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Dicing Station

Goal: Cut tomatoes and onions using vegetable chopper.

Student 1: Dice ½ onion and place into plastic bowl.

Student 2: Dice a tomato and place into another plastic bowl.

Student 3: Dice another tomato and place into another plastic bowl.

Guacamole Station

Goal: Make guacamole.

Student 1: Remove avocados from peel.

Student 2: Smash avocados in a plastic bowl using a fork.

Student 3: Pick ¼ cup of cilantro leaves off plant and chop in food dicer, then place into bowl with mashed avocado.

Student 4: Squeeze the juice from one lime into mashed avocado, add salt using measuring spoons, and mix to create guacamole.

Prep Station

Goal: Prepare spices for cooking fish and cups for eating.

Student 1: Lay out a small paper cup with a single tortilla chip for each student in your group.

Student 2: Measure out cumin, paprika, salt, and pepper using measuring spoons into small bowl.

Day 5: Make a Difference

Goal: Students will learn how they can help protect fish and share conservation messages with their families.

Technology:

- Large Smart Board with "OS Fish are Friends Camp" PPT loaded to desktop
  - If a guest speaker joins - connect a speaker, microphone, microphone stand, and camera.
  - If a video will be shown - connect the speaker.
  - *PLAZA DEL SOL LAB ONLY* - connect the lavalier to speaker for Team Lead.

Supplies:

***For one group of 10 students – multiple all supply numbers based on the number of groups expected.**

Visual Materials:

- Ocean Poster
- Word Wall Poster
  - Laminated words:
    - Make a Difference – making the world a better place

Lab Supplies

- Magnetic Fishing poles (5)
- Magnetic Fish (70)
- Wading pool (1)
- Small white board (5)
- Dry erase marker (5)
- Whiteboard eraser (5)
- Piece of butcher paper 6 feet tall (1)
- Pencils (10)
- Magic Markers in a variety of colors (20)
- Paper $100 bills (70)
- Paper $50 bills (10)

Process Reflection:

- Pre-cut Odi w/thought bubble
  - Papi://Curriculum/CI New/OS Fish are Friends Camp/Materials for Fish are Friends Camp

Timing:

Time	Activity	Learning Cycle
9:45a – 9:55a	Introduction	Engagement
9:55a – 10:15a	Fishing Game	Exploration
10:15a – 10:35	Make a Difference: Conservation Messages	Guided Analysis
10:35a – 10:40a	Process Reflection	Reflection

Commented [JLN12]: I know we are trying to get away from plastic but I think this might be worth the investment as we would use it every year we do Fish are Friends camp and I think the kids would really enjoy it. Thoughts?

You would need 10 sets of these. https://www.amazon.com/Magnetic-Fishing-Floating-Animals-Toddlers/dp/B09LM2J992/ref=sr_1_6?gclid=Cj0KCQjw-JyUBhCuARIsANUqQ_IdiGv9_vrWSiLGwCsy10sNWQIO45N_qYYpFvjj1h8CXh5FYfMbKnAaAgiXEALw_wcB&hvadid=409943095836&hvdev=c&hvlocphy=9031329&hvnetw=g&hvqmt=e&hvrand=11924476062289081867&hvtargid=kwd-39622308513&hydadcr=4096_11139251&keywords=magnet+fishing+toy&qid=1653079249&sr=8-6

Commented [JLN13]: Something like this or maybe we could use the ROV pool? https://www.target.com/p/wading-kiddie-pool-blue-sun-squad-8482/-/A-77334694?ref=tgt_adv_XS000000&AFID=google_pla_df&fndsrc=tgtao&DFA=71700000012767052&CPNG=PLA_Sports%2BShopping_Local%7CSports_Ecomm_Hardlines&adgroup=SC_Sports_Local&LID=700000001170770pgs&LNM=PRODUCT_GROUP&network=g&device=c&location=9031329&targetid=pla-332213662220&ds_rl=1246978&ds_rl=1248099&gclid=Cj0KCQjw-JyUBhCuARIsANUqQ_J8cmeUWoPFU6ltiOrxYFr1bUQQGquo6r8NczyWAb2WZD-di_bJL60aAvlTEALw_wcB&gclsrc=aw.ds

Time	Activity	Learning Cycle
2:15p – 2:25p	Introduction	Engagement
2:25p – 2:45p	Fishing Game	Exploration
3:45p – 3:05p	Make a Difference: Conservation Messages	Guided Analysis
3:05p – 3:10p	Process Reflection	Reflection

Set Up

- Write daily agenda on white board.
- For Fishing Game:
  - Fill up wading pool about ½ way full of water.
  - Place 70 magnetic fish in the pool.
  - Place fishing poles and small dry erase boards, markers and erasers off to the side.
- For Conservation Message:
  - Cut a piece of butcher paper for your group that is six feet tall.
  - Hang the butcher paper up in a location where all students will be able to reach it and draw on it.
- For Process Reflection:
  - Place a pre-cut "Odi thought bubble" into each student bin.

Assistant Team Lead Teaching Notes

- Help students to place words on the Word Wall.
- For Make a Difference Day Activity:
  - Help monitor students at the fishing hole – remind them to be respectful.
  - Potential questions:
    - What do you and your partner want to do differently next round? Why?
    - What do you think caused the fish population to crash?
- During Conservation Message:
  - Help students who are struggling to come up with a message. Potential questions include:
    - What do you think it's important for people to know about fish?
    - What was something you learned this week about fish?
- During Process Reflection:
  - While the Team Lead is running the Process Reflection, the Assistant Team Lead should take the mural to the Watershed Plaza and hang it on the back wall so that all the murals are together to create one large mural and it is ready for family celebration.

Introduction

- Review daily agenda on the white board.
- Review the previous day using the Word Wall and Ocean poster. Potential questions include:
    - What did we learn about yesterday?
    - What are some things you have learned about fish this week?
- This week we have learned a lot about fish, their internal and external anatomy, their ability to help keep our bodies healthy and about their body shapes.
- Today we will wrap up Fish are Friends camp but learning how we can Make a Difference in the world.
    - As science leaders it is important that we not only learn science, but we also take that information and try to make a difference in the world.
    - Reference any science leaders they met throughout the week that are making a difference.
        - (i.e., Remember (scientist's name) who we talked to on Zoom? They are studying _____ and helping to make a difference by _____.)
    - At Ocean Discovery we believe that all young people can make a difference right now and in the future.
    - (Give a student the laminated words "Make a Difference" to place on the Word Wall.)

Fishing Game

- Introduce Fishing Game
    - We are going to play again about fishing.
    - Each of you will be a fisherman. While there are many ways to catch fish in the ocean, today everyone will be using a fishing rod to catch fish.
        - (Show students fishing rod.)
    - As a fisherman your job is to fish – it is how you make money to support yourself and your family.
    - Review expectations.
        - (Show Expectations slide.)
        - You and a partner will be a fishing team.
        - Only one partner will fish each round the other partner will hold the fish that are caught.
        - Each fish you catch will earn you $100.
        - Each night, after the day's fishing is over, the remaining fish in the pool will reproduce.
            - They will reproduce 20% of the remaining number of fish.
                - Example: if at the end of the day there are 15 fish left (20% of 15 is 3), so the instructor will place 3 additional fish in the water. If at the end of the day there are 35 fish in the water (20% of 35 is 7) so the instructor will place 7 more fish in the water.
        - Each day before you fish, you and your partner will discuss how many fish you want to catch.
            - Once you decide you cannot catch more than that.
            - The highest limit you can catch is 14 fish.

- Be your best self when playing.
  - Be respectful – you are fisher people – do not try to knock other fisher people's fish off their lines.
- We will play several rounds so both partners will get to fish.

- <u>Play Fishing Game</u>

Students should observe/understand:
- If they overfish the fish population will be unable to reproduce and will crash.
- Encourage students to find a way (fishing every other day, only fishing for 1-2 fish/day, etc.) to make the population sustainable (not just slow down the crashing).
- The goal of the game is for students to understand communication is key to keeping fish populations healthy. Scientists study fish populations and work with fisherman to determine how many fish it is possible to catch while keeping the population stable and allowing fisherman to make a living.
  - Older students may understand this concept quickly and adjust their methods. Younger students may need some scaffolding. Potential questions after Round 1:
    - What happened to all the fish?
    - If there are no fish left, can more fish be made?
    - What could we do differently in order to make sure we leave some fish behind to reproduce?

- (Pair up students and give each pair a fishing pole.)
- (Have all students gather around the pool.)
- Remind students:
  - Each fish they catch will earn them $100.
  - The highest number of fish they can catch is ten.
  - Whatever fish are left at the end of the fishing day will reproduce.
- During the game:
  - <u>Round 1:</u>
    - Give each fishing pair 30 seconds to decide on the number of fish they are going to catch and write it on their board.
    - They may only talk to their partner and no one else.
    - Have all groups show the number they are going to fish for.
    - Give students three minutes to fish.
    - When three minutes is up have students remove their fishing poles, count the number of fish they caught.
    - Have them hand you the fish and tell them the amount of money you are paying the.
    - Look at the number of fish left in the pool.
      - If there are fish remaining calculate what 20% is and add those fish to the pool.
      - If there are no fish remaining do not add any more.
      -

- Round 2:
  - Repeat the above steps but students will quickly realize there are no fish or very few fish to catch.
  - Explain to students they have overfished and crashed the fish population. With no fish left they will not be able to reproduce to keep the population going.
- Play again:
  - Repeat round 1 steps but this time allow students to talk to one another (if they want to) when deciding how many fish to catch.

6th – 12th grade adaptation
- Start the game by paying students $50 a fish.
- After a few rounds when they figure out how to regulate the population by catching less – tell student that since there are less fish available people are willing to pay more for fish so they are going to be paid $100 per fish.
- Discuss the economic concept of supply and demand.

- Debrief:

Students should observe/understand:
- The importance of fisheries management in keeping fish populations healthy.
- Fisheries management is a job where people use science (like monitoring fish populations and methods of fishing) to determine rules/laws that should be in place to keep fish populations sustainable.

  - Potential questions include:
    - What did you learn from this game?
    - Why is it important for fishermen and scientists to work together?
    - How could you make a difference in the future as a science leader?

Make a Difference: Conservation Messages

- Review Making a Difference Today:
  - Now is our opportunity to make a difference in the world by sharing our knowledge with others.
  - You have the opportunity to share what you know with family and friends.
  - Today, several families will visit the Living Lab to hear about your week at camp.
  - We will create a mural to share our knowledge about the importance of fish and how we might help protect fish through art.
  - Remember we want everyone to know – Fish are Friends!
  - Quickly review what students have learned all week.

- K – 2nd Grade Students:
  - Work together to decide on one conservation message to place in the center of the butcher paper (to be written by Team Lead).
    - Ask students: What would you want people to know about how they could help conserve fish?
  - All students will decorate the conservation message by drawing fish, decorating, etc.
- 3rd – 12th Grade Students:
  - Students will create individual conservation messages.
    - Ask students: What would you want people to know about how they could help conserve fish?
    - Remind students that we have limited space so their conservation message should be short.
  - Do a Think-Pair-Share: What message do you want to share about the importance of fish and helping to protect fish?
    - They can draw a fish and write the conservation message inside the fish, outside the fish, as a thought bubble from the fish, etc.
  - All students will take markers and add their conservation message and fish to the mural.

Process Reflection

- Return to Ocean Poster
  - As scientists this week we have learned so much about fish and how important fish are.
    - (Point to poster.)
  - Today we learned some ways we can make a difference today, by sharing our knowledge with others (conservation messages) and make a difference tomorrow by becoming scientists who help regulate the fishing industry so our fish populations can stay healthy.
  - Do you think there are other ways that humans can help protect fish?
    - Have students brainstorm other ways humans can protect fish.
  - (Give each student an Odi thought bubble)
    - Ask each student to share how people can make a difference to protect fish and to write that idea in a thought bubble.
  - Have each student come up and tape their thought bubble on the poster.
  - Great job science leaders!

Instructor Supplement

Fish Morphology

Common Angel Shark
Body Shape: Flat
Diet: Ambush predator (lies on bottom camouflaged waiting for prey).
- Fish, crustaceans, mollusks

Adaptations:
- Camouflage for hiding
- Flat body for staying buried and hidden while waiting for prey

Great White Shark
Morphology: Body Shape: Fusiform; Tail-fin shape: Lunate
Adaptations:
- Body shape- torpedo like for fast swimming to catch prey
- Counter shading – dark on top/light on the bottom, if a form of camouflage – blend with the ocean bottom when seen from above and blend in with the sky/clouds when seen from below.

Great Hammerhead Shark
Morphology: Appendage: Elongated head or rostrum
Diet: Stingrays, sharks
Adaptations:
- Large hammer-shaped head – more Ampullae of Lorenzini- for better detection of stingrays hiding under the sand
- Large hammerhead – can be used to pin down prey.
- Eyes far apart- give a wider field of view

Ornate Wobbegong
Diet: Bottom dwelling invertebrates- ambush predator
Adaptations:
- Flat body to more easily lie on bottom camouflaged waiting for prey.
- camouflage – blend in with the ocean floor while waiting for prey to swim by

Pelagic Thresher Shark
Diet: Small fish and squid
Adaptations:
- Tail- uses tail like whip to stun fish for eating

Smalltooth Sawfish
Diet: Fish, shrimp and crabs.
Adaptations:
- Long rostrum – lots of Ampullae of Lorenzini for detecting prey under the sand
- Long rostrum – used to slash through schools of prey to stun or kill them

Shortfin Mako Shark
Diet: Tuna, mackerel and swordfish.
Adaptations:
- Streamlined body: For speed and catching prey. Fastest species of shark

- Counter shading – dark on top/light on the bottom, if a form of camouflage – blend with the ocean bottom when seen from above and blend in with the sky/clouds when seen from below

Eel
Body shape: Ribbon (Long, skinny, snake-like) – helpful because it can maneuver amongst rocks where it lives.
Adaptations:

- Camouflage: Body coloration matches rocks
- Teeth: Eels are carnivores – sharp teeth good for tearing up prey

SHARK ANATOMY

External Structures

- **Integument (skin/protective covering)**- hold sharks together, site for muscle attachment, protection against abrasion/infection, aids in hydrodynamic efficiency (aids in swimming), it does not allow water and ions to flow through, but does allow gases such as oxygen to flow through.
- **Color** is usually grays, browns, and blues, **countershading** is important since it can be used to camouflage to "hide" from their prey. Since the top of their body is darker it looks like the bottom or the water from above and from below their light bellies makes it hard to differentiate between them and the surface of the sun.
- **Dermal denticles**, very similar to teeth they (evolved from teeth) placoid scales do not increase in size as the shark grows, rather new scales are added in between older scales. It feels like sandpaper.
- **Fins-**used for stability, propulsion, communication, reproduction
- caudal (tail): used for propulsion-it moves side to side.
- dorsal: used to keep shark from tipping side to side (may have 1 or 2).
- pectoral: paired fins used for turning, changing direction.
- pelvic: paired fins used for stability (like a rudder).
- anal: used to keep shark from tipping from side to side.
- **Claspers**-male sharks only, used for internal fertilization. These transfer sperm into the reproductive tract of the female.
- **Jaws**: entry point for food and water, open and shut, clumsy, usually subterminal (interior) mouths, replaceable teeth used for gripping and tearing prey, some sharks and rays are filter feeders which take water or sediment into their mouths and pass it over their gills where the food gets trapped, these species have terminal mouths.
- **Eyes** are used to detect movement, color changes, predators, prey, companions, design of eye is different than those in terrestrial organisms due to air/water interface, sharks are often nocturnal predators and have developed guanine platelets behind their retinas to aid in reflecting light for increased night vision, this is why shark eyes often seem to "shine".
- **Nostrils**: olfactory sense strong in sharks, smell more accurate than taste, detects negative stimuli, they are closed of at the end because they are only used for smelling, not breathing.
- **Taste**: sensors may be located inside and outside of mouth (barbels, fin tips, body), used to detect food, noxious substances.
- **Ampullae of Lorenzi**: cells used in electroreception located on the head, snout, and mouth, similar to the hair cells found in the lateral line these nerve cells fire in pit organs: scattered throughout the body these cells are used for detecting water displacement similar to the function of the lateral line in fishes.
- **Lateral line**: row of microscopic organs sensitive to changes in the surrounding water pressure, enabling the shark to detect minor vibrations.

Internal structures

- **Heart**: pumps blood throughout circulatory system (heart to gills to become oxygenated to body to heart), heart size in sharks is small compared to other vertebrates.
- **Muscles**: red (aerobic (with oxygen)/sustained (for normal activity)), white (anaerobic (without oxygen) /burst (when there is high activity and less oxygen present)), usually distinctly separate.
- **Gills**: respiratory organs, most sharks have five gill slits.

- **Kidneys**: ion concentration in sharks is slightly greater than that of seawater, and therefore they do not need to excrete large amounts of salts like marine fish, they achieve this concentration by increasing the amount of organic compounds (urea and TMAO) in their tissues, kidneys are still important for removing waste.
- **Liver**: sharks have exceptionally large livers that hold large amounts of light oil, these oil stores act much as the swim bladder in fish does and helps sharks to maintain neutral buoyancy in water. This oil is lighter (less dense) than water.
- **Digestive system**: stomach, intestines, used for digestion, food absorption.
- **Nervous system**: sharks have small brains compared to other vertebrates, but similar design.
- **Gonads**: ovaries (female)/testes (male), used for reproduction, claspers used for internal reproduction.
- There are three types of reproduction: oviparous, ovoviviparious, viviparous.
- oviparous: lay eggs that hatch outside the mother's body.
- ovoviviparous: retain the fertilized eggs in the oviduct where they develop and are born after they hatch .
- viviparous: the young develop within the uterus.

BONY FISH ANATOMY

External Structures

- **Integument (skin)**: holds fish together, site for muscle attachment, protection against abrasion/infection, allows gases such as oxygen to pass through.
- **Scales**: modern fish have cycloid/ctenoid scales, lightweight, overlapping for increased flexibility, evolved from plate-like armor in ancient fish, scales can **regenerate** (grow back), provide protection from abrasion/infection/predators.
- **Fins**: used for stability, propulsion, communication, reproduction.
- caudal (tail): used for propulsion, many different types of caudal morphologies.
- dorsal: used to keep fish from tipping from side to side (have 1 or 2).
- pectoral: paired fins used for turning, changing direction.
- anal: used to keep fish tipping from side to side, sometimes have reproductive uses.
- **Color:** important in social roles, communication, mimicry, disguise, camouflage, physiological importance.
- **Jaws**: entry point for food and water, different morphologies evolved for different life histories, different teeth also for different feeding strategies (canine/rockfish, villiform/mackerel, molariform/bat ray), filter feeders consume very small prey whereas hinged jaws like sharks consume very big prey.
- **Eyes:** used to detect movement, color changes, predators, prey, companions, design of eye is different than those found in terrestrial organisms due to the air/water interface, focusing is done by changing the distance between the lens and the retina.
- **Nostrils**: smell more accurate than taste, detects negative stimuli.
- **Taste:** sensors may be located inside and outside of mouth (barbels, fin tips, body), used to detect food, noxious substances.
- **Lateral Line:** used to detect vibrations in the water that may originate from predators, prey, schoolmates, or inanimate objects, this is how fish school, find prey, etc.

Fisheries Management

An Overview of Fisheries Management (NOAA): https://www.fisheries.noaa.gov/insight/understanding-fisheries-management-united-states