Introduction to Research

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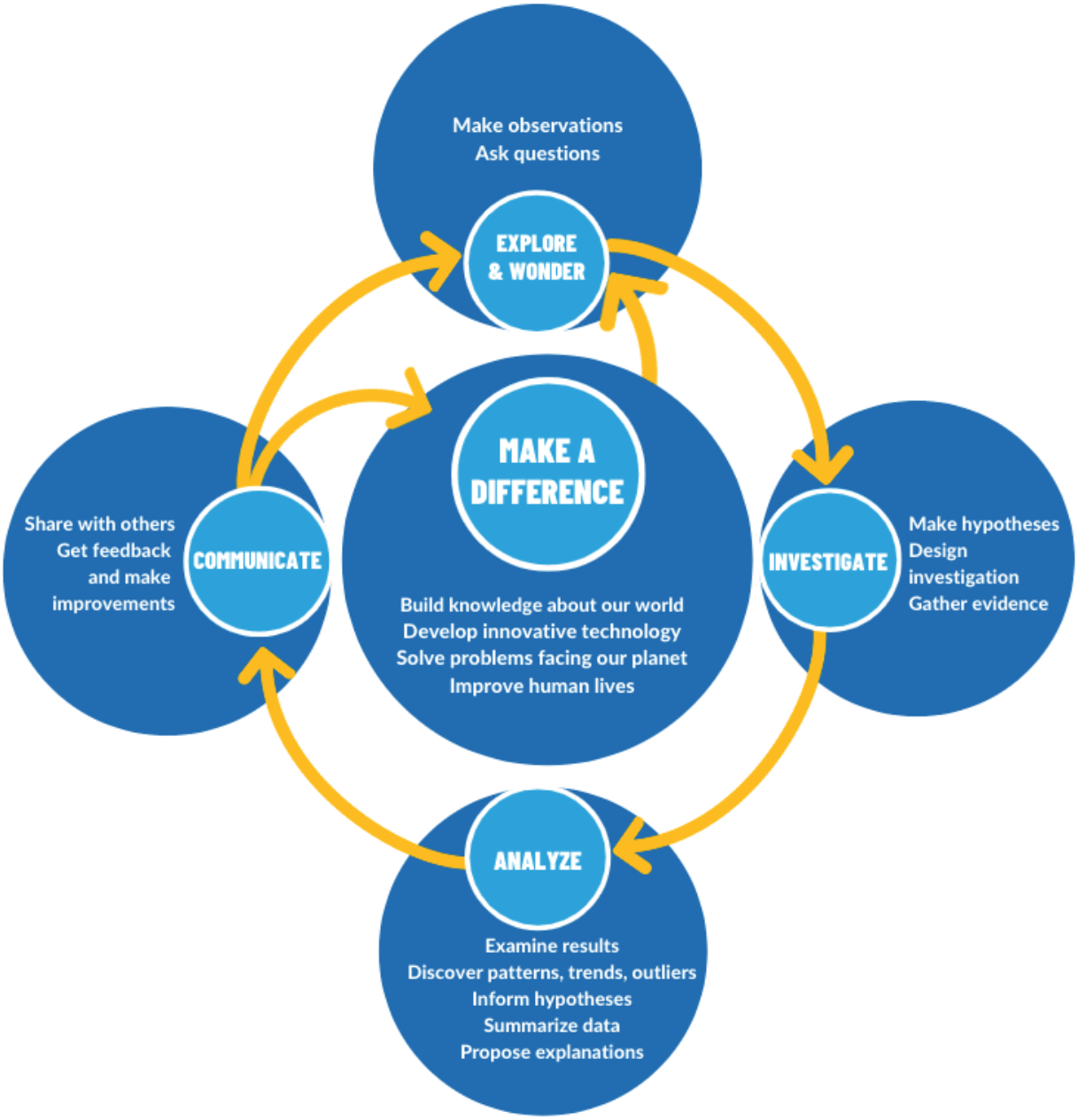
Introduction to Research Program Overview

Program Goals

- Students experience all aspects of the Science Discovery Process firsthand.
- Students can name and describe all parts of the Science Discovery Process.
- Students learn and utilize a series of tools to support a growth mindset.

Science Discovery Process



Ocean Leader Intro to Research Story

We have been Ocean Leaders for over a year now, and it's time to embark on our biggest adventure yet! This summer we travel to Bahía de los Àngeles in Baja, California, Mexico to eat, sleep, and live at a field station and experience how scientific research works by participating in community research projects.

Each day starts with getting to know my Ocean Discovery community of peers, staff, and mentors better. We eat breakfast together, discuss a daily question, and do a team building activity. After breakfast we have a short lecture, and the rest of the morning is research, research, research! Whether we take off from the field station in a van or a boat, I know we are going to experience something amazing and learn about ways people in the community are working to make a difference in the world. One day we swim with whale sharks and learn how the community has been tracking these giant creatures for over a decade, one day we visit a local island and collect data about cactus and indigenous spiders, one day we head to a pristine wetland to work with Mujeres Con Alas, a group of women, who have been monitoring the bird populations in Bahía for almost a decade, and that's just a few of the research projects we work on. When we are out in the field, we see all kinds of wildlife! Dolphins, sting rays, ospreys, and scorpions, and did I already mention… whale sharks!

After returning from a full morning of research and eating a tasty lunch, we have Siesta, a time for me to take a moment for myself for reading, writing, or resting, followed by Salud, a time to shower, do laundry or go for a swim. I really need this break because it is HOT here and by early afternoon, I need a nap and some time to relax!

The late afternoon is spent reflecting on what we saw that day in the field, gaining a stronger understanding of the Science Discovery Process, and making sure we can connect what we've learned to previous knowledge. We learn to take this new knowledge and make it our own by using study skills like flash cards and concept maps. We also have time to ask an "expert" if we have questions or don't understand something.

One part of the day I really enjoy is when we learn new parts of the Science Discovery Process and then utilize them by designing our own experiment with paper airplanes! Not only is it fun, but I'm really starting to understand how science works and how scientists learn new things.

In the evening, we experience a series of activities like Zumba, circuit training, and night snorkeling. Zumba is so fun and great exercise! I'm going to have to find a class in City Heights when we get back. When bedtime rolls around, I'm exhausted. I jump into my cot and sleep the night away. Who would have thought I would ever want to go to bed at 9PM??

Throughout these weeks in Baja, I learn about my own ability to overcome obstacles using a growth mindset. Each day brings new challenges, and I learn that I am more resilient than I ever thought I was. It makes me think that although 10th grade will be challenging, I now have lots of tools that will help me be successful in high school, college, and in life!

I am excited to continue my journey with Ocean Discovery Institute as an Ocean Leader! Over the years, Ocean Discovery has helped me believe that science is something I can do, and a science leader is someone I can become. I can't wait to see what next summer has in store!

Daily Schedule

Start Time	End Time	Activity
6:00 AM	6:30 AM	Wake Up
6:30 AM	7:15 AM	Community Building
7:15 AM	12:15 PM	Field Research
12:30 PM	1:00 PM	Lunch
1:05 PM	1:45 PM	Self-Reflection
1:45pm	2:30pm	Siesta
2:30pm	4:00pm	Salud
4:00 PM	5:55 PM	Know it! Own it!
6:00 PM	6:30 PM	Dinner
6:35 PM	7:10 PM	Servant Leadership
7:15 PM	8:25 PM	Evening Activity
8:30 PM	9:00 PM	Sleep prep

Field Research Overview

Overview: Field Research is one of the main components of the Introduction to Research program. Students experience the Science Discovery Process (see diagram above) by participating in multiple field research projects for a day. Whenever possible, we partner with local scientists and community science organizations to work on ongoing research projects (sea turtle monitoring with Grupo Tortuguero, bird monitoring with Mujeres Con Alas, etc.) or continue work started by Ocean Discovery Institute in years past (Pesca, Wetlands, etc.).

Team Leads and mentors will help students make connections during their field experiences to the Science Discovery Process. Each field experience has a specific focus based on what the students learned about the day prior during Know it! Own it!, however the process is scaffolded and past areas of focus should be reviewed and new areas previewed when opportunities arise.

Goals: Students experience the Science Discovery Process by participating in a series of community-based field research projects.

Timing/Location: ~ 3 hours*
*Timing for each research project is listed in the specific Field Research Protocol below.

- Drive time to research location: ~30-60 min
- Collecting Data: ~1.5 hours
- Analyzing Data: ~30 min

Supplies (All days):

- Science Discovery Process poster + easel (1)
- White board markers (2)
- Whiteboard eraser (1)
- See specific Field Research Protocol supply list
- See General Field Research Supplies checklist

Set Up

- Set up projector, screen, laptop, and PowerPoint for lecture.
- Load the day's PowerPoint.
    - See specific Field Research Protocol for specific lecture.
- Set up Science Discovery Process poster.
- On whiteboard draw the day's Science Notebook set-up for students to copy later.
    - See specific Field Research Protocol.

Summer 2022 Schedule: Session 1

Day	Date	Tides (Low)	Tides (High)	Science Discovery Process	Field Research Protocol
1	July 19	12:23PM/72	6:35AM/156	N/A	N/A
2	July 20	1:46PM/102	8:16AM/156	Explore & Wonder	Explore the Bay
3	July 21	2:32AM/49	10:11AM/169	Investigate	Spider & Cactus Survey
4	July 22	3:38AM/48	11:27AM/187	Investigate	Fisheries
5	July 23	4:38AM/43	12:17PM/202	Investigate	Wetlands
6	July 24	5:25AM/36	12:52PM/214	Analyze	Whale Shark Monitoring
7	July 25	6:00AM/27	1:18PM/223	Analyze	Sea-Level Rise
7 (Evening)	July 25	7:39PM/96	0:07AM/145	Analyze	Sea Turtle Monitoring
8	July 26	6:30AM/16	1:40PM/231	N/A	N/A (Recovery from Sea Turtle Monitoring)
9	July 27	6:59AM/5	2:03PM/238	Analyze	Bird Monitoring
10	July 28	7:29AM/-3	2:27PM/243	N/A	Celebrate Success
11	July 29	8:00AM/-5	2:53PM/244	Communicate	Museo
12	July 30	8:32AM/-1	3:21PM/240	Communicate	N/A (Prep for Community Celebration)

Summer 2022 Schedule: Session 2

Day	Date	Tides (Low)	Tides (High)	Overview	Field Research Protocol
1	July 26	6:30AM/16	1:40PM/231	N/A	N/A
2	July 27	6:59AM/5	2:03PM/238	Explore & Wonder	Explore the Bay
3	July 28	7:29AM/-3	2:27PM/243	Investigate	Sea-level Rise
4	July 29	8:00AM/-5	2:53PM/244	Investigate	Fisheries
5	July 30	8:32AM/-1	3:21PM/240	Investigate	Wetlands
6	July 31	9:04AM/10	3:47PM/232	Analyze	Whale Shark Monitoring
7	Aug 1	9:37AM/27	4:12PM/220	Analyze	Spider & Cactus Survey
7 (Evening)	Aug 1	10:34PM/60	N/A	Analyze	Sea Turtles Monitoring
8	Aug 2	10:12AM/42	4:37PM/208	N/A	N/A (Recovery from Sea Turtle Monitoring)
9	Aug 3	10:53AM/69	5:04PM/195	Analyze	Bird Monitoring
10	Aug 4	11:50AM/93	6:04AM/166	N/A	Celebrate Success
11	Aug 5	1:17PM/113	7:36AM/169	Communicate	Museo
12	Aug 6	3:13AM/121	9:24AM/186	Communicate	N/A (Prep for Community Celebration)

*Field Research Protocols in red are the ones that will occur in a different order due to tides.

Field Trips Overview

Overview: Each Field Research Protocol is paired with a field trip. Field trips are an opportunity for students to explore some of the natural wonders of Bahía de los Àngeles. Field trips are a time of relaxation and enjoyment.

Goals: Students experience the natural wonders of Bahía de los Àngeles.

Timing/Location: ~ 1.5 hours*
*Timing will always be dependent on the Field Research project which is always the priority.
**TBD Field Trips should be decided and confirmed with Team Leads the day prior during Prep Meeting.
***Most Field Research Protocols are "paired" with a preferred field trip, however all field trips can be mixed and matched depending on weather and other conditions.

Supplies (All days):

- See Field Trip Supplies Checklist

FIELD TRIP "IDEAL" PAIRINGS

Field Research Protocol	Field Trip	Field Trip Activity
Explore the Bay	N/A	N/A
Whale Shark Monitoring	TBD (see list below)**	Snorkel Fun
Fisheries	TBD (see list below)**	Snorkel Fun
Bird Monitoring	La Gringa	Snorkel Fun Cave Exploration
Wetlands	Punta Arena	Beach Fun
Sea Level Rise	Shara's House	Snorkel Fun
Spider & Cactus	Mitlan	Snorkel Fun
Sea Turtle Monitoring	N/A	N/A
Celebrate Success	N/A	N/A
Museo	N/A	N/A

TBD Field Trip Options:

- San Juan Cove
- La Mona
- Piedras Abogados
- Wildlife watching
- Other snorkel locations

Field Research Protocols

Explore The Bay

Overview

Location:

- The Bay (Calavera, Coronadito, Mitlan, Ventana, and Island Tour)

Supplies:

- *Students need to bring tennis shoes for the hike
- Laminated Map of the Islands of Bahía de los Àngeles
- Large dry bag (for student shoes) (1/boat)

Timing:

Time	Activity/Location	Breakdown
7:15 – 7:50AM	**Lecture and Prep:** Field Station	*Remind students to bring tennis shoes for hike 7:15 – 7:25AM: Students get field & boat ready 7:25 – 7:40AM: Lecture 7:40 – 7:45AM: Prep Science Notebooks 7:45 – 7:50AM: Walk to boats

7:50 – 11:45AM	**Field Research:** Field	7:50 – 8:00 Introductions
		8:00 – 8:30AM: Drive to Calavera
		8:30 – 8:45AM: Hang with Sea Lions
		8:45 – 9:00AM: Drive to Coronadito Area
		9:00 – 11:20AM: Rotations
		• 9:00 – 9:45AM Rotation 1
		  ○ Boat 1 & 2: Hike Coronadito
		  ○ Boat 3 & 4: Wildlife watching
		  ○ Boat 5 & 6: Snorkel Coronadito
		• 9:45 – 9:55AM Switch
		• 9:55 – 10:40AM Rotation 2
		  ○ Boat 1 & 2: Snorkel Coronadito
		  ○ Boat 3 & 4: Hike Coronadito
		  ○ Boat 5 & 6: Wildlife watching
		• 10:40 – 10:50AM Switch
		• 10:50 – 11:35AM Rotation 3
		  ○ Boat 1 & 2: Wildlife watching
		  ○ Boat 3 & 4: Snorkel Coronadito
		  ○ Boat 5 & 6: Hike Coronadito
		11:35 – 12:05PM: Island Tour with Ventana photo shoot & Return

12:05 – 12:15PM	**Return to Field Station**	12:05 – 12:10PM Unload Boats 12:10 – 12:15PM Thank You's to boat guides

Overview of Explore the Bay (Instructors Only):

This is not a research project but rather an opportunity for students to have a "Wow!" moment while exploring the bay, seeing the islands, hiking, snorkeling, and looking for wildlife while they record observations and questions.

Lecture & Prep

Explore and Wonder

- Review Program Goals:
    - Focus of this program is to experience scientific research.
    - Scientists doing research use the Science Discovery Process.
        - (Show Science Discovery Process poster.)
    - One goal of program: Everyone can name and describe all the parts of the Science Discovery Process by the end of this program.
        - One way we will do this is through the Paper Airplane lab each day.
        - Another way we do this is by participating in field research each day.
- Introduce Explore the Bay Day.
    - Today is your first field day. You will be exploring the Bay!
    - While we won't be participating in an actual research project today, we will be orienting you to The Bay, an area where many of your research projects will take place.
    - We will tour the islands of the bay, stopping on one of the islands for a hike, and also doing a snorkel.
    - Always have your eyes open for wildlife sightings.
        - Birds, turtles, fish, whale sharks, rays, etc.
- Explore and Wonder
    - Throughout the day we will be concentrating on the Explore and Wonder portion of the Science Discovery Process.
        - With a focus on <u>Making Observations</u> and <u>Asking Questions</u>.
    - Review definitions:
        - Review definition of observation: using the senses to gather information from the natural world.
        - Review definition of question: something that may help us to answer or figuring out the reason for some observation.
    - Our goal is to observe the natural surroundings of the Bay and write down a minimum of five observations and five questions before we return to the field station.
- Prep Science Notebooks for the field.
    - Open science notebook to next blank page.
    - (See below for science notebook set-up.)

Science Notebook*

**amend notebook set up if not using "ideal week" schedule*

EXPLORE THE BAY

Explore & Wonder

Observations	Questions

Field Research

7:50 – 8:00am: Introductions

- Break into boat groups + boat guide
- Have each person take a turn and introduce themselves and say their name and their favorite animal.
    - Ocean Discovery students and staff should try to make their introductions in English and Spanish.
- If time remains play a name game:
    - Option 1: Toss an object to another person in the circle and says their name and favorite food.
    - Option 2: Once everyone has introduced themselves, have each person in the circle say their name again and make a signal (i.e., Yo soy Emma. Signal: Puts hands on head and waves finger like antlers.). Everyone says "Hola Emma!" and repeats her sign

8:00 – 8:30am: Drive to Calavera

- Take out map of the islands and point out different islands as you go.
    - Island names and translations:
        - Ventana = window Llave = wrench Cerraja = locksmith
        - Pata = paw Bota = boot San aremar = xx;
        - Flecha = arrow Jorabado = hunchback Coronado = crown
        - Ballena Channel = whale channel Ventana = window
    - Ask students if they can think of reasons for the given names of the islands.

- Island Information:
    - Coronado = Osprey Nest
        - Mate for life; Add to their nest each year; Can weigh up to 1,000 lbs
    - Ballena Channel = Whale Channel
        - Deep water – allows space for migrating whales.
        - Blue-footed Boobies

8:30 – 8:45am: Calavera

- Point out Calavera.
    - Translation = skull
    - Guano (bird poop)
        - Point out birds on the island; guano gives the island it's white color;
        - Is high in nutrients which can provide nutrients for other organisms that live on the island
- Observe sealions
    - Males are larger (up to 800 lbs. and 7 feet long)
    - Females are smaller (up to 250 lbs. and 6 feet long)
- Continue observing sea lions while recording observations and questions in science notebook.

8:45 – 9:00am: Drive to Coronadito

9:00 – 11:20am: Begin Rotations (see schedule above)

<u>Hike Coronadito</u>

- Boats will off load both groups on a rocky shoreline.

- Team Lead:
    - Students put tennis shoes in dry bag to bring ashore.
    - Bring snacks.
    - Hold boats at shore and help students get off the boats.
- Students:
    - Bring water bottles, hat, sunglasses, and backpack.
- Once on land:
    - Have students change into tennis shoes.
    - Review safety:
        - Watch for cactus; rocks may be loose; don't put hands or feet in hidden areas
        - Always do 3 points of contact when on hike to top of island
        - Wait to take photos at top
    - Hike to top of Coronadito with hiking guide.
        - Have an adult at front and back of line.
        - Point out:
            - Geology – pumice, ingenious rocks
            - Blue-footed boobies
            - Look for turtles
            - Point out La Guardia – what makes this island different? Fisherman camps, lots of invasives, 2nd largest island in Sea of Cortez
            - Coronado clouds: as it gets windy the air expands which causes moisture and forms the ring at the top.
        - Take a photo at the top.
        - Stop at clearing below the summit:
            - Snacks and water
            - Write observations & questions in science notebook.
    - Hike down to meet boat for pick-up.

<u>Snorkel Coronadito Bay</u>

- Change into snorkel gear.
- Students snorkel around the protected bay
- Utilize snorkel protocol.

<u>Wildlife Watching</u>

- Boat guides can drive around the area to look for whales, whale sharks, etc.
- Have boat guides stop for 5-10 minutes so students can write in their science notebooks

11:35am – 12:05pm: Island Tour w/ Photo shoot at Ventana & Return to Field Station

- Begin making your way back to the field station while continuing to look for wildlife and make observations about the islands.
- Take out islands map for students to look at.
    - Ventana Photo Shoot
        - Photo shoot: Take a group photo with Ventana in the background.

Sea-Level Rise

Overview

Research Contact: Drew Talley (University of San Diego)

Research Location(s):

- Shara's House

Supplies:

- Field Research Protocol: Sea-Level Rise PowerPoint (for lecture portion)
- Sea-level Rise Datasheet copied on Write in the Rain paper (2/group)
- Clipboards + pencils (2/group)
- 100m transect tape (1/group)
- 10-sided dice (2/group)
- Intertidal organisms ID cards (2/group)
- Thermometer (1/group)
- Weather station (1/group)

Timing:

Time	Activity/Location	Breakdown
7:15 – 7:50AM	**Lecture and Prep:** Field Station	7:15 – 7:25AM: Students get field ready 7:25 – 7:40AM: Lecture 7:40 – 7:45AM: Prep Science Notebooks 7:45 – 7:50AM: Walk to vans
7:50 – 9:40AM	**Field Research:** Field	7:50 – 8:20AM: Drive to Research Location 8:20 – 8:35AM: Review Data Collection Methods 8:35 – 9:40AM: Investigate
9:40 – 10:00AM	**Analyze Data, Communicate, and Process Reflection:** Field	
10:00 – 11:45AM	**Field Trip:** Field	10:00 – 10:30AM: • Group 1: Snorkel • Group 2: Beach fun + snorkel prep • Group 3 Snack break 10:30 – 10:35AM: Switch 10:35 – 11:05AM: • Group 1: Snack • Group 2: Snorkel • Group 3 Beach fun + snorkel prep 11:05 – 11:10AM: Switch 11:10 – 11:40AM • Group 1: Beach fun • Group 2: Snack • Group 3 Snorkel 11:40 – 11:55AM: Clean-up & Depart
11:55 – 12:15PM	**Return to Field Station**	

Overview of Research (Instructors Only):

Students will identify intertidal species along two transects parallel to the shoreline. One transect will be set close to the waterline (low tide zone) and one will be set in the high tide zone. Students should notice a stark difference in types of species that inhabit these two areas.

The goal is for students to understand that sea-level rise could have an impact on the animals that live along the shores of the islands. As sea-level increases, organisms that live in the low tide zone may not be able to adapt to being covered with water all day every day, and organisms that live in the high tide zone may not be able to adapt to water covering them for longer amounts of time when currently they may only be covered once or twice a month.

Overtime, we may lose some species of intertidal organisms who cannot adapt to the changes due to sea level rise. Losing species of animals can cause lower diversity worldwide, a disruption of food webs, and issues in the local economy as some species found in the intertidal zone may be valuable to the local community as a food or income source.

See Dr. Talley's short paper on climate change in Instructor Resources section.

Lecture & Prep

Make a Difference

- Scientists are often driven to do research to Make a Difference in the world.
    - One of the ways we can make a difference is by "solving problems that face our planet".
    - One of the major problems facing our planet today is climate change.
    - As science leaders it is important that we understand what climate change is, how it works, and consider what we might do to make a difference today and in the future.
- What is climate change:
    - Define: Climate change is the long-term change in the weather patterns across the Earth.
- Why we care about climate change:
    - Review impacts from climate change.
        - Warmer temperatures, increases in extreme weather events, increased ocean temperatures and acidity, sea-level rise, etc.
    - Review potential impacts on humans.
        - Ex. Increased temperatures can cause heat waves which can negatively impact people's health – heat exhaustion, heat stroke, exacerbate asthma, heart conditions, etc.
        - Extreme weather events and sea-level rise can destroy homes, buildings, businesses, and infrastructure.

Explore and Wonder

**A review of Climate Change can be found in Instructor Resources section.*

- How climate change works:
    - Review Greenhouse Effect.
    - Review composition of Earth's atmosphere.
    - Review greenhouse gasses.
    - Review industrial revolution.
    - Compare pre-industrial versus post-industrial situation.
    - Review amount of CO_2 in atmosphere and corresponding temperature increases.
- Effects of climate change:
    - List effects.
    - Today's focus: Sea-level rise.
        - Define: Sea level rise is an increase in the level of the world's oceans because of climate change.
        - How: Thermal expansion & melting of land-based ice (glaciers, etc.)
        - Current state: Amount sea-level has risen since pre-industrial times.
- What are some observations and questions people in the community might have about sea-level rise?
    - What is sea-level rise? What is causing sea-level rise to happen?
    - How could sea-level rise impact my community? My home?
    - Will it impact my ability to make money and support my family?

Investigate

- We will investigate how sea-level rise could impact some of the animals that live along the coast of Bahia.
    - Sea-level rise occurs very slowly, it can be difficult to predict its impacts in the future.
    - Can simulate changes in sea-level by studying the intertidal zone.

- Introduce intertidal zone:
    - Define intertidal zone: where the ocean meets the land between high tide and low tide.
    - Describe low and high tide.
- Introduce Hypothesis:
    - We will sample the amount and types of organisms that live in two places: low tide zone and high tide zone.
    - If the types of organism we find in both locations are the same, we might conclude that sea-level rise will not have an impact on the animals along the coast.
    - If the types of organisms we find in both locations are different, we might conclude that sea-level rise will impact some of the animals along the coast.
- Determine a Hypothesis:
    - If we survey the types of organisms in the low tide zone and the high tide zone, then the types of organisms (will/will not) change.
- Prep Science Notebooks:
    - (See Science Notebook set up below.)

Science Notebook*

**amend notebook set up if not using "ideal week" schedule*

Field Research: Sea-Level Rise **Explore & Wonder** Observations | Questions	**Investigate** Hypothesis: **Make a Difference** How could this research be used to make a difference?

Field Research

Review Data Collection Methods

- Review collection methods below.
    - Be sure to point out appropriately sized rocks to choose – larger rocks are better but no larger than the size of a human head (approximately between 30-70cm).
- Review data sheet.
    - (See datasheet below.)
    - Show students that each time they identify a new organism they should write the name on their data sheet and place a tick mark next to that organism.
- As students are working, potential questions include:
    - Why do you think we didn't count every organism along the whole transect?
    - Why do we use random numbers to find places on the transect to collect data?
    - Why do we turn the rock back over when we are finished counting organisms?
    - What are you wondering?

Data Collection (Investigate):

- Divide your research group into two groups.
    - Give each group a clipboard, data sheet, pen, a 10-sided die, tape measure, and two Intertidal Organisms ID cards.
    - Have each group fill out the top of the data sheet.

- Transect 1:
    - Lay a 100 m transect tape along the parallel to the shoreline as close to the waterline as possible.
    - Have each group start at opposite ends of the transect tape.
    - Each group should:
        - Generate a random number by rolling the 10-sided die once.
        - The number generated will correspond to a meter marking in the first 10 meters of their side of the transect tape (ex. Group 1 starts in 0-10 m and Group 2 starts in 90-100 m).
            - Example: Group 1 rolls a 4. They walk to meter 4 on the transect tape.
            - Example: Group 2 rolls a 6. They walk to meter 96 on the transect tape.
        - When standing at your location on the transect tape pick the closest rock that is between 30-70cm.
            - GENTLY turn the rock over and use Intertidal Organisms ID card identify, count, and record on the data sheet all the organisms you see.
            - Count all organisms under and attached to the rock.
            - When all organisms have been counted GENTLY turn the rock back over.
    - Move to the next 10-meter section of the transect tape
        - (Example: Group 1 goes to 10-20 m and Group 2 goes to 80-90 m).
    - Repeat the above process.
    - Repeat until both groups meet in the middle and the transect is complete.

- Transect 2:
    - Move the transect tape up to the high tide zone keeping it parallel to the shoreline.
    - Repeat the protocol for Transect 1.

- When both transects are complete have students add up total numbers for each organism.

Analyze Data, Communicate, & Make a Difference

Analyze

- Give students time to look over data they collected and fill out their science notebook pages.
- Debrief as a group.
    - What do you notice about the types of animals you see in Transect 1 versus Transect 2?
        - Why do you think they are different?
    - If the sea were to rise to the level of Transect 2, how could it impact the organisms in Transect 1? Transect 2?
        - Would you still see the same types of organisms in Transect 1? Transect 2?
    - After looking at your data do you accept or reject the hypothesis?
        - Scientists NEVER change their hypothesis, even if it's wrong. We can learn just as much from a hypothesis we accept as from a hypothesis we reject.
    - If sea-level rise were to continue how would this shoreline look different in 20 years? 50 years? 100 years?

Communicate

- Ask students:
    - Based on your research what would you want people to know?
    - Who would benefit the most from hearing about your research?
    - How could having this data help the community?

Make a Difference

- Ask students:
    - How could the research they participated in this morning be used to make a difference?
    - Do you think sea-level rise could also impact San Diego? How?

Sea-Level Rise Data Sheet

Researchers: _____

Transect 1: Low Tide Zone

Date:	**Water Temperature:**	**Wind Speed:**
Time:	**Air Temperature:**	**Wind Direction:**

Name of Organism (use ID card)	**# of organisms**	**Name of Organism (use ID card)**	**# of organisms**

Transect 2: High Tide Zone

Date:	**Water Temperature:** N/A	**Wind Speed:**
Time:	**Air Temperature:**	**Wind Direction:**

Name of Organism (use ID card)	**# of organisms**	**Name of Organism (use ID card)**	**# of organisms**

Fisheries

Overview

Research Contact: Hector Morales (Bahía de los Àngeles)

Research Location(s):

- La Gringa or Cabeza de Caballo

Supplies:

- Field Research Protocol: Fisheries PowerPoint (for lecture portion)
- Fishing traps + bait (4) – (Supplied by Hector)
- LED lights w/ AA batteries (6)
- LED lights w/o batteries (6)
- Extra AA batteries in Ziploc
- Zip ties
- Gloves (for pulling in traps) (4/pairs)
- Clipboard with a Fisheries Data Sheet printed on Write-in-the-Rain paper (1)
- Pencils
- Depth/Temp recorder (1)
- Secchi Disk (1)
- Large white board + easel (3)
- White board markers + eraser

Timing:

Time	Activity/Location	Breakdown
7:00AM	**Hector to Set Traps**	*This will be done without the students.
7:15 – 7:50AM	**Lecture and Prep:** Field Station	7:15 – 7:25AM: Students get field & boat ready 7:25 – 7:40AM: Lecture 7:40 – 7:45AM: Prep Science Notebooks 7:45 – 7:50AM: Walk to boats
7:50 – 11:20AM	**Field Research & Field Trip:** Field	**7:50 – 9:05AM: Data Collection & Field Trip** • Group 1: Collect data w/ Hector • Group 2 & 3: Field Trip 9:05 – 9:15AM: Switch **9:15 – 10:15AM: Data Collection & Field Trip** • Group 2: Collect data w/ Hector • Group 1 & 3: Field Trip 10:15 – 10:25AM: Switch **10:25 – 11:25AM: Data Collection & Field Trip** • Group 3: Collect data w/ Hector • Group 1 & 2 Field Trip
11:25 – 11:45AM	**Analyze Data, Communicate, and Process Reflection:** Field	11:25 – 11:30: Team Leads Copy Full set of data onto whiteboards 11:30 – 11:45: Analyze Data & Communicate
11:45 – 12:15PM	**Return to Field Station**	

Overview of Research (Instructors Only):

- Bahía de los Àngeles is a small-scale coastal gillnet fishery. Coastal gillnet fisheries are one of the most common forms of fishing throughout the world. A gillnet is a wall of netting that hangs in the water column, typically made of monofilament. Mesh sizes of the gillnet are designed to allow fish to get their head through but not their body. The fish's gills then get caught in the mesh as the fish tries to back out of the net.
- Unfortunately, this type of fishing has high rates of bycatch (shark spp., turtle spp., fish spp., etc.). Bycatch is when other marine species, which aren't the fisherman's target species, are caught in the gillnets.
- Sea turtles are one species that have been subject to bycatch over the years. Turtles need to come to the surface every few minutes to breathe, but when they get caught in gillnets, they are unable to surface and can die.
- In the past, Ocean Discovery has worked with several scientists to study ways to reduce sea turtle bycatch from gillnet fishing, including the use of sensory-based deterrents. Sensory-based deterrents attempt to help an animal use its senses (sight, hearing, smell, taste, or touch) to locate a net and be able to avoid it. Ocean Discovery students and their scientist mentors have tested visual deterrents (attaching shark shapes – a natural predator or sea turtles and lights to nets so animals can see them) and acoustic deterrents (attaching speakers to nets so animals can hear them). These types of sensory deterrents were all effective in reducing the number of sea turtles caught.
- Ocean Discovery students and mentors also studied how these devices impact a fishermen's target fish collection rate (the amount of the type of fish they want to catch). It is important to look at this because fishing is the fishermen's livelihood and if we want them to utilize sensory deterrents, we must also show that using them does not impact their target catch rates. Additionally, the cost, durability, and ease of use of the deterrents is important if we want fisherman to adopt these devices.
- Summer fishing in Bahía de los Àngeles is often done with traps versus gillnets. This year students will expand on past research by collecting data to understand if the use of a visual deterrent (lights) would reduce the amount of bycatch (puffer fish and small manta rays) while not impacting the fisherman's target catch in traps (Octopus and xx).

Lecture & Prep

Make a Difference

- (Use Fisheries PowerPoint.)
- Review coastal gillnet fisheries & what gill nets are.
- Review bycatch and target catch.
- Review past Ocean Discovery research.
- Introduce summer fishing with traps.

Explore and Wonder

- What are some observations and questions fishermen and people in the community might have about fishing with traps?
    - Is there bycatch related to fishing with traps?
    - Could we reduce the bycatch using a sensory deterrent?
    - If fishermen use a sensory deterrent, how will it impact the target catch?

Investigate

- We will collect data to determine if lighted traps:
    - 1) Reduce bycatch
    - 2) Affect target species catch rates
- Introduce Hypothesis:
    - If fisherman use LEDs to light their traps:
        - 1) It will/will not reduce bycatch
        - 2) It will/will not affect their target fish catch rates.
- Review collection methods below.
- Review data sheet.
    - (See datasheet below.)
- Prep Science Notebooks:
    - Open science notebook to two blank pages across from each other.
    - (See below for science notebook set-up.)

Science Notebook

**amend notebook set up if not using "ideal week" schedule*

Field Research: Fisheries

Explore & Wonder

Observations	Questions

Investigate

Hypothesis:

Which traps are control? Which are experimental?

Make a Difference

How could this research be used to make a difference?

Field Research

Data Collection

- Data Collection group load up on Hector's boat.
    - Boat guides for data collection group will drive over to San Juan Cove without students.
- Field trip groups will go with their boat guides to San Juan Cove.
    - See Field Trip description below.

Data Collection (Investigate):

- Assign roles to students:
    - Trap puller (1): Wears gloves and helps Hector pull the trap in.
    - Data recorder (1): Listens to the species name and makes a tick mark on the datasheet for each one collected. Has clipboard with datasheet and pencil.
    - Fish handlers (1-2): Unload the trap and says the species name of each fish (helped by Hector) to be recorded by data recorder.
- Review Echo Data Recording:
    - The fish handler says the species of fish and the data recorder repeats the species back and records it on the datasheet.
    - Any species that haven't been added to the sheet can be added to the blank spots.
- Pull Control Trap (unlit trap):
    - Once trap is in the boat collect data using "Echo Data Recording."
        - **One data sheet will be used by all groups!**
    - Fish handlers should place target species in buckets and release bycatch species.
- Switch roles
- Pull Experimental Trap (lit trap):
    - Repeat the above.
- Rebait and set traps for the next group.
- Hector to drive to San Juan Cove and drop off group and pick up next Data Collection group.

Analyze Data, Communicate, & Make a Difference

Analyze

- Team Leads copy data for their group:
    - Once all groups have returned to the beach Team Leads will take the data sheet and copy it onto their own whiteboard so data can be analyzed in small groups.
    - Students should take this time to fill in their science notebook pages.
- Give students time to look over data they collected and debrief as a group.
    - Was this a study or an experiment? How do you know?
    - What does the data tell you?
    - Why do we have a control trap? Why did we attach unlit lights to the control trap?
    - Would you accept or reject the hypothesis?
    - Is there anything that we might not be considering using these methods (weight of fish vs. number of fish, value of different fish species, etc.)
    - Do you think this one set of data is enough to make a conclusion? Why or why not?

Communicate

- Ask students:
    - Do you think this kind of information is important for the community? Why or why not?
    - How do you think local fishermen would respond to this data?
    - Are there any reasons that fishermen might find adopting the use of visual deterrents difficult? Are there disadvantages? Are there other options?

Make a Difference

- Ask students:
    - Why is testing to see if the LED lights impact the fishermen's target catch important?
    - How could the research they participated in this morning be used to make a difference?
    - Do you think what you learned today could be applied in other settings? How?
    - Can you think of any reasons why implementing something like this on a large scale could be difficult?

Fisheries Data Sheet

1st Group

Names:	**Date:**	**Water Depth:**
	Water Temp:	**Visibility:**

Control Trap			
Target Species		**By-Catch**	
Species Name	**Number Counted**	**Species Name**	**Number Counted**
Octopus (Pulpo)		Manta Ray (Manta raya)	
		Pufferfish (Pez globo)	

Experimental Trap			
Target Species		**By-Catch**	
Species Name	**Number Counted**	**Species Name**	**Number Counted**
Octopus (Pulpo)		Manta Ray (Manta raya)	
		Pufferfish (Pez globo)	

2nd Group

Date:	**Water Temperature:**	**Visibility:**
Time:	**Depth:**	

Control Trap			
Target Species		**By-Catch**	
Species Name	**Number Counted**	**Species Name**	**Number Counted**
Octopus (Pulpo)		Manta Ray (Manta raya)	
		Pufferfish (Pez globo)	

3rd Group

Experimental Trap			
Target Species		**By-Catch**	
Species Name	**Number Counted**	**Species Name**	**Number Counted**
Octopus (Pulpo)		Manta Ray (Manta raya)	
		Pufferfish (Pez globo)	

Date:	**Water Temperature:**	**Visibility:**
Time:	**Depth:**	

Control Trap			
Target Species		**By-Catch**	
Species Name	**Number Counted**	**Species Name**	**Number Counted**
Octopus (Pulpo)		Manta Ray (Manta raya)	
		Pufferfish (Pez globo)	

Experimental Trap			
Target Species		**By-Catch**	
Species Name	**Number Counted**	**Species Name**	**Number Counted**
Octopus (Pulpo)		Manta Ray (Manta raya)	
		Pufferfish (Pez globo)	

Wetlands

Overview

Research Contact: Lindsay Goodwin (Ocean Discovery Institute)

Research Location(s):
- Punta Arena

Supplies:
- Field Research Protocol: Wetlands PowerPoint (for lecture portion)
- Wetlands Datasheet copied on Write in the Rain paper (3/group)
- Clipboards + pencils (3/group)
- Thick long socks (1/student)
    - To protect from scratch grasses in wetlands
- 100m transect tape (3)
- 50cm x 50cm quadrat (w/ four quadrats within) (9)
- Wetland ID Guide (9)
- Shell guide (1)

Timing:

Time	Activity/Location	Breakdown
7:15 – 7:50AM	**Lecture and Prep:** Field Station	7:15 – 7:25AM: Students get field ready 7:25 – 7:40AM: Lecture 7:40 – 7:45AM: Prep Science Notebooks 7:45 – 7:50AM: Walk to vans
7:50 – 10:00AM	**Field Research:** Field	7:50 – 8:30AM: Drive to Research Location 8:30 – 9:00AM: Review Data Collection Methods 9:00 – 10:00AM: Collect Data
10:00 – 10:30AM	**Analyze Data, Communicate, and Process Reflection:** Field	
10:30 – 11:45AM	**Field Trip:** Field	Beach Fun @ Punta Arena
11:45 – 12:15PM	**Return to Field Station**	

Overview of Research (Instructors Only):
Wetlands are areas of land that are wet and inundated by water, at least sometimes. The wetlands we will be studying are mostly formed by the saltwater that the tides bring into low land areas. These wetlands have unique soil conditions that differ from land or sea and support plants adapted to wet conditions.

Wetlands provide many important functions which include wildlife housing, plant production or growth, stops for migratory birds, water treatments, air purification, erosion prevention, and flood control. These functions within the wetland help many species survive and avoid extinction. Wetland ecology helps to understand the natural world well enough to predict changes in the wetland. By knowing how

wetlands will respond to future situation such as development, pollutants, or climate change we can protect them and therefore, all their functions.

Bahía de Los Angeles is a hot, arid region that is surrounded by a productive marine environment. The wetlands of Bahía de los Angeles are relatively pristine and they provide an example of what a healthy community looks like. The wetlands in BLA are unique because they have a mix of more temperate salt marsh species and tropical salt marsh species primarily red mangrove. Salt marshes in BLA occur within the intertidal zone in areas with low wave energy. They have soft substrates (mud or fine sand) and may support plants, such as mangroves or marsh succulents, or may be unvegetated (tidal flats).The northern range limit of red mangrove is in BLA, which is along the western North American coast line. Red mangrove can limit the growth of shorter marsh plants, such as succulents and grasses. Ecosystems, including tidal wetlands, have undergone great change in short periods of time. This change can be from natural causes such as changes in abiotic properties like storm events or biotic properties like plant succession and animal colonization. Therefore the spread of mangrove could change the structure and function of existing wetlands in BLA.

No previous studies on wetlands in BLA had ever been conducted before Ocean Discovery began in 2004. Since 2004 monitoring efforts have taken place in five wetlands (El Rincon, Coronado, Punta Arena, La Gringa, and Las Animas).

During this field research students will collect data to see if there is a relationship between types of flora and fauna in the wetlands. They will take data on types and amounts of flora and fauna along a transect which moves from the uplands (drier) to the lowlands/aquatic areas (wetter) to see if the types of fauna change as the types of flora change.

Lecture & Prep

Make a Difference

- (Use Wetlands PowerPoint.)
- Review what wetlands are.
    - Transition from uplands to aquatic.
- Review the importance of wetlands.
- Review past Ocean Discovery research.

Explore and Wonder

- What are some observations and questions people in the community might have about wetlands?
    - What is the current state of our wetlands?
    - What types of plants and animals are present in the wetlands today?
    - Do the type of and number of plants and animals change throughout the wetlands?

Investigate

- Do certain animals prefer certain types of plants in the wetlands?
    - As you move from the drier upland areas of the wetlands to the wetter lowland areas we see a change in the types of plants. (Show overview of wetlands.)
    - Does that change the types of animals we would find in the drier vs. wetter parts of the wetlands?
- Introduce Hypothesis: If the type and amount of flora (plants) change, then the type and amount of animals will change.
    - xx
- To inform this hypothesis, we will collect data on:
    - 1) The amount and types of plants in the uplands and the lowlands
    - 2) The amount and types of animals in the uplands a the lowlands
- Review collection methods below.
- Review data sheet.
    - (See datasheet below.)
- Prep Science Notebooks:
    - Open science notebook to two blank pages across from each other.
    - (See below for science notebook set-up.)

Science Notebook*

**amend notebook set up if not using "ideal week" schedule*

Field Research: Wetlands **Explore & Wonder** Observations | Questions	**Investigate** Hypothesis: What types of evidence did we collect: How many replicates did we do? **Make a Difference** How could this research be used to make a difference?

Field Research

Drive to Research Location

- Parking area in Punta Arena behind wetlands

Data Collection Method

- Demonstrate how to lay the quadrat.
    - Capture and count anything moving quickly out of the quadrat (i.e., crabs).
- Demonstrate how to take % plant coverage measurements using a quadrat.*
    - Show how each square is 25%.
    - How much does each type of plant take up if you pushed them all into one corner?
    - * Expect difficulties in students understanding % coverage.
        - If necessary do multiple demonstrations by moving the quadrat to different locations before releasing students to practice.
- Demonstrate how to count epifauna.
    - Push plants away to look around on the surface.
- Allow students to practice

Data Collection

- Each Field Research Group will be assigned a transect (see map below.)
    - Transects do not need to be in a specific area just need to be spaced far enough apart so that the three transects do not intersect and each transect travels from the uplands toward the coast.
    - Each Field Research Group will divide into three teams w/ one staff member with each team.
- Start in the uplands and lay a 100m transect along your general transect line.
    - Place one quadrat at the below locations along your 100m transect:
        - 33m
        - 66m
        - 99m
    - For each quadrat take the below plant measurements:
        - % cover *Batis maritima*
        - % cover *Distichlis spicata*
        - % cover *Sarcocornia pacifica*
        - % open space
    - For each quadrat take the below epifauna measurements, be sure to move the plants aside gently to see the ground:
        - # of Horn snails (*Cerithidea mazatlanica)*
        - # of Fiddler Crabs + holes *(Uca crenulate)*
        - # of other crabs
        - # of other snails
- Pick up transect and lay it out for another 100m towards the waterline and repeat above until a total of 300m of wetlands has been surveyed.

Analyze Data, Communicate, & Make a Difference

Analyze

- Set up umbrellas to create a shady location for Analyzing Data.
- Team Lead copy data from each group onto the whiteboard:
    - Students should take this time to fill in their science notebook pages.
- Give students time to look over data they collected and debrief as a group.
    - What does the data tell you in relation to the hypothesis?
        - What do you notice about the plants as we moved from the upland (drier) area towards the aquatic (wetter) part of the wetlands?
            - Did the plant community change as you moved towards the water? In what way? What types of plants do you see more or less of?
            - Why do you think this change occurs?
        - What do you notice about the animals as we moved from the upland (drier) area towards the aquatic (wetter) part of the wetlands?
    - How many replicates did we do?
        - Do you think that is enough replicates to say if our hypothesis is correct or incorrect? Why or why not?
        - What would you do to collect enough data to prove or disprove your hypothesis?

Communicate

- Ask students:
    - How could this data be used? How could this data set be improved upon?
    - Do you think this data would be of interest to other people in the community? Why or why not?
    - What does this research make you think of? What other studies could be conducted here?

Make a Difference

- Ask students:
    - How could the research we participated in this morning be used to make a difference?
    - Many wetlands exist in and around San Diego, do you think monitoring those wetlands would be beneficial? Why or why not?

Wetland Transect Map

Wetlands Data Sheet

Names:	**Date:**
	Air Temp:

1st – 100 meters

Measurement	33mm	66m	99m
PLANTS			
% cover *Batis maritima*			
% cover *Distichlis spicata*			
% cover *Sarcocornia pacifica*			
% open space			
ANIMALS			
# of Horn snails (*Cerithidea mazatlanica)*			
# of Fiddler Crabs + holes *(Leptuca crenulate)*			
# of other snails			
# of other crabs			

2nd – 100 meters

Measurement	133mm	166m	199m
PLANTS			
% cover *Batis maritima*			
% cover *Distichlis spicata*			
% cover *Sarcocornia pacifica*			
% open space			
ANIMALS			
# of Horn snails (*Cerithidea mazatlanica)*			
# of Fiddler Crabs + holes *(Leptuca crenulate)*			
# of other snails			
# of other crabs			

3rd – 100 meters

Measurement	233mm	266m	299m
PLANTS			
% cover *Batis maritima*			
% cover *Distichlis spicata*			
% cover *Sarcocornia pacifica*			
% open space			
ANIMALS			
# of Horn snails (*Cerithidea mazatlanica)*			
# of Fiddler Crabs + holes *(Leptuca crenulate)*			
# of other snails			

# of other crabs			

Wetlands ID Guide

Sarcocornia pacifica

Batis maritima

Distichlis spicata

Horn Snail
(Cerithidea mazatlanica)

Fiddler Crab
(Leptuca crenulate)

Whale Shark Monitoring

Overview

Research Contact: Vanessa Vazquez (Masters in Marine Biotechnology)(Bahia de los Angeles)

Research Location(s):

- The Bay (specific area chosen by Vanessa)

Supplies:

- Field Research Protocol: Whale Shark Monitoring PowerPoint (for lecture portion)
- Whale Shark Monitoring Datasheet copied on Write in the Rain paper (1/boat)
- Clipboard (1/boat)
- Pencils (2/boat)
- GPS (2)

Timing:

Time	Activity/Location	Breakdown
7:15 – 7:50AM	**Lecture and Prep:** Field Station	7:15 – 7:30AM: Students get field & boat ready 7:30 – 7:45AM: Lecture 7:45 – 7:50AM: Prep science notebooks 7:50 – 8:00AM: Stretch Break 8:00 – 8:50AM: Intro to Project by Vanessa 8:50 – 9:00AM: Walk to boats
9:30 – 12:00PM	**Field Research:** Field	9:00 – 9:30AM: Drive to Whale Shark Research or Beach Fun (see below schedule) 9:30 – 10:20AM: Group 1: Whale Shark Research Group 2 & 3: Beach fun 10:20 – 11:10AM: Group 2: Whale Shark Research Group 1 & 3: Beach fun 11:10 – 12:00PM: Group 3: Whale Shark Research Group 1 & 2: Beach fun
12:00 – 12:15PM	**Return to Field Station**	
4:00 – 4:20PM	**Analyze Data, Communicate, and Process Reflection:** Field Station	*Because whale sharks aren't often seen until 9:30-10:00AM we will do Analyze Data & Communicate during Process Reflection time.

Overview of Research (Instructors Only):

- Whale sharks gather in the waters off of Bahía de los Àngeles because the Bay is considered one of the most biologically productive areas in the Gulf of California. The morphology of the bay, localized upwelling, wind patterns, and temperature of the water make it the perfect habitat for whale sharks to congregate seasonally for feeding.

- Whale sharks have been studied in Bahía de los Àngeles for many years. Community members have been involved in collecting data since 2008 and even earlier more informally, this is called community science. Based on some of this work by the community, a set of rules has been created called the "Code of Conduct" for safe interactions with whale sharks.
- Different types of data have been collected over time, including ways of feeding, composition of diet, and population information (identification of individuals, population numbers, males vs. females, size, tracking, etc.).
- This past year (2021) Vanessa and her team were able to collect biological samples and satellite tag two whale sharks. Satellite tags can last up to three years so will be very important in understanding the life cycle and yearly movement patterns of whale sharks. This is the first-time whale sharks have been satellite tagged in the Pacific Ocean! Prior to this it had only been done in the Caribbean.
- This research is important because whale sharks are an endangered species and much of their life history is unknown. This research is also important to the community because tourism focused on whale sharks to this area has increased tremendously, and therefore the need to manage the industry has also increased. It is now more important than ever, that scientists understand the population make-up and overall health of the whale sharks that migrate into the bay each year (June-December) so that the ecotourism industry can continue to prosper while whale sharks remain protected.
- Vanessa and her group share their data in several ways – they share their data with an online platform called Whalebook which is a worldwide database. They share their information with Comisión Nacional de Áreas Naturales Protegidas (CONAP) and report any illegal activity they might see. Additionally, they work with CONAP to offer a Whale Shark refresher course which is required by the government for all captains and guides who work with whale sharks. They share information with locals (who are often part of the whale shark ecotourism industry or other local boat drivers) to share sightings and behaviors of whale sharks and let boat drivers know where to drive more slowly and keep an eye out for whale sharks.

Lecture & Prep

Make a Difference

- Whale Sharks:
    - Whale sharks are the largest known fish and the largest shark (up to 30 feet long).
        - They are easily identified by their size and their white spots.
    - Filter feeders.
        - Filter feeding: swim with their mouth open (up to four feet wide) and suck plankton in using their gill rakers.
        - Plankton: any organism that can't swim against the current; often microscopic
        - Whale sharks must travel large distances to get enough plankton to survive.
    - Bahia de los Angeles is one of a very few places where whale sharks can be predictably observed by humans because there is a reliable source of plankton.
        - The shape of the bay, water temperatures, and wind patterns, create upwelling (water moving from the deep ocean up to the shallows) that bring plankton (organisms that can't swim against the current -generally tiny) to the surface.
        - Whale sharks come here to eat that plankton.
- Make a Difference:
    - Whale sharks have recently been listed as endangered.
    - They are often killed for their highly valued meat, fins, and oil.
    - They are often by-catch, die by ship strikes, and increasing pressure from ecotourism is negatively impacting whale sharks.
        - Define ecotourism: tourism that centers around awareness of the environment and the local community.
    - Whale sharks are part of the ecotourism industry here in Bahía de los Àngeles.
        - People come from all over the world to interact with the whale sharks.
        - They migrate into the Bay each year ~May to December.
        - People enjoy swimming and snorkeling with them in this protected environment
    - Many people in the community make a living off from whale shark ecotourism.
        - It is an important source of income for the community.

Explore and Wonder

- What are some things the people of the community might be wondering and want to explore about whale sharks?
    - How healthy is the population of whale sharks?
    - How many whale sharks migrate to the bay each year? Are the same sharks returning?
    - Are the increased number of ecotours impacting the whale sharks that migrate to the bay? Does it change their behavior or harm their health?

Investigate

- Community Science:
    - It is important to the community that whale sharks are protected and treated respectfully.
    - In order to make sure the whale sharks stay healthy, members of the community collect data about the whale shark population each year.
    - Community members have been studying whale sharks in Bahía de los Àngeles since 2008.

        - Community Science: is scientific research and monitoring done by local communities.
    - Today we will be working with Vanessa Vasquez to see how the community collects this data.
    - Vanessa Vasquez grew up in Bahia de los Angeles.
        - She has a Masters in Marine Biotechnology.
        - She has studied horn sharks and has been studying whale sharks for years.
    - Vanessa will be here shortly to talk about the project, how we will be collecting data, and her experiences working with whale sharks.
- Prep Science Notebooks:
    - (See Science Notebook set up below.)

Intro to Project (By Vanessa)

- Vanessa (and partners) introduction and background.
- History of Whale Shark research in Bahía de los Àngeles.
- Description of current Whale Shark research.
- Description of today's data collection methods.
- Spot pattern analysis + database.
- Rules for swimming with Whale Sharks.

Science Notebook*

**amend notebook set up if not using "ideal week" schedule*

Field Research: Whale Sharks **Explore & Wonder** Observations | Questions	**Investigate** What types of evidence did we collect? Is this an observational study or controlled experiment? **Make a Difference** How could this research be used to make a difference?

Field Research

Drive to Whale Shark Research or Beach Fun

- Whale Shark research group will depart for Whale Sharks.
    - Vanessa will join one boat and Socde (or other researcher) will join the other boat.
- Beach Fun groups will depart with their boat guides to Field Trip location.
    - See Field Trip description below.

Data Collection (Investigate):

- Assign roles: (these can be rotated throughout the data collection time)
    - Data Recorder (1): – fills out data sheet
    - GPS Person (1): operates GPS and provides information to data recorder
    - Whale Shark Spotter and Watcher (1): always keep eyes on the whale shark
    - Whale Shark Length Estimators (2): will estimate the size of the whale shark in relation to the boat
- Review Echo Data Recording:
    - The GPS person says the Latitude coordinate and the data recorder repeats the coordinates back after recording it on the datasheet.
- Find out the length of the boat to estimate whale shark length later.
- Fill out the top of the data sheet (Data recorder).
- When a whale shark is sighted:
    - Point at whale shark and follow it. (Whale Shark Spotter and Watcher)
    - Take a GPS location and record that on the data sheet. (GPS Person)
    - Estimate length of whale shark using the boat. (Whale Shark Length Estimators)
    - Allow researcher to get into the water and sex the shark and take photos of its spot patterns. (Researcher)
    - When the researcher has gotten all the data necessary, they may allow students in the water to swim with whale sharks.
        - Follow all the rules and directions given by the researcher.
        - Explain rules of swimming with whale sharks:
            - 1 meter from body
            - 2 meters from tail
            - Up to four people on one side
            - Can't have people on both sides
            - 1 boat per whale shark
- Repeat for additional whale sharks.
- Return to beach to switch groups.
    - Team Lead should take a photo of all data sheets to be used back at the Field Station.
    - GPSs should go with Vanessa and Socde.

Analyze Data, Communicate, & Make a Difference

Analyze*

**Analyze Data and Communicate will happen during Process reflection time due to timing (see above timetable).*

- (Team Leads to consolidate data and write it on the whiteboard.)
- Give students time to look over data they collected and fill out their science notebook pages.
- Debrief as a group.
    - Was this a study or an experiment? How do you know?
    - What types of data did we collect?
    - How many replicates did we do?
    - Ask students how Vanessa and Socde will use the data they collected?
        - They will do spot pattern recognition to determine if it a new whale shark or one they have observed before. This data will be added to the online database – *Whalebook*.
    - How could a database like *Whalebook* help researchers?
    - Why do you think it's important for community scientists to participate in this type of research?
    - Would it be beneficial to continue collecting this data each year? Why or why not?

Communicate

- Ask students:
    - Do you think this kind of information is important for the community? Why or why not?
    - Who do you think would benefit most from hearing about this research?
    - How could having this data help the community?
- Vanessa and her group share their data in several ways:
    - Sharing their data on Whalebook.
    - Sharing their information with Comisión Nacional de Áreas Naturales Protegidas (CONAP) and reporting any illegal activity they might see. Additionally, they work with CONAP to offer a Whale Shark refresher course which is required by the government for all captains and guides who work with whale sharks.
    - They share information with locals (who are often part of the whale shark ecotourism industry or other local boat drivers) to share sightings and behaviors of whale sharks and let boat drivers know where to drive more slowly and keep an eye out for whale sharks.

Make a Difference

- Have students pair-share about:
    - How could the research they participated in this morning be used to make a difference?
    - Do you think what you learned today could be applied in other settings? Where? How?

Spider & Cactus Survey

Overview

Research Contact: Drew Talley (University of San Diego)

Research Location(s):

- Scientist Present (whole group): Coronado

Supplies:

- Field Research Protocol: Cactus & Spider Powerpoint for lecture
- Cactus & Spider Survey Datasheet printed on Write in the Rain paper (6/group)
- Laminated Spider and Cactus Survey Data Set (1/pair of students)
- Cactus & Spider Survey ID Card (5/group)
- Calculator (5/group)
- Clipboards + pens (5/group)
- Tape measures (5/group)
- 100m transect tape (1)
- Handheld weather station (2/group)
- GPS (1/group)

Timing:

Time	Activity/Location	Breakdown
7:15 – 7:50AM	**Lecture and Prep:** Field Station	7:15 – 7:25AM: Students get field & boat ready 7:25 – 7:40AM: Lecture 7:40 – 7:45AM: Prep Science Notebooks 7:45 – 7:50AM: Walk to boats
7:50 – 10:10AM	**Field Research:** Field	7:50 – 8:20AM: Boat to Research Location 8:20 – 8:40AM: Hike to Cactus Monitoring Location 8:40 – 8:55AM: Review Data Collection Methods 8:55 – 9:50AM: Data Collection 9:50 – 10:10AM: Hike back to boat drop-off
10:10 – 10:30AM	**Analyze Data, Communicate, and Process Reflection:** Field	
10:30 – 11:45AM	**Field Trip:** Field	
11:45 – 12:15PM	**Return to Field Station**	

Overview of Research (Instructors Only):

Students will continue to add to Dr. Polis & Dr. Talley's long-term data set of spiders and cactus found on the islands. The goal is for students to understand that adding to a long term data set in ecology is important because data sets like this can provide an early warning of changes happening in an ecosystem such as reduced populations of plants or animals, the presence of an invasive species, or effects from global climate change.

Island version ONLY: Students may notice a difference in the of abundance of spiders between cactus on the interior of the island and those closer to the water's edge. The reason for this is the nutrient rich

Sea of Cortez deposits algae, detritus, etc. on the shores, the detritus attracts invertebrates that act as decomposers, and these decomposers are a food source for the spiders. Further inland there are less food sources to support the spiders.

Lecture & Prep

Make a Difference

- Dr. Gary Polis and Dr. Drew Talley have studied the islands of Bahia for over 30 years.
- Through their research, they have collected more than three decades worth of taxonomic data for many of the insects, lizards, and plants that live on the islands.
- Long term data sets like these are rare in ecology but are very important.

Explore and Wonder

- What are some questions people in the community might be wondering about long term plant and animal monitoring?
    - What can long term data sets tell us?
    - How do scientists collect long term data?
    - What have Dr. Polis and Talley learned from their data collection?

Investigate

- Long term data sets can tell us a lot about an ecosystem, especially if we start to see changes in the ecosystem like different types or amounts of plants or animals, changes in soil composition or changes in weather patterns change, etc.
- One of Dr. Polis and Dr. Talley's areas of focus is cactus and spider populations.
    - They have collected data related to the local cactus species Opuntia and the spider *Metepeira arizonica* for 34 years!
    - They have collected this data on all but two of the islands in Bahía de los Àngeles (because those two islands do not have cactus).
- Today we will be adding to this long-term data set by collecting data on cactus and spiders on Coronado Island.
    - We will also have the opportunity to look at some of the data Dr. Talley has collected in the past and see what we can learn from it.
- Review data sheet & cactus and spider ID card.
    - Review data collection methods.
- Prep Science Notebooks:
    - (See Science Notebook set up below.)

Science Notebook*

**Field Research: Spider & Cactus Survey*amend notebook set up if not using "ideal week" schedule*

Explore & Wonder

Observations	Questions

Make a Difference

How could this research be used to make a difference?

Investigate

What types of evidence did we collect?

Is this an observational study or controlled experiment?

Analyze

Do you notice any trends/patterns in today's data? Outliers?

What do you think that tells you?

Field Research

Review Data Collection Methods

- Review collection methods below using an example cactus and datasheet.
    - Remind students to be very careful when measuring cactus.
- Divide students into pairs.
    - Give each group a clipboard, data sheet, pencil, a tape measure, and a Cactus & Spider Survey ID Card.
    - Goal is to survey five cacti.
    - Provide boundaries and time limit for cactus survey.
- As students are working, potential questions include:
    - What are you noticing?
    - Why do you think Drs. Polis and Talley chose to focus on cactus and spiders? What are the advantages? Disadvantages? Are there other options?
    - Why do you think spiders would choose to live on a cactus?
    - Why do you think we take measurements of the cactus?
        - Why do you think we take three measurements of the cactus and not just the height of the cactus?
    - Do you notice any difference between the shore and inland? Why do you think that is?
    - Do you notice any difference between smaller and larger cactus?
    - What else you would want to collect data on here? Why?

Data Collection (Investigate):

- Near-shore survey:
    - Have each group fill out the top of the data sheet.
        - The weather station can be passed around from group to group while they are collecting data.
    - For each Opuntia cacti:
        - Record GPS location.
        - Take the following measurements:
            - Height – Top to bottom
            - Width 1 – widest horizontal measurement
            - Width 2 – horizontal measurement 90 degrees to Width 1.
        - On each Opuntia cactus count the number of:
            - *Metepeira spp.*
            - *Argiope spp.*
            - Egg sacks on each cactus
            - Add any other interesting cactus features or any other spiders seen (E.g., *Latrodectus mactans*, *Argiope argentata*) in “Comments”
    - Repeat the above for up to four more cactus.
    - Give students a five-minute warning before moving to the next transect.

- In-land survey:
    - Move students inland and repeat the above process for five additional Opuntia cacti.

Analyze Data, Communicate, & Make a Difference

Analyze

- Give students time to look over data they collected and fill out their science notebook pages.
- Debrief as a group.
    - Was this a study or an experiment? How do you know?
        - What difference if any, do you notice between the shore and inland? Why do you think that is?
        - What differences if any, to you notice between smaller and larger cactus?
    - Do you see any trends/patterns in the data?
    - Do you see any outliers?
        - How do you know they are outliers?
    - Based on the data do you think there are any environmental factors that influence the number of spiders? What tells you that?
    - Would it be beneficial to continue collecting data here each year? Why or why not?

Communicate

- Ask students:
    - Do you think this kind of information is important for the community? Why or why not?
    - Who do you think would benefit most from hearing about this research?
    - How could having this data help the community?

Make a Difference

- Ask students:
    - How could the research they participated in this morning be used to make a difference?
    - Why is it important to collect long term data sets about different types of organisms?
    - What do you think might be some of the barriers to scientists collecting long term data sets?

Spider and Cactus Survey Data Sheet
(Island Version)

NEARSHORE SURVEY

Researchers:	**Date/Time:**	**Wind Speed/Direction:**
Location:	**Air Temperature:**	**Humidity:**

Opuntuia Cactus	**Latitude**	**Longitude**	**Height (cm)**	**Width 1 (cm)**	**Width 2 (cm)**	***No. of Metepeira spp.***	***No. of Argiope spp.***	**Egg Sacs**	**Comments**
1									
2									
3									
4									
5									
6									
7									
8									

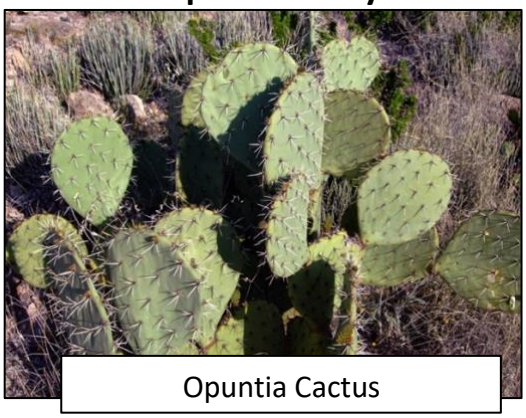
INLAND SURVEY

Researchers:	**Date/Time:**	**Wind Speed/Direction:**
Location:	**Air Temperature:**	**Humidity:**

Opuntuia Cactus	**Latitude**	**Longitude**	**Height (cm)**	**Width 1 (cm)**	**Width 2 (cm)**	***No. of Metepeira spp.***	***No. of Argiope spp.***	**Egg Sacs**	**Comments**
1									
2									
3									
4									
5									
6									
7									

8									

Cactus & Spider Survey ID Card



Opuntia Cactus

Metepeira arizonica adult

Metepeira arizonica adult

Metepeira arizonica juvenile

Metepeira arizonica egg sac

Argiope spp. adult

Argiope spp. adult

Sea Turtle Monitoring

Overview

Research Contact: Erika Santacruz Lopez (Grupo Tortuguero)

Research Location(s):

- La Gringa, Punta Arena, Glendale Field Station, South of Villa Bahia*
    - *Specific area to be chosen by Erika close to day of research

Supplies:

- Field Research Protocol: Sea Turtle Monitoring PowerPoint (for lecture portion)
- Grupo Tortuguero Morphometricos Datasheet sheets printed on Write-in-the-Rain paper (50)
- Roll of red cellophane (1)
- Rubber bands (100)
- Batteries (AA + AAA)
- Dead battery bag
- Latex Gloves
    - Medium (1 box)
    - Large (1 box)
    - XL (1 box)
- Clipboards (4)
- Pencils (10)
- Large Sea Turtle Stuffed Animal (1)
- Beach umbrellas (9)
- To go dinners + utensils + napkins (1/person)
- Trash bags (5)
- Gloves for picking up trash (10)
- Bucket for sharps (1)
- Large Food Cooler (2)
- Water jugs (3)
- Floodlights (3)
- Large map of Baja (1)
- Poster board + easel (1)
    - To hang up map of Baja
- Box of push pins (1)

Timing:

Time	Activity/Location	Breakdown
2:00 – 2:20PM	**Lecture and Prep:** Field Station	2:00 – 2:10PM: Lecture 2:10 – 2:20PM: Prep Science Notebooks
2:20 – 9:30PM	**Field Research:** Field	2:20 – 3:00PM: Drive to Research Location 3:00 – 3:15PM: Set up umbrellas 3:15 – 4:10PM: Overview of Project/Data Collection Methods (Erika) 4:10 – 4:15PM: Divide into groups 4:15 – 5:45PM Rotation 1

		• 4:15 – 4:30PM: Introductions
		• 4:30 – 5:45PM:
		  ○ Group 1: Morphometrics
		  ○ Group 2: Blood & Tissue
		  ○ Group 3: Data Analysis
		
		5:45 – 6:15PM: Dinner
		6:15 – 7:45PM: Rotation 2
		• 6:15 – 6:30PM: Introductions
		• 6:30 – 7:45PM:
		  ○ Group 1: Data Analysis
		  ○ Group 2: Morphometrics
		  ○ Group 3: Blood & Tissue
		
		7:45 – 9:15PM: Rotation 3
		• 7:45 – 8:00PM: Introductions
		• 8:00 – 9:15PM:
		  ○ Group 1: Blood & Tissue
		  ○ Group 2: Data Analysis
		  ○ Group 3: Morphometrics
		
		9:15 – 9:30PM: Wrap up/Thank You

9:30 – 10:00PM	**Return to Field Station**	

Overview of Research (Instructors Only):

- Students will participate in an ongoing turtle monitoring program run by Grupo Tortuguero. Sea turtles have been monitored by community scientists in Bahia since 1980 (Antonio Resendiz and Co. but the community began to be more involved around 1998-2000). Grupo Tortuguero has been in existence since 2018, some of the people who are now part of the group started with Antonio as children and grew up working on this project.
- Ocean Discovery Institute has been involved in sea turtle research since 2004.
- Bahía de los Àngeles is a small-scale coastal gillnet fishery. Coastal gillnet fisheries are one of the most common forms of fishing throughout the world. A gillnet is a wall of netting that hangs in the water column, typically made of monofilament. Mesh sizes of the gillnet are designed to allow fish to get their head through but not their body. The fish's gills then get caught in the mesh as the fish tries to back out of the net.
- Unfortunately, this type of fishing has high rates of bycatch (shark spp., turtle spp., fish spp., etc.). Bycatch is when other marine species, which aren't the fisherman's target species, are caught in the gillnets.
- Sea turtles are one species that have been subject to bycatch over the years. Turtles need to come to the surface every few minutes to breathe, but when they get caught in gillnets, they are unable to surface and can die.
- In the past, Ocean Discovery has worked with several scientists to study ways to reduce sea turtle bycatch from gillnet fishing, including the use of sensory-based deterrents. Sensory-based deterrents attempt to help an animal use its senses (sight, hearing, smell, taste, or touch) to

locate a net and be able to avoid it. Ocean Discovery students and their scientist mentors have tested visual deterrents (attaching shark shapes – a natural predator or sea turtles and lights to nets so animals can see them) and acoustic deterrents (attaching speakers to nets so animals can hear them). These types of sensory deterrents were all effective in reducing the number of sea turtles caught.

- There are seven species of sea turtles in the world. Currently six of the seven are endangered.
- Five of the seven types of sea turtles can be seen here in Bahía.
    - Green (most abundant)
    - Olive Ridley
    - Hawksbill
    - Loggerhead
    - Leatherback
- Common threats to sea turtles are:
    - Destruction of nesting beaches
    - Disease
    - Artificial light
    - Harvest by humans
    - Pollution
    - Fisheries bycatch
- All of these occur here in Bahía, so there is a need to monitor turtle populations to make sure they stay healthy.

Lecture & Prep

Prep for the Field

- Everyone check batteries on headlamps/flashlights.
- Everyone cut a piece of cellophane and cover their headlamp light with cellophane and rubber band.
    - Red light does not impact the turtles like white light does.
    - Red light will be easier to work in at night – prevents "night blindness".

Make a Difference

- Sea turtles have been monitored by community scientists in Bahia since 1980 - this is another example of community science.
    - Community Science is scientific research and monitoring done by local community members.
- Ocean Discovery students have been involved in the community science - sea turtle monitoring projects since 2004.
- Today we will be working with Erika Santa Cruz who has worked with Ocean Discovery Institute for years here in Baja and has also visited the Living Lab as a Scientist in Residence.
    - Masters degree: Marine Ecology
    - Was one of the first people to work with sea turtles in Ensenda and returned to Bahia de los Angles around 2017 to work with the community sea turtle restoration project and start Grupo Tortuguero.
- Grupo Tortuguero continues to carry out the conservation work the group started back in 1980. Many of the current members were children when the community began monitoring the sea turtle population and grew up working on the project.
- Currently Grupo Tortuguero does sea turtle population monitoring (which we will participate in tonight) and sea turtle nest monitoring along the beaches.

Explore and Wonder

- What are some questions people in the community might be wondering about sea turtle populations?
    - How healthy is the population of sea turtles in BLA?
    - What is the composition of the population? Males v females? Juvenile v adults? Etc.
    - Are any of the fishing regulations or use of turtle exclusion devices (relate to fisheries research) helping to improve sea turtle populations?

Investigate

- Two pieces of information scientists use to check the health of the turtle population are: 1) overall number of sea turtles in the population and 2) characteristics of the population- called morphometric data.
    - Define morphometric: external measurements of living organisms.
- Scientists can track the overall sea turtle population and characteristics of the population and look for change over time.
- In order to collect this data, scientists need to capture sea turtles to take their measurements.
- Tonight, Groupo Tortuguero will set nets in the bay and then check those nets for sea turtles approximately every 75 minutes. Any turtles they find in the nets will be removed and placed in the boats and brought back to the beach where we will take their morphometric measurements.

- Once we have collected the data, we will release the turtles back to the ocean from the beach.
- Let's take a look at some of the data we will help collect tonight and how we will take these measurements.
- Review Grupo Tortuguero Morphometricos Datasheet
    - (Erika and her team will review data collection methods in the field.)
    - (If time allows use stuffed turtle and calipers to demonstrate some of the measurements.)
- Prep Science Notebooks:
    - (See Science Notebook set up below.)

Science Notebook*

**amend notebook set up if not using "ideal week" schedule*

Field Research: Sea Turtle Monitoring

Explore & Wonder

Observations	Questions

Make a Difference

How could this research be used to make a difference?

Investigate

What types of evidence did we collect?

Is this an observational study or controlled experiment?

Analyze

Do you notice any trends/patterns in today's data? Outliers?

What do you think that tells you?

Field Research

Overview of Project & Data Collection Methods

- General introductions of Groupo Tortugero volunteers a staff.
- Overview of Groupo Tortugero and their work.
- Biology of sea turtles and endangered species status.
- Student Q & A
- Review Data Collection Methods:
    - Morphometrics
    - Blood & Tissue Samples

ROTATIONS

Introductions (small group):

- Bring members of Ocean Discovery and Grupo Tortuguero staff and volunteers and form a circle.
- Have each person take a turn and introduce themselves and say their name and their favorite sea creature.
    - Ocean Discovery students and staff should try to make their introductions in English and Spanish.
- If time remains play a name game:
    - Option 1: Toss an object to another person in the circle from the opposite organization, (i.e., Ocean Discovery throws to someone from Grupo Tortuguero and vice versa), and says their name and favorite sea creature.
    - Option 2: Once everyone has introduced themselves, have each person in the circle say their name again and make a signal (i.e., Yo soy Emma. Signal: Puts hands on head and waves finger like antlers.). Each person must repeat all the people that went before them, so person #2 has to say the name and the signal of person #1, Person #3 has to say the name and signal of person #1 and person #2, and so on.
- (Repeat this for each small group you work with.)

Data Collection

<u>Morphometric Data Station</u>

- Maximum number of people around a turtle is FOUR (including one Grupo Tortuguero person).
- Assign roles:
    - <u>Turtle Intake Card</u> (works w/ Grupo Tortugero volunteer) records information laminated card provided by Grupo Tortuguero.
        - *ideally this person should be a spanish speaker so they can communicate with Grupo Tortugero volunteer.
        - (See example Turtle Intake Card below.)
    - <u>Photographer</u> – takes photos of:
        - Completed Turtle Intake Card near head of turtle
        - Overhead shot of turtle with the completed Turtle Intake Card visable.
    - <u>Data Collector</u> (works w/ Grupo Tortugero volunteer)*– records information on “Ocean Discovery Sea Turtle Morphometrics” data sheet while Grupo Tortugero volunteer records on a separate data sheet for Grupo Tortugero data collection.

        - *ideally this person should be a spanish speaker so they can communicate with Grupo Tortugero volunteer
    - Materials person – (stands to the back of the group) – hands supplies over as needed.
    - Capture/Recapture person – (stands to the back of the group) - checks turtle tag number for whether this turtle has been captured before and shares data with the group.
        - Set up map of Baja (pin to posterboard and set on the easel).
        - If data is available show past locations of turtle using map and pins.
- When fishermen arrive back from nets help unload turtles from the boat.
- Take morphometrics:
    - Allow Grupo Tortuguero volunteer to determine how/what measurement is taken.
    - If Grupo Tortuguero volunteer feels it is appropriate, students may help take some measurements.
        - Emphasize the importance of precise measurements.
- When all turtles have been measured help release them back to the ocean by way of the beach.

Blood & Tissue Sample Station

- Students will take the following samples:
    - Blood
    - Skin
    - Carapace

Data Analysis

- Students will:
    1. Fill in their science notebook pages.
    2. Look over and analyze data they collected on data sheet.
        - Was this a study or an experiment? How do you know?
        - What have you learned today?
        - Do you think the data we collected is enough to tell a story? Why or why not?
        - Would it be beneficial to continue collecting this data each year? Why or why not?
        - Why do you think it's important to take precise measurements in a study like this?
        - Based on what you see here, what other kind of data would you want to collect?
    3. Look over and analyze past data that Erika provides.
        - What does the data tell you?
        - Do you see any trends/patterns in the data? Any outliers?
    4. Review how Grupo Tortugero communicates their findings to others:
        - Grupo Tortuguero conducts their research in a Natural Protected Area, therefore all their data is shared with the National Parks.
        - They are part of a larger network – Grupo Tortuguero de las Californias which works for the conservation of sea turtles through the commitment of all people within a community from fishermen to students to teachers to scientists to hotel workers and everyone in between.

- They use Social Media to communicate with the community of Bahia de los Angeles.
- They host booths at events such as Conservation Week.
- They run Turtle Camp for kids in the summer.
- The community is very involved with this organization because it is the community that is doing the monitoring!

5. Discuss making a difference. Ask students:
    - How could the research you did today help make a difference in the world?
    - Why might this research be important to the people of this community?
    - Based on what you have learned, what do you think next steps should be?
    - Do you think there are endangered sea turtles that live in San Diego?
6. If time allows and conditions are appropriate do a short beach clean-up.
    - Remind students not to damage plants while collecting garbage.
    - Remind students to let a staff member know if they find any sharps and to leave them until a staff member can dispose of them.

Ocean Discovery Sea Turtle Morphometrics Data Sheet

Nombre de la tortuga: BLA_____ Sexo: I / H / M
(*Name of turtle*) (*Sex*)

Especie: ☐ prieta/negra ☐ Golfina ☐ Amarilla/Perica ☐ Laud ☐ Carey
(*Species*)

Informacion de Captura:
(*Capture Information*)

Fecha: _____ Hora de captura: _____ Sitio de monitoreo: _____
(*Date*) (*Hour of capture*) (*Monitoring site*)

Sustrato: _____ Marea: Pleamar Bajamar Muerta
(*Substrate*) (*tide*) (*high tide*) (*low tide*) (*dead tide*)

Metodo de captura: red / manual / otro
(*capture method*) (*net*) (*by hand*) (*other*)

Informaction de placas:
(*Turtle tag information*)

Recaptura: Si / No Evidencia de placas Viejas: Si / No Comentarios: _____
(*Recapture*) (*Evidence of old turtle tag*) (*Comments*)

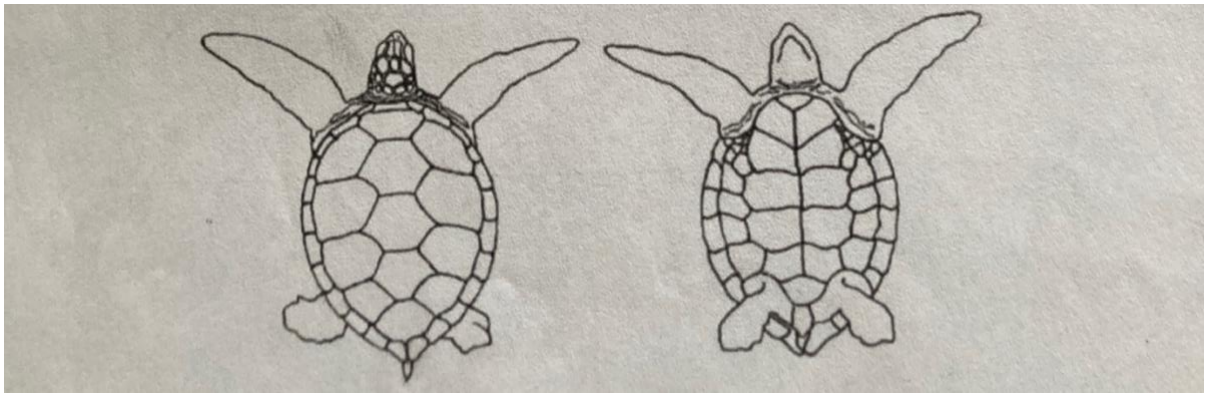
Placas Viejas # dcha: _____ izq: _____ Plastico / Metal / Anterior / Posterior
(*Old tag # on right*) (*on left*) (*Plastic*) (*Metal*) (*Front*) (*Back*)

Placas nuevas # dcha: _____ izq: _____ Anterior / Posterior
(*New tag # on right*) (*on left*) (*Front*) (*Back*)

Informaction de muestras:

TIPO (*type*)	SI	NO	LOCALIZACION (*Location*)	COMENTARIOS (*Comments*)
Fotografia				
Sangre				
Piel				
Otras				

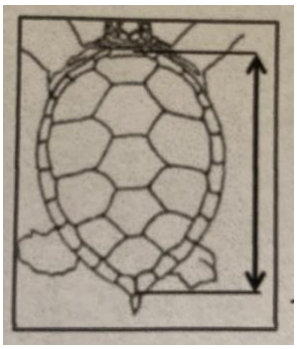
Parasitos: (Presencia / Ausencia) Epibiontes: (Presencia / Ausencia)
(*parasites*) (*present*) (*absent*) (*epibiontes*) (*present*) (*absent*)



(Indicar epibiontes, cicatrices, marcas, etc.) (*Indicate epibionts, scars, marks, etc.*)

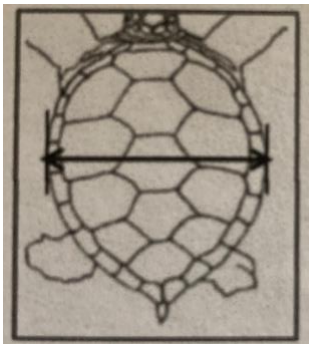
Datos morfometricos:
(*Morphometric data*)

Largo Recto Caparazon
(*long straight shell*)



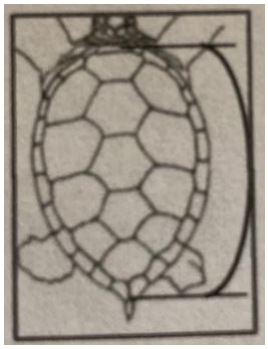
LRC: _____cm

Ancho Recto Caparazon
(*width straight shell*)



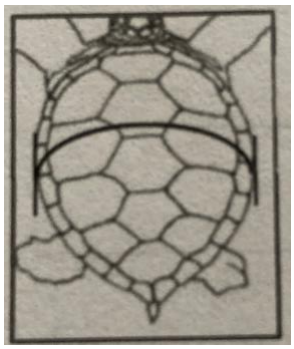
ARC: _____cm

Largo Curvo Caparazon
(*long curved shell*)



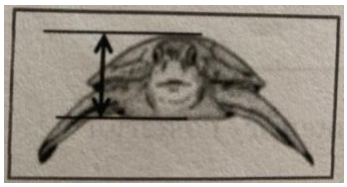
LCC: _____cm

Ancho Curvo Caparazon
(*curved shell width)*



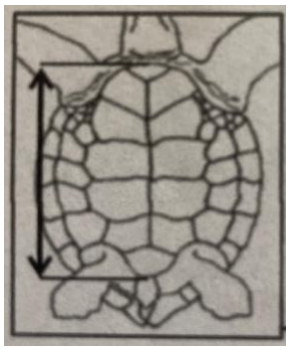
ACC: _____cm

Profundidad de cuerpo
(*body depth*)



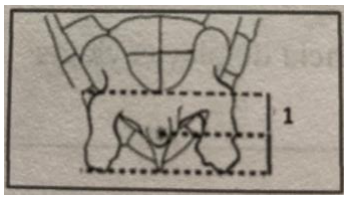
PC: _____cm

Largo de Plastron
(*Plastron length*)



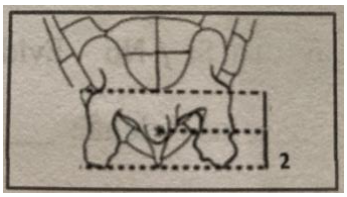
LP: _____cm

Largo Pre-Cloacal
(*Pre-cloacal length*)



LPreC: _____cm

Largo post-cloacal
(*Post cloacal length*)

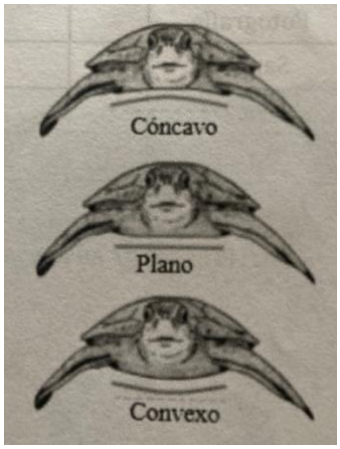


LPC: _____cm

P (kg) : _____

Presencia de unas: SI / NO
(*presence of some*)

Morfologia del Plastron:
(*plastron morphology*)



Comentarios: _____
(*Comments*)

_____

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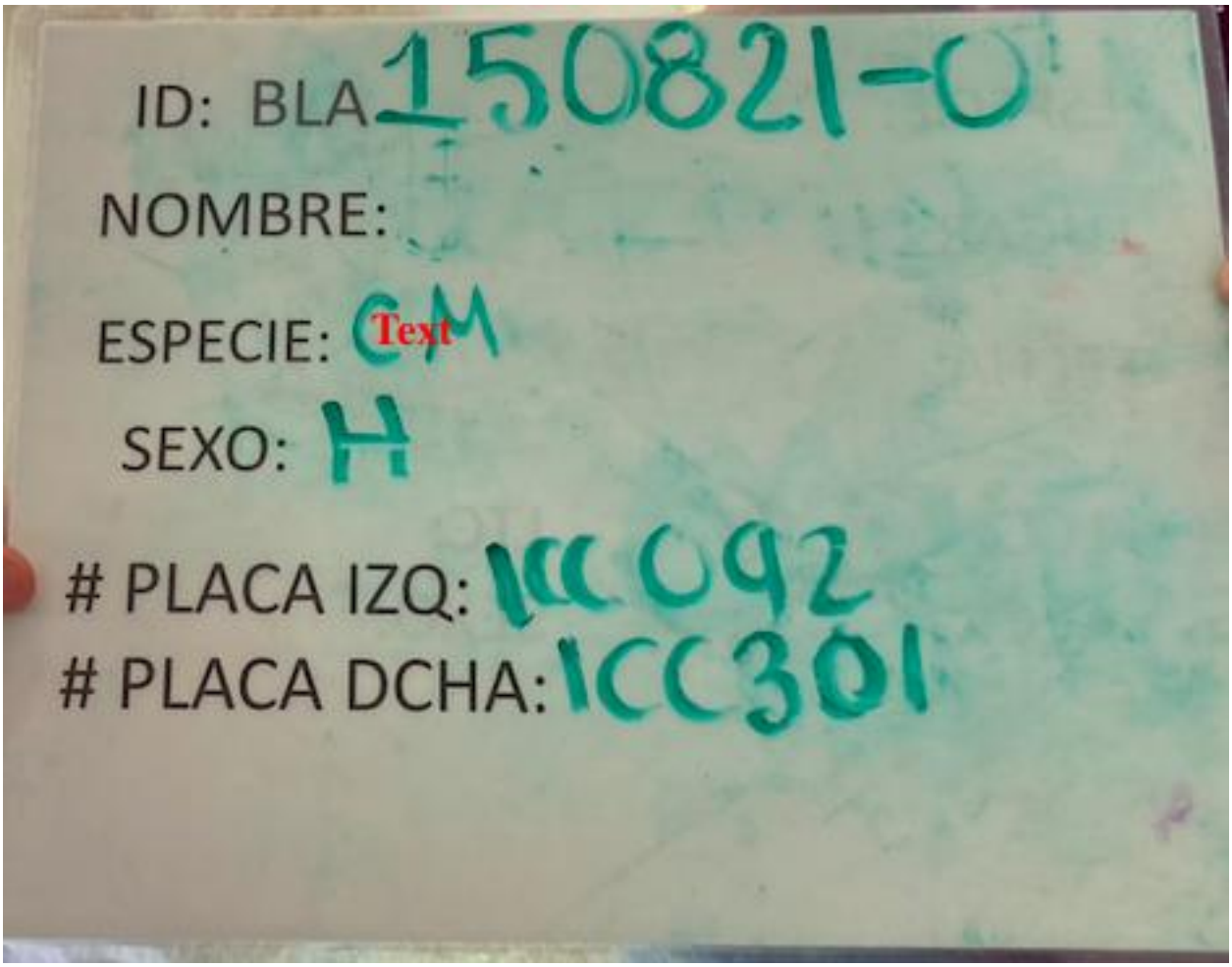
Turtle Intake Card Example



Bird Monitoring

Overview

Research Contact: Mujeres Con Alas (Bahía de los Àngeles)

- Yahaira Torres, WhatsApp (+526151131246).
- Martha
- Mercedes

Research Location(s):

- Punta Arena (2 groups)
- La Gringa (1 group)

Supplies:

- Binoculars (1/student)

Timing:

Time	Activity/Location	Breakdown
6:00 – 6:10AM	**Lecture and Prep:** Field Station	*Science Notebook Prep will be done the day before during Know it! Own it!
6:10 – 9:00AM	**Field Research:** Field	6:10 – 6:30AM: Drive to Research Location • Punta Arena (2 groups) • La Gringa (1 group) 6:30 – 6:40AM: Meet w/ Mujeres Con Alas • Introductions 6:40 – 7:00AM: Overview of Project • History of Mujeres Con Alas • Explanation of Project • Review Data Collection Methods 7:00 – 9:00AM: Walk Transect & Collect Data
9:00 – 9:30AM	**Analyze Data, Communicate, and Process Reflection:** Field	
9:30 – 10:00AM	**Departure:** Field	9:30 – 9:40AM: Thank you & Goodbyes 9:40 – 10:00AM: Drive to La Gringa
10:00 – 11:45AM	**Field Trip:** Field	
11:45 – 12:15PM	**Return to Field Station**	

Overview of Research (Instructors Only):

Mujeres Con Alas is a community science group that has been monitoring bird populations for over six years. The group consists of nine women who work in pairs and make three trips a month to three locations (La Gringa, Punta Arena, and El Rincon) to monitor the bird populations. They do their monitoring in the mornings (~6:30am) and/or the evenings (~4-5pm). The women walk a line along the shore and record the number and type of birds they find, as well as the GPS locations and behaviors they see the birds engaging in (i.e., eating, diving, resting, etc.)

- Monitoring at Punta Arena is 2km transect and goes around the point.

- Monitoring at La Gringa is a 0.8 m transect from the wooden sign by the parking area and along the shore.
- Monitoring in El Rincon is a 0.8m transect and is tide dependent – it can only be done at low tide (so this location will not be used for our protocol).

Lecture & Prep

Make a Difference

- Mujeres Con Alas is a community science group that has been monitoring bird populations for over six years. The group consists of nine women who work in pairs and make three trips a month to three locations (La Gringa, Punta Arena, and El Rincon) to monitor bird populations.
- They do their monitoring in the mornings (~6:30am) and/or the evenings (~4-5pm). The women walk a line along the shore and record the number and type of birds they find, as well as the GPS locations and behaviors they see the birds engaging in (i.e., eating, diving, resting, etc.)

Explore and Wonder

- People and scientists who live in this community may wonder:
  - Are the bird populations in Bahía de los Àngeles healthy?
  - Do the bird populations stay the same over the course of the year? (Migration vs. those that live here full time, etc.)

Investigate

- Mujeres con Alas will give us an overview of their history and review their data collection methods when we meet with them today.

Science Notebook*

**amend notebook set up if not using "ideal week" schedule*

Field Research: Bird Monitoring

Explore & Wonder

Observations	Questions

Make a Difference

How could this research be used to make a difference?

Investigate

What types of evidence did we collect?

Is this an observational study or controlled experiment?

Analysis

Do you notice any trends/patterns in today's data? Outliers?

What do you think that tells you?

Field Research

Drive to Research Locations & Meet Mujeres Con Alas

- One group will meet at La Gringa.
    - Meet at the wooden sign (see picture below).
- Two groups will meet at Punta Arena.
    - Meet in parking lot (see map below).

Introductions:

- Break into monitoring groups (Punta Arena only).
- Have each person take a turn and introduce themselves and say their name and their favorite animal.
    - Ocean Discovery students and staff should try to make their introductions in English and Spanish.
- If time remains play a name game:
    - Option 1: Toss an object to another person in the circle and says their name and favorite food.
    - Option 2: Once everyone has introduced themselves, have each person in the circle say their name again and make a signal (i.e., Yo soy Emma. Signal: Puts hands on head and waves finger like antlers.). Everyone says "Hola Emma!" and repeats her sign.

Overview of Project: (by Mujeres Con Alas)

- History of Mujeres Con Alas
- Explanation of Project
- Review of Data Collection Methods
- Do an introduction to binoculars.
    - Have students try to focus on some items to practice.

Investigate:

- Students will walk a transect with Mujeres con Alas and collect and record data.
    - La Gringa group will walk a 0.8m transect along the shore.
    - Punta Arena groups will each walk half of the 2m transect, starting closer to the parking lot and meeting at the sandy point.
        - See map below.
- Data collection will include:
    - Species identification
    - GPS location of birds
    - Bird behavior

Analyze Data, Communicate, & Make a Difference

Analyze

- Give students time to look over data they collected and fill out their science notebook pages.
- Debrief as a group.
    - Was this a study or an experiment? How do you know?
    - What does the data tell you?
        - What behaviors do you most often see birds engaging in? Do you think this would be true if you returned at noon? 4pm? Midnight?
    - Do you see any trends/patterns in the data? Any outliers?
    - Based on what you see here, what other kind of data would you want to collect?
    - Why do you think Mujeres Con Alas collects this data?

Communicate

- Ask Mujeres Con Alas:
    - Who they share their data and the things they are learning with?
    - Why they think their work is important?
    - Do they think they are making a difference in the world?
- Ask students:
    - Who do you think would benefit most from hearing about this research?
    - What do you think people should know about the work Mujeres con Alas is doing?
    - What are other ways the women can share their work with others?

Make a Difference

- Ask students:
    - Why do you think monitoring bird populations in Bahía de los Àngeles is important?
    - What could this type of data tell us?
    - How are Mujers Con Alas making a difference?
    - Is there any other data you think it would be helpful to collect?

Museo

Overview

Contact: Carolina Espinoza (Bahía de los Àngeles)

Research Location:

- El Museo de Naturaleza y Cultura (Museo)

Supplies:

- N/A

Timing:

Time	Activity/Location	Breakdown
7:15 – 7:50AM	**Lecture and Prep:** Field Station	7:15 – 7:25AM: Students get field ready 7:25 – 7:40AM: Lecture 7:40 – 7:45AM: Prep Science Notebooks 7:45 – 7:50AM: Walk to vans
7:50 – 10:15AM	**Field Research:** Field	7:50 – 8:10AM: Drive to Museo 8:10 – 8:30AM: Introduction & History of Museo 8:30 – 9:15AM: Explore Exhibits 8:30 – 8:45AM: Rotation 1 ○ Group 1: Whale Shark Exhibit ○ Group 2: Wetlands Exhibit ○ Group 3: Shell Wall Exhibit 8:45 – 9:00AM: Rotation 2 ○ Group 1: Wetlands Exhibit ○ Group 2: Shell Wall Exhibit ○ Group 3: Whale Shark Exhibit 9:00 – 9:15AM: Rotation 3 ○ Group 1: Shell Wall Exhibit ○ Group 2: Whale Shark Exhibit ○ Group 3: Wetlands Exhibit 9:15 – 9:35AM: Explore Museo Independently 9:35 – 10:35AM: Servant Leadership/Clean Museo 10:35 – 10:45AM: Thank you & Load Vans
10:45 – 11:00AM	**Return to Field Station**	

Overview of Research (Instructors Only):

Students will visit the Museo de Naturaleza y Cultura to consider a way that science is communicated – through museum exhibits. Ocean Discovery has worked with Carolina and the Museo since 2004 helping to create and update exhibits and do hands-on leaning with the community.

Lecture & Prep

Make a Difference

- The Museo de Naturaleza y Cultura is small local museum in the town of Bahia de los Angeles.
- The Museo is open to the public and shares information about the history of BLA, the natural resources of the area, and the native people of the area.
- There are many exhibits inside and outside the museum including full whale skeletons, artifacts from native people, and a shell collection with hundreds of shells, just to name a few.

Communicate

- While we won't be participating in field research today, we will be focused on the "Communicate" portion of the Science Discovery Process.
    - We will be looking at one of the ways scientists can "share what they have learned" which is through museum exhibits.
- When we visit the museum today we will be looking at some of the exhibits in detail to determine what they are communicating and how they are communicating it.
- When exhibits are designed to communicate knowledge, several things must be considered:
    - Who is my audience?
        - Not other scientists – communicating w/ the general public.
        - Information must be communicated in a way your audience can understand.
    - What is being communicated?
        - Be clear about what you want to share with people and include only the relevant details.
    - How does what's being communicated relate to people's lives?
        - Explain to people why it is important they care about this subject.
    - How is the exhibit grabbing and holding people's attention?
        - Colors, visuals, touch, sound, etc.

Servant Leadership

- While at the museum today we will also be participating in some Servant Leadership.
- It will be an opportunity for us to give back to the community of Bahia de los Angeles who have welcomed us these past two weeks and spent time helping us to learn about how the science discovery process works by inviting us to participate in their science research projects and letting us look through the Museo.
- We will be helping the museums director, Carolina Espinoza, by doing some light cleaning.
- Remember that you are representing Ocean Discovery Institute today and to Be Your Best Self! Even if you aren't excited about cleaning today remember this is a chance to give back to the community, give 110% on whatever task you are assigned!

Science Notebook*

**amend notebook set up if not using "ideal week" schedule*

Communication: Museo	
Exhibit #1 What is being communicated (main idea)?	**Exhibit #2** What is being communicated (main idea)?
How does this relate to people's lives?	How does this relate to people's lives?
How is this exhibit grabbing people's attention (color, visuals, touch, etc.)?	How is this exhibit grabbing people's attention (color, visuals, touch, etc.)?
What would you add to make this exhibit even stronger?	What would you add to make this exhibit even stronger?

Field Research

8:10 – 8:30AM: Introduction & History of Museo

- This will be done by Carolina Espinoza

8:30 – 9:15AM: Explore Exhibits

- (See rotations above ~15 min/exhibit)
- Take students to your first exhibit.
- Let students simply look over the exhibit for a few minutes.
- Then have student sit quietly and fill in their science notebook page based on the exhibit.
- Have a short group discussion about the answers to the questions on their science notebook page.
- Repeat for 2nd and 3rd exhibits.
    - Students do not need to fill in science notebook pages for their 3rd exhibit, you can simply discuss and answer questions as a group.
- If you finish filling out and discussing the science notebook page ask students:
    - Why do you think museums are important?
    - What other ways could scientists communicate the things they learn from their research?
    - Why might having the Museo be important to the people of this community?
    - Are there museums in San Diego you like to visit or would like to visit?

9:15 – 9:35AM: Explore Museo Independently

- Allow student to explore indoor and outdoor exhibits at their leisure.

9:35 – 10:35AM: Servant Leadership/Clean Museo

- Gather all students together remind them they will be participating in some Servant Leadership here at the Museo.
- Remind students that this is an opportunity to give back, that they should be their Best Self and give 110% to whatever task Carolina asks them to do.
- Carolina will assign and describe tasks.

10:35 – 10:45AM: Thank you & Load Vans

- Remind students to walk up and shake Carolina's hand and do a personal thank you before getting into vans.

Know it! Own it!

Know it! Own it! Overview

Overview: Students learn a series of tools to record new knowledge, organize it, identify and fill gaps in their new knowledge, and recall this knowledge to utilize in new circumstances.

Goals: Students learn and utilize Know it! Own it! growth mindset tools to support their learning through the below activities:

- Process Reflection: Students reflect on their field research experiences and link these experiences to the Science Discovery Process.
- Science Discovery Process Lecture: Students can name and describe all parts of the Science Discovery Process and learn a new Growth Mindset tool to support learning – Notetaking with Bullet Points.
- Paper Airplane Lab: Students experience all parts of the Science Discovery Process through an investigation of their own.
- Study Hall: Students practice using Growth Mindset set tools to support learning – Asking an Expert, Study Time, and Study Skills while utilizing the Growth Mindset Practice to analyze Exit Ticket data and determine next steps for themselves.

Timing/Location: 115 minutes

- Process Reflection: (~20 min) Classroom
- Science Discovery Process Lecture & Paper Airplane Lab: (~ 50 min) Classroom & Quad
- Study Hall & Office Hours: (~45 min) Classroom & Quad

Supplies (All days):

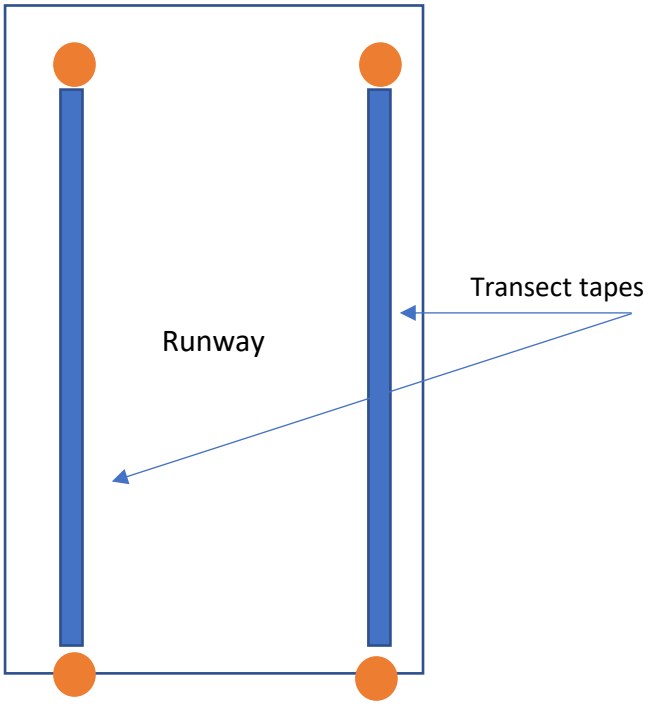
- Projector (1/cohort)
- Laptop (1/cohort)
- Know it! Own it! PowerPoint
- Science Discovery Process poster + easel (1/cohort)
- Dry erase markers (3/cohort)
- Ream of blank white paper 8 x 11” (2/cohort)
- Ream of blank white paper 11 x 17” (1 cohort)
- Blank “Science Discovery Process Concept Map” on 11 x 17” paper (200/cohort)
- Student Communication Presentation document (1/pair of students)
    - Papi://Curriculum/LI New/Ocean Leader Intro to Research Program/Intro to Research Materials
- Index cards (~25/student)
- Large paper clips (1/student)
- 100m transect tape (6/cohort)
- Small orange cones (12/cohort)
- Simple calculators (15/cohort)
- Scissors (3/cohort)
- Growth Mindset Article (1/student)* (Day 1 only)
- Question Set (for the specific day) (1/student)
- Bubble Water (1/student)

- Sun Tea or Lemonade (1 glass/student)

Set Up

- Set up Science Discovery Process poster at front of room.
- Set up laptop, projector and screen and project the day's Know it! Own it! slideshow.
- Place reams of paper, index cards, paper clips, and Question Sets off to the side.
- Create three "runways" for paper airplane testing (see diagram below)*.
    - **runways do not need to be set up every day – check curriculum.*
    - For each runway:
        - Set up two orange cones for front of runway and two for end.
        - Set up two 100m transect tapes along the left and right side of the runway.

Paper Airplane Runway Set-up



Know it! Own it! Overview				
Day	**Process Reflection**	**Science Discovery Process Lecture**	**Paper Airplane Lab**	**Study Hall**
1	Overview of Growth Mindset and Know it! Own it!	Explore & Wonder: **Ask Questions and Make Observations**	Explore & Wonder: **Ask Questions and Make Observations**	Overview
2	Explore & Wonder: **Ask Questions and Make Observations**	Investigate: **Make Hypothesis**	Investigate: **Make Hypothesis**	Flash Cards
3	Investigate: **Make Hypothesis**	Investigate: **Design Investigation: Control vs. Experimental**	Investigate: **Design Investigation: Control vs. Experimental**	Flash Cards
4	Investigate: **Design Investigation: Control vs. Experimental**	Investigate: **Replicates & Gather Evidence**	Investigate: **Replicates & Gather Evidence**	Flash Cards Ask an Expert
5	Investigate: **Replicates & Gather Evidence**	Investigate: **Observational Study vs. Controlled Experiment**	Investigate: **Run Investigation & Collect Evidence**	Concept Map Ask an Expert
6	Investigate: **Observational Study vs. Controlled Experiment**	Analyze: **Examine Results through Trends & Outliers**	Analyze: **Examine Results through Trends & Outliers**	Flash Cards Ask an Expert
7	N/A	N/A	N/A	N/A
7 night	Anazlyze: **Examine Results through Trends & Outliers**	N/A	N/A	N/A
8	Analyze: **Examine Results through Trends & Outliers**	Analyze: **Accept/Reject Hypothesis and Propose Explanations**	Analyze: **Accept/Reject Hypothesis and Propose Explanations**	Concept Map Ask an Expert
9	**Accept/Reject Hypothesis and Propose Explanations**	Analyze & Communicate: **Summarize Data**	Analyze & Communicate: **Summarize Data**	Test Questions Ask an Expert
10	All	Communicate: **Share with Others**	Communicate: **Share with Others**	Concept Map Ask an Expert
11	Analyze & Communicate: **Summarize Data and Publish Your Work**	Communicate: **Share with Others**	Communicate: **Share with Others**	Test Questions Ask an Expert
12	Study for Final Exam	Study for Final Exam	Final Exam	Grade and Reflect

Day 1: Asking Questions & Making Observations

Timing:*
** There is extra time today because there is no process reflection.*

- Growth Mindset:
  - 0:00 – 0:05 Overview
  - 0:05 – 0:15 Read Article on Growth Mindset
  - 0:15 – 0:25 Discuss Article on Growth Mindset
  - 0:25 – 0:30 Know it! Own it! Overview

- Science Discovery Process Lecture:
  - 0:30 – 0:35 Share Goals & Science Discovery Process Overview
  - 0:35 – 0:45 Focus: Explore & Wonder
  - 0:45 – 0:50 Growth Mindset Tool
  - 0:50 – 0:55 Model Notetaking w/ Bullet Points
  - 0:55 – 1:00 Copy Notes

- Paper Airplane Lab:
  - 1:00 – 1:05 Share Goals & Paper Airplane Lab Overview
  - 1:05 – 1:10 Design a Paper Airplane
  - 1:10 – 1:15 Gallery Walk
  - 1:15 – 1:20 Science Notebook
  - 1:20 – 1:35 Testing Zone
  - 1:35 – 1:45 Debrief

- Study Hall:
  - 1:45 – 1:50 Study Hall Overview
  - 1:50 – 1:55 Science of Studying

Growth Mindset

Overview
- One of the things we want you to focus on as an Ocean Leader is having a Growth Mindset.
- Define Growth Mindset.
  - Growth Mindset: means you believe your intelligence, abilities, and skills can be developed over time through dedication and hard work and challenges are an opportunity to grow.
  - Having a growth mindset is important because science research tells us that people with a growth mindset perform better in school, take on more challenging tasks, and persist through challenges.

Read article on Growth Mindset
- Students should underline two things they think are interesting.
- Students should put one "?" next to something they don't understand.

Discuss article on Growth Mindset

- Think-Pair-Share:
  - What was something you found interesting in the article?
  - Do you think a growth mindset would be an asset in life? Why or why not?
  - Do you think you have a fixed or growth mindset? Why?
- Review Fixed vs. Growth Mindset
  - Give an example: I'm bad at Math.
- Science behind a Growth Mindset:
  - In simplistic terms, neural pathways in our brain are things we learn. When we learn something or connect something new to something we already know we are laying down new neural pathways = we are learning.
  - People with a growth mindset believe they can create more neural pathways by asking questions, challenging themselves, working hard when things are difficult, and persevering. And they are right!
  - Science has shown our brains are plastic – meaning they can change and grow over time.
  - The amazing thing about a growth mindset is that anyone can develop a growth mindset even if you've had a fixed one in the past.
  - All of us can add more neural pathways in our brain, we just need to realize that sometimes it is easier for put these pathways down than others but that when it's difficult we shouldn't give up because everyone is capable of learning with hard work.
  - Having a growth mindset applies to all aspects of our lives, not just school. You can have a growth mindset about, your ability to play sports, cook, read, be artistic, etc. It's possible to have a growth mindset about all these things and many others.
- Introduce Growth Mindset Tools
  - Throughout this program we will help you learn some tools to help support having a growth mindset.
  - Try to think of each of these tools like tools in a toolbox. They are tools that can be helpful when you encounter a challenge or an opportunity in your life.
  - Going forward try to think of challenges as an opportunity to grow. When you face an opportunity to grow, consider which tools could help you along your way.

Know it! Own it! Overview

- We will teach you tools to support:
  - Learning
  - Healthy Bodies
  - Strong Hearts and Mind
- Every day after Salud we will work on tools to support your learning.
  - These are tools you can use throughout your life and especially in high school and college.
- Review the daily agenda for Know it! Own it! and describe the goal of each part.
  - Process Reflection
  - Science Discovery Process Lecture
  - Paper Airplane Lab

  - Study Hall
- Process Reflection will begin tomorrow after our first day in the field.
- Science Discovery Lecture, Paper Airplane Lab, and an overview of Study Hall will begin today.

Science Discovery Process Lecture

Share Goals (**Slide**)

- Students can name and describe all parts of the Science Discovery Process.
  - Through a daily lecture you will learn each part of the Science Discovery Process in detail.
  - You will then apply this new knowledge during a lab where you will design your own experiment.
- Students learn a new Growth Mindset Tool to support Learning: Taking notes using bullet points.
  - During the lecture portion each day you will learn to take notes using bullet points.
  - Today simply listen to the lecture and we will create a set of notes together afterwards.

Science Discovery Process Overview

- The Science Discovery Process is at the heart of science.
- It is used to test a hypothesis and answer a question.
- Review the Science Discovery Process using an example and the poster.
  - It is a cycle.
  - Making a Difference is at the center because, scientists often want to make a difference in the world, so their observations and questions come from this.
    - Review an example (point to each part on the poster):
      - **Make a Difference**: A scientist cares about the environment.
      - **Explore & Wonder:**
        - Observes: Lots of trash on the beach.
        - Question: Where is this trash coming from?
      - **Investigate**: Observes the beach every day to see where trash is coming from.
      - **Analyze**: Most of the trash is blowing out of trash cans that are too full.
      - **Communicate**: Shares this information with waste management who agrees to pick up the trash daily instead of twice a week.
      - **Make a Difference**: There is less trash on the beach now.

Focus: Explore and Wonder

- We will learn about each of the parts of the Science Discovery Process in depth over the next two weeks.
- Today, we will focus on Explore and Wonder.
  - Making Observations and Asking Questions.
    - Define observation: using the senses to gather information from the natural world.
    - Define question: something that may help us to answer or figure out the reason for some observation.

- Questions often come from something we are curious about. Curiosity is simply the desire to know or learn about something.
- Making observations and asking questions is an important part of the Science Discovery Process because it is these observations and questions that often lead scientists to create an investigation.
- Not all questions and observations lead to an investigation, but it is important to write down your questions and observations because you never know what will create a spark.

- Review examples of observations and questions.
  - Example #1:
    - Observation: Sometimes the water in the bay is blue and sometimes it is gray.
    - Question: I wonder if the water temperature influences what color the water is.
  - Example #2:
    - Observation: Some of the plants in my mom's garden are short and some are tall.
    - Question: I wonder if fertilizer can affect how tall the plants will grow?
  - Example #3:
    - Observation: Sometimes water shot out of a water gun goes further than other times. People shoot water out of their water guns at different angles.
    - Question: I wonder if the angle of the water gun effects how far the water will go?

<u>Growth Mindset Tool</u>

- Introduce why notetaking is important.
  - Note-taking is a way to learn knowledge (Know it!)
  - Lectures are a way for professors/teachers to share information quickly.
    - You may have been expected to "take notes" while a teacher talks or shows a PowerPoint.
  - Having a "tool" to help you take notes during a lecture is important.
    - This is a skill that can be used in your high school classes and in college.
    - At this point you may have a certain mindset about taking notes.
    - Remember to focus on growth mindset. If taking notes has been a challenge before, you can work on learning this tool, so that you can get better at taking notes in the future.
- Introduce notetaking using Bullet Points.
  - During a lecture don't try to copy everything.
  - Write down main points and big ideas only – these are your bullet points.
  - When taking notes using bullet points you need to listen and stay focused. Your goal is to identify what the main ideas are.

<u>Model Notetaking with Bullet Points</u>

- Use mental modeling to show students how to create bullet pointed notes from Science Discovery Process Lecture slides on the whiteboard.

<u>Students Copy Bullet Point Notes</u>

Paper Airplane Lab

Share Goal

- During the Paper Airplane Lab, you will participate in the entire Science Discovery Process yourself.

Paper Airplane Overview

- Everyone will work with a partner to answer a question and test a hypothesis by designing an investigation, collecting, and analyzing evidence, coming to a conclusion, and sharing what they learned.
- We will do this using paper airplanes.
- Although we are limiting your experiment to paper airplanes to keep supplies low, you will be able to test the hypothesis of your choice.

Focus: Explore and Wonder

- During today's lab we will focus on Asking Questions and Making Observations.

Design a Paper Airplane:

- Everyone will make a paper airplane using a single piece of paper.
- You will have four minutes to work.
- Do not throw your airplane until told to do so.

Gallery Walk:

- (Let students walk around and look at everyone's paper airplane.)

Science Notebook:

- Set up science notebook page.
    - (Student open to next blank page in their notebook.)
        - Create a T-chart:
        - One side title: Observations
        - One side title: Questions
    - Give students time to write down any observations or questions that might have come up with while they were walking around looking at everyone's paper airplanes.
        - Give an example and show on whiteboard:
            - Observation: I noticed that someone cut their paper in half and made a smaller paper airplane.
            - Question: I wonder if small planes fly further?

Testing zone:

- Let students know they will have 8-10 minutes to test their paper airplanes and make observations.
- Review expectations:
    - Be your best-self.
    - Students may do as many tests as they want during the 8-minute testing period.
    - Throughout the testing period they should stop occasionally to write down observations and questions they think of in their science notebooks.

- Students can change their airplanes but must use their original piece of paper.

Debrief

- Give students two minutes to write down any last-minute observations and questions they want to note.
- Have students share with the group observations/questions they made during the testing zone time.
- In the following days during paper airplane lab you will decide on a hypothesis to test, design an investigation, collect and analyze data, and come to a conclusion about your paper airplane hypothesis.
- Remind students that recording observations and questions is one step in the Science Discovery Process.
    - When we go out in the field tomorrow I want you to all focus on making observations and asking questions.

Study Hall

Study Hall Overview

- Every day after the Paper Airplane Lab we will have Study Hall.
- Remember on or our big goals for the program is for you to understand and be able to describe all the parts of the Science Discovery Process.
- You will take both a mid-term and a final exam so we can see if this program is helping you to meet that goal.
- Study hall is a time to prepare for those exams.

Science of Studying:

- A lot of research has been done looking at how people studying. Here's what science tells us about studying:
    - Short study sessions (~30-45 min) is better than long study sessions.
    - Several study sessions over a period of time before a test is better than cramming a day or two before.
    - Studying using several short study sessions over a period of several days will increase your ability to retain the knowledge (remember it).
    - Therefore, we will have study hall for ~20 minutes each day for several days before your mid-term exam and again before your final.
- How you use your study time is much more important that how long you study for.
    - Some of the best things you can do during study time are:
        - Utilizing strong study skills such as flash cards, concept maps
        - Creating and answering your own test questions
        - Teaching someone else what you know
        - Stay focused – don't multi-task (no phones or off topic conversations)
- We will start Study Hall tomorrow.

Day 2: Make Hypothesis

Timing

- Process Reflection:
  - 0:00 – 0:10 Share Goals and Process Reflection Overview
  - 0:10 – 0:15 Independent Work
  - 0:15 – 0:20 Pair-Share
- Science Discovery Process Lecture:
  - 0:20 – 0:30 Science Discovery Process Lecture
  - 0:30 – 0:35 Model Notetaking
  - 0:35 – 0:40 Students Copy Notes
- Paper Airplane Lab:
  - 0:40 – 0:50 Paper Airplane Hypothesis
  - 0:50 – 1:00 Students Write Hypothesis
  - 1:00 – 1:10 Choose a Hypothesis to Test
- Study Hall
  - 1:10 – 1:20 Flash card into
  - 1:20 – 1:30 Create flash cards
  - 1:30 – 1:40 Study Hall
  - 1:40 – 1:55 Data and Next Steps

Process Reflection

Share Goals and Process Reflection Overview:

- Students reflect on their experiences in the field to link these experiences to the Science Discovery Process. **(Slide)**
- Remind students why reflection is important.
  - Reflection is part of "Knowing". **(Slide)**
  - Reflection is another tool we have in our toolbox that supports our learning. **(Slide)**
  - Reflection is a time to reflect on our experiences and organize new knowledge into what we already know.
- Every day we will take time to think about how what we experience during the morning's field research fits into the Science Discovery Process.
  - We will do this using a concept map of the Science Discovery Process.
    - It is an exact replica of the SDP poster we use every day without the words.
    - The goal is for you to fill out this concept map as you learn new things and have difference experiences in the field.
- Demonstrate how to fill out the concept map:
  - Today's area of focus was "Explore and Wonder" and "Making observations" and "Asking Questions"
    - Write all those words into the concept map.
  - Now I want to add additional things to the concept map that I think are important about these things.

        - For example: I might want to add the definition of making observations to this concept map. I will draw a new bubble to write the definition of "making observations" and since it is an idea that is related to this Explore and Wonder I will draw a line connecting the two.
    - During our field time today, although we didn't participate in research project, we spent the morning making observations and asking questions about the Bay.
        - Let's take a moment to add some connecting ideas to our Explore and Wonder bubble.
            - Give an example: Today I observed some Blue-footed Booby birds high up on the cliff side.
                - Draw a connecting bubble from Explore and Wonder and write in it: "Observation: Blue-footed Booby birds sitting high on cliff side."
            - It made me wonder: How are they able to stay up there without falling?
                - Draw a connecting bubble from the above bubble and write in it: "Question - How are they able to stay up there without falling?
            - Do they raise chicks up there?
                - Draw a connecting bubble from the "observation" bubble and write in it: "Question - Do they raise chicks up there?
    - Concept maps should make sense to you!
        - Everyone's will look a little different.
        - Lines between bubbles means ideas are connected.

<u>Independent Work</u>

- Give students five minutes to work on their own concept map.

<u>Pair-Share</u>

- Students to pair up and share their concept maps.
- Ask students to share some of the things they added to their concept map.
- Have students write their names on their concept maps and collect them to be used the next day.

Science Discovery Process Lecture

<u>Science Discovery Process Lecture</u>

- Investigate.
    - Delve into the next step of the Science Discovery Process - Investigate. **(Slide)**
    - Focus on "Make Hypotheses".
- Hypothesis.
    - Define <u>Hypothesis</u>: an educated guess based on information you already know. **(Slide)**
    - After scientists have come up with a question, they will then form a hypothesis based on information they already know or research from other scientists.
    - If…Then…:

        - Most but not all hypotheses are written as if… then… statements that show a cause-and-effect relationship.
- Examples.
    - Example #1: **(Slide)**
        - Observation: My aunt has plants and most of them are short. My grandpa also has plants but many of his are tall. It rains more where my grandpa lives.
        - Question: I wonder if the amount of water a plant gets can affect how tall it will grow?
        - Hypothesis: If a plant gets more water, then it will grow taller.
    - Example #2: **(Slide)**
        - Observations: Some of the plants in my mom's garden are short and some are tall. My mom puts fertilizer on some of her plants but I'm not sure which ones.
        - Question: I wonder if fertilizer can affect how tall it will grow?
        - Hypothesis: If a plant gets fertilizer, then it will grow taller.
    - Example #3: **(Slide)**
        - Observations: Sometimes water shot out of a water gun goes further than other times. People shoot water out of their water guns at different angles.
        - Question: I wonder if the angle of the water gun effects how far the water will go?
        - Hypothesis: If I create a greater angle to the floor with my water gun then, the water will shoot further.
- If time allows have students look at the observations and questions they wrote in their science notebook at try to make a hypothesis.

<u>Model Notetaking</u>

- Review why taking notes is important.
    - Notetaking is part of "Knowing". **(Slide)**
    - Notetaking allows us to write down the main ideas of new knowledge. It creates a record that we can look back at and use to organize our knowledge later.
    - Notetaking is another tool we have in our toolbox that supports our learning. **(Slide)**
- Use mental modeling to show students how to create bullet pointed notes from Science Discovery Process Lecture slides.

<u>Students copy notes</u>

- (Have students copy bullet pointed notes into their notebooks.)

Paper Airplane Lab

<u>Paper Airplane Hypothesis:</u>

- Write a Hypotheses: **(Slide)**
    - You and your partner will write several hypotheses based on your observations, questions, and personal knowledge about paper airplanes.
    - Remember the goal isn't to write a hypothesis you know is correct. The goal of writing a hypothesis is that it is something that you can test.

- Use the If…., then…. format.
- To be sure we have time to create an investigation, make sure your hypothesis is only testing one thing.
- Examples: **(Slide)**
  - Not strong hypotheses:
    - Not in If.. then.. format: Longer paper airplanes fly further.
    - Testing more than one thing: If I make the wings on my paper airplane wider and longer my paper airplane will fly further.
  - Well written hypotheses:
    - Testing one thing: If I make the wings on my paper airplane wider, then my plane will fly further.
    - Testing one thing: If I cut my paper airplane wings into a curve, then my plane will be able to fly in a circle.
- Your goal is to write 2-3 hypotheses.

Students Write Hypothesis

Choose a Hypothesis to Test:

- Have each pair chose ONE hypothesis to test for the duration of the program.
  - Be sure to choose a hypothesis that interests you- this what you will be testing over the next few weeks.
  - Each pair must agree on their hypothesis and circle it in their notebooks.
- Give students time to choose.
  - (Walk around and make sure all chosen hypotheses can be tested.)
- Tomorrow during our field research we will focus on hypothesis but continue to ask questions and make observations.

Study Hall

Intro to Flash Cards

- Owning Knowledge.
  - Flash cards are a part of "Owning" new knowledge. **(Slide)**
  - Owning knowledge means that we understand the knowledge, have organized it into our existing knowledge, memorized it, and can now apply it in new circumstances.
  - One part of owning knowledge is memorizing it. Memorizing knowledge allows us to recall it more easily and apply it to future learning.
  - Flash cards are a way to memorize knowledge.
  - Flash cards are another tool we have in our toolbox that supports our learning. **(Slide)**

- Introduce Flash Cards. **(Slide)**
  - One of the best ways to memorize knowledge is by using flash cards.
  - Flash cards are simply cards that have related information on both sides.
  - Review example flash cards.
    - Definitions
      - Write "Define Question"

- Write on opposite side "Question: something that may help us to answer or figure out the reason for some observation."
- Short Answer
  - Write: What are the parts of Explore and Wonder?
  - Write on the opposite side: "Making Observations and Asking questions"
- Examples:
  - Write "Give one example of a hypothesis."
  - Write on the opposite side: "If a car has circular headlights, then it will get better gas mileage."

- Review places to look for information to make flash cards:
  - Science notebook
  - Concept map

<u>Create Flash Cards</u>

- Review expectations for creating flash cards. **(Slide)**

<u>Study Hall</u>

- Purpose of Study Hall:
  - Taking time to study is another tool for owning your knowledge. (Slide)
  - Study hall is a time and place that is set aside for you to start owning your knowledge by studying your flash cards.
  - When you look at flash cards you are trying to memorize what is on them.
  - Read them to yourself. If you can answer the question correctly, put it in one pile and if you can't put it in another.
    - Spend more time reading and rereading the questions from the pile you don't know.
- Give students five minutes to study their flash cards independently.
  - Remind students that science tell us we should be focused during this short study time.
  - Take this time to read over both sides of your flash cards and memorize the knowledge.
- Have partners test each other's knowledge by using their flash cards.

<u>Data and Next Steps</u>

- Introduce Question Set.
  - Each day we will end Study Hall with a short set of questions.
  - We will answer the questions independently.
  - This is not a test. It's a tool for you to understand what you know and don't know yet.
- Complete Question Set.
  - (Hand out Question Set Day 2 to each student and let students work ~ 5 minutes.)
- Grade Question Set.
  - Each of you will assess your own Question Set.
  - (Share answers to questions.)
- Data Analysis.
  - Try to look at how you did without judgement. There isn't a good or bad score – this is data.

  - The data tells you what you know and what you don't know.
  - Growth Mindset means we can all learn through hard work. If there are things you don't know yet, you can make it a point to study them tomorrow and improve.
- Next Steps
  - Let's take this data and create a next step for ourselves for tomorrow.
  - Next steps should be short and specific.
    - Review example Next Steps. **(Slide)**
  - At the bottom of your question set write ONE next step for tomorrow – be sure your next step is short and specific.
- (Collect Next Steps so they can be returned to students the next day.)

Day 3: Design Investigation: Control vs. Experimental

- Process Reflection:
  - 0:00 – 0:05 Review Goals and Process Reflection Overview
  - 0:05 – 0:15 Independent Work
  - 0:15 – 0:20 Pair-Share
- Science Discovery Process Lecture:
  - 0:20 – 0:30 Science Discovery Process Lecture
  - 0:30 – 0:35 Create Notes as a Group
  - 0:35 – 0:40 Students Copy Notes
- Paper Airplane Lab:
  - 0:40 – 0:45 Paper Airplane Investigation
  - 0:45 – 1:05 Students Design an Investigation
  - 1:05 – 1:10 Share Investigation Design
- Study Hall
  - 1:10 – 1:15 Review Flash Cards
  - 1:15 – 1:25 Create flash cards
  - 1:25 – 1:40 Study Hall
  - 1:40 – 1:55 Data and Next Steps

Process Reflection

Review Goals and Process Reflection Overview

- Remind students why reflection is important.
  - Reflection is part of "Knowing". **(Slide)**
  - Reflection is another tool we have in our toolbox that supports our learning. **(Slide)**
  - Reflection is a time to reflect on our experiences and organize new knowledge into what we already know.
- Each day we will take time to think about how what we experience during the morning's field research fits into the Science Discovery Process.
  - We will do this using a concept map of the Science Discovery Process.
    - The goal is for you to fill out this concept map as you learn new things and have difference experiences in the field.
    - We will build off the concept map we started yesterday.
  - Every day one area of focus will be: Make a Difference.
    - That is because almost all science starts with someone thinking about how they can make a difference in the world.
      - (Fill in the Make a Difference Bubble.)
    - Through today's field research in what way were we looking to make a difference?
      - (Fill in Solve Problems Facing Our Planet.)

- (Create a bubble connected to Make a Difference that says, "exploring how climate change can effect animals in the intertidal".)

Independent Work

- Hand back students concept maps from the previous day.
- Give students ten minutes to work on their own concept map.

Pair-Share

- Students to pair up and share their concept maps.
- Facilitate a group discussion using the Science Discovery Process poster.
    - What connections have students made to the SDP and today's research.
- Have students write their names on their concept maps and collect them to be used the next day.

Science Discovery Process Lecture

Science Discovery Process Lecture (Slide)

- Investigate.
    - Delve into the next step of the Science Discovery Process - Investigate. **(Slide)**
    - Focus on "Design Investigation".
- Investigation.
    - Define Investigation: a plan for testing a hypothesis.
        - Once scientists have come up with a hypothesis they must design an investigation to test their hypothesis.
    - Experimental Group versus Control Group
        - Often when designing an investigation a scientist must create both a control group and an experimental group.
            - Define Control Group: The group that you are exposing to "normal" conditions.
                - Control groups are critical during an investigation. They are the benchmark to which the experimental group will be compared to show that whatever treatment you applied to the experimental group was what caused the change.
            - Define Experimental Group: The group where you are changing something. There can be more than one experimental group in an investigation.
- Examples:
    - Example #1 **(Slide)**
        - Observations: Some of the plants in my mom's garden are short and some are tall.
        - Question: I wonder if fertilizer can affect how tall it will grow?
        - Hypothesis: If a plant gets fertilizer, then it will grow taller.

        - Investigation: Take two plants that are the same height and put them next to each other where they get the same amount of sun each day.
            - Give plant #1 fertilizer (Experimental)
            - Give plant #2 no fertilizer (Control)
            - Measure the heights of both plants every other day for 30 days.
    - Example #2 **(Slide)**
        - Observations: Sometimes water shot out of a water gun goes further than other times. People shoot water out of their water guns at different angles.
        - Question: I wonder if the angle of the water gun effects how far the water will go?
        - Hypothesis: If I create a greater angle to the floor with my water gun then, the water will shoot further.
        - Investigation: Fill seven of the same water guns with water.
            - Create an angle of 15 degrees to the floor with one water gun and shoot the water (Experimental).
            - Create an angle of 30 degrees to the floor with one water gun and shoot the water (Experimental).
            - Create an angle of 45 degrees to the floor with one water gun and shoot the water (Experimental).
            - Create an angle of 60 degrees to the floor with one water gun and shoot the water (Experimental).
            - Create an angle of 75 degrees to the floor with one water gun and shoot the water (Experimental).
            - Create an angle of 90 degrees to the floor with one water gun and shoot the water (Experimental).
            - Create an angle of 0 degrees to the floor with one water gun and shoot the water (Control).
            - Measure the distance the water goes for each gun.

<u>Create Notes as a Group</u>

- Remind students why taking notes is important.
    - Notetaking is part of "Knowing". **(Slide)**
    - Notetaking allows us to write down the main ideas of new knowledge. It creates a record that we can look back at and use to organize our knowledge later.
    - Notetaking is another tool we have in our toolbox that supports our learning. **(Slide)**
- Work together as a group to create a set of notes students can copy. Potential questions include:
    - What is the main topic today?
    - What are some important pieces vocabulary/definitions/ideas that you think we should capture?
- (As students come up with strong bullet points – write them on the board.)

<u>Students copy notes</u>

- (Have students copy bullet pointed notes into their notebooks.)

Paper Airplane Lab

Paper Airplane Investigation:

- Design an investigation. **(Slide)**
  - Now you and your partner will design an experiment to test the hypothesis you decided on yesterday.
  - You must label the control and the experimental versions.
    - Example 1:
      - Hypothesis: If I make the wings on my paper airplane wider, then my plane will fly further.
      - Investigation: Design two paper airplanes. One with wings that are two inches wide **(control)** and one with wings that are six inches wide **(experimental)**. Fly both paper airplanes and measure their distance.
    - Example 2:
      - Hypothesis: If I cut my paper airplane wings into a curve, then my plane will be able to fly in a circle.
      - Investigation: Design two paper airplanes. One with regular wings **(control)** and one with wings cut into a curve **(experimental)**. Fly both paper airplanes and observe what they do.

Students Design an Investigation

- As students work, walk around to each pair, and look at their design.

Share Investigation Designs:

- Have 2-3 groups share their hypothesis and investigation design.
  - Have the other students determine the control and experimental versions.
- Tomorrow during our field research, we will focus on design investigation, looking for the control and experimental versions, but we will continue to ask questions, make observations, and learn what the hypothesis is.

Study Hall

Review Flash Cards

- Review Owning Knowledge.
  - Flash cards are a part of "Owning" new knowledge. **(Slide)**
  - Owning knowledge means that we understand the knowledge, have organized it into our existing knowledge, memorized it, and can now apply it in new circumstances.
  - One part of owning knowledge is memorizing it. Memorizing knowledge allows us to recall it more easily and apply it to future learning.
  - Flash cards are a way to memorize knowledge.
  - Flash cards are another tool we have in our toolbox that supports our learning. **(Slide)**

Create Flash Cards

- Review locations to look to create flash cards (lecture notes, concept maps, etc.)
- Review expectations for creating flash cards. **(Slide)**
- Goal is to create a minimum of five flash cards.
- Remember while you are looking over your notes to create flash cards if questions come up you will have time to ask an expert during study hall.
- Give students ten minutes to create flash cards.

<u>Study Hall</u>

- Review Next Steps from previous day:
    - Return the previous day's Next Steps to each student.
    - Ask students to read over the next step they wrote for themselves.
    - Today is a new day. With our growth mindset we can decide to work hard today if we didn't yesterday or to continue working hard if we did yesterday so that we can be successful in understanding the Science Discovery Process.
- Review purpose of Study Hall:
    - Taking time to study is another tool for owning your knowledge. **(Slide)**
    - Study hall is a time and place that is set aside for you to start owning your knowledge by studying.
- Use your flash cards to study.
    - Create two piles – cards you know and cards you don't
    - Study the ones you don't.
    - Later during study hall we will pair you up and you will get tested using someone else's flash cards.
        - This is helpful because it will allow you to recognize the same question written in a different way and to experience questions you haven't thought of.
- Give students time to study independently.
- During the last five minutes of study hall let students quiz each other using their partners flash cards.

<u>Data and Next Steps</u>

- Review Question Set.
    - Each day we will end Study Hall with a short set of questions.
    - We will answer the questions independently.
    - This is not a test. It's a tool for you to understand what you know and don't know yet.
- Complete Question Set.
    - (Hand out Question Set Day 3 to each student and let students work ~ 5 minutes.)
- Grade Question Set.
    - Each of you will assess your own Question Set.
    - (Share answers to questions.)
- Data Analysis.
    - Look at how you did without judgement. There isn't a good or bad score – this is data.
    - The data tells you what you know and what you don't know.

  - Growth Mindset means we can all learn through hard work. If there are things you don't know yet, you can make it a point to study them tomorrow and improve.
- Next Steps
  - Let's take this data and create a next step for ourselves for tomorrow.
  - Next steps should be short and specific. **(Slide)**
  - Turn over your Question Set and write ONE next step for tomorrow – be sure your next step is short and specific.
- (Collect Next Steps so they can be returned to students the next day.)

Day 4: Replicates & Gathering Evidence

- Process Reflection:
  - 0:00 – 0:10 Independent Work
  - 0:10 – 0:15 Pair
  - 0:15 – 0:20 Share
- Science Discovery Process Lecture:
  - 0:20 – 0:30 Science Discovery Process Lecture
  - 0:30 – 0:35 Create Notes as a Group
  - 0:35 – 0:40 Students Copy Notes
- Paper Airplane Lab:
  - 0:40 – 0:45 Paper Airplane Gather Evidence & Replicates
  - 0:45 – 1:05 Students Determine How to Gather Evidence & Replicates
  - 1:05 – 1:10 Share Gathering Evidence Designs
- Study Hall
  - 1:10 – 1:20 Intro to Ask and Expert
  - 1:20 – 1:25 Create Flash Cards
  - 1:25 – 1:45 Study Hall & Ask an Expert
  - 1:45 – 1:55 Data and Next Steps

Process Reflection

Independent Work
- Hand students back their concept map from the previous day.
- Give students ten minutes to work on their own concept map.

Pair
- Students to pair up and share their concept maps.

Share
- Facilitate a group discussion using the Science Discovery Process poster.
  - What connections have students made to the SDP and today's research.
- Have students write their names on their concept maps and collect them to be used the next day.

Science Discovery Process Lecture

Science Discovery Process Lecture

- Investigate.
  - Science Discovery Process – Continue with Investigate. **(Slide)**
  - Focus on "Gathering Evidence".
- Evidence.
  - Define Evidence: data that either supports or counters a hypothesis.
    - Evidence is usually collected on a data sheet or in a science notebook.
    - The way evidence will be collected must be clear and consistent.
      - Same measurement units (centimeters, kilograms, etc.)
      - Clear measurements (measure from soil to top of plant, etc.)
- Examples.
  - Example #1 **(Slide)**
    - Observations: Some of the plants in my mom's garden are short and some are tall.
    - Question: I wonder if fertilizer can affect how tall it will grow?
    - Hypothesis: If a plant gets fertilizer, then it will grow taller.
    - Investigation: Take two plants that are the same height and put them next to each other where they get the same amount of sun each day. Give plant #1 fertilizer. Give plant #2 no fertilizer.
    - Evidence: Measure the heights of all plants in centimeters (to the nearest tenth of a centimeter) from the soil to the highest point on the plant every other day for 30 days.
  - Example #2 **(Slide)**
    - Observations: Sometimes water shot out of a water gun goes further than other times. People shoot water out of their water guns at different angles.
    - Question: I wonder if the angle of the water gun effects how far the water will go?
    - Hypothesis: If I create a greater angle to the floor with my water gun then, the water will shoot further.
    - Investigation: Fill seven of the same water guns with 30mL of water. Create an angle of 15 degrees to the floor with one water gun and shoot the water. Create an angle of 30 degrees to the floor with one water gun and shoot the water. Create an angle of 45, 60, 75, and 90 degrees to the floor with four other water guns. Create an angle of 0 degrees to the floor with one water gun and shoot the water.
    - Evidence: Pull the water gun trigger for three seconds and measure the distance in meters the furthest droplet of water goes for each water gun.
- Replicates
  - Look at our first experiment. Is there anything that concerns you as a scientist?
    - Issue: We only had one of each plant. Something else could have happened to Plant #2 (i.e., it had better light during part of the day, better air currents, etc.)
  - Replicates:
    - When doing a scientific experiment, you want to make sure you are using replicates.

        - Define <u>Replicates</u>: an exact copy on which exactly the same procedure is done.
    - Replicates are important because they reduce experimental error and increases confidence (extra light on one plant, one of the water guns being poorly made, etc.)
- Examples.
    - Example #1 **(Slide)**
        - Observations: Some of the plants in my mom's garden are short and some are tall.
        - Question: I wonder if fertilizer can affect how tall it will grow?
        - Hypothesis: If a plant gets fertilizer, then it will grow taller.
        - Investigation: Take six plants that are the same height and put them next to each other where they all get the same amount of sun each day. Give plant #1, 2, and 3 fertilizer. Give plants #4, 5, and 6 – no fertilizer.
        - Evidence: Measure the heights of all plants in centimeters (to the nearest tenth of a centimeter) from the soil to the highest point on the plant every other day for 30 days.
        - Replicates: 3

    - Example #2 **(Slide)**
        - Observations: Sometimes water shot out of a water gun goes further than other times. People shoot water out of their water guns at different angles.
        - Question: I wonder if the angle of the water gun effects how far the water will go?
        - Hypothesis: If I create a greater angle to the floor with my water gun then, the water will shoot further.
        - Investigation: Fill 28 of the same water guns with 30 mL of water. With four of the water guns, create an angle of 15 degrees to the floor and shoot the water. With four of the water guns, create an angle of 30 degrees to the floor and shoot the water. Continue with four guns for 45-, 60-, 75-, and 90-degree angles with the floor. With the last four water guns, create an angle of 0 degrees to the floor and shoot the water.
        - Evidence: Pull the water gun trigger for three seconds and measure the distance in meters the furthest droplet of water goes for each water gun.
        - Replicates: 4

<u>Create Notes as a Group</u>

- Remind students why taking notes is important.
    - Notetaking is part of "Knowing". **(Slide)**
    - Notetaking allows us to write down the main ideas of new knowledge. It creates a record that we can look back at and use to organize our knowledge later.
    - Notetaking is another tool we have in our toolbox that supports our learning. **(Slide)**
- Work together as a group to create a set of notes students can copy. Potential questions include:
    - What is the main topic today?

  - What are some important pieces vocabulary/definitions/ideas that you think we should capture?
- (As students come up with strong bullet points – write them on the board.)

Students copy notes

- (Have students copy bullet pointed notes into their notebooks.)

Paper Airplane Lab

**Teaching Note: be sure to communicate with mentors that the largest number of replicates for any group should be 10 (20 total flights (10 of control and 10 of experimental). Otherwise, there will not be enough time for all groups to test.*

Paper Airplane Gather Evidence & Replicates:

- Gathering evidence. **(Slide)**
  - You and your partner will determine how to collect evidence based on the investigation you designed yesterday.
    - You will write a description of how you want your evidence collected.
    - Remember that evidence collection needs to be clear and consistent.
    - Show example description.
- Determine the number of replicates:
  - You and your partner will also determine how many replicates you want to have for your investigation.
  - The more replicates the less experimental error and the more confidence you will have in your data – however the number of replicates must be reasonable to collect in the time you have.
  - Tomorrow you and your partner will have about 20 minutes to run your experiment and collect evidence.
- Your description for gathering evidence and the number of replicates you will do must be written in your science notebook.

Students Determine How to Gather Evidence & Replicates

- As students work, walk around to each pair, and be sure their evidence gathering is clear and consistent and they have determined a number of replicates.

Share Gathering Evidence Designs:

- Have 2-3 groups share their plant for gathering evidence.
  - Have the other students determine if there are any holes in their plan.
- Tomorrow during our field research, we will focus on looking at how evidence is gathered and replicates, but we will continue to design investigation, looking for the control and experimental versions, but we will continue to ask questions, make observations, determine the hypothesis, and see how investigations are designed.

Intro to Ask an Expert

- Knowing Knowledge.
  - Asking an Expert is part of "Knowing" new knowledge and is another Growth Mindset tool that helps support your learning. **(Slide)**
  - When we look at new knowledge from lectures or concept maps sometimes, we realize there is gap in our understanding - something we didn't understand.
  - That's when "Asking an Expert" comes into play.
- Ask an Expert.
  - Every day during study hall you can opt to "Ask an Expert" something that you don't understand, or you want to know more about.
  - Who are experts?
    - People who have knowledge about the field you have a question about.
      - High school teachers, college professors, mentors, etc.
- Comfort level.
  - Have a growth mindset when seeking help from an expert. Challenges we sometimes face:
    - Feeling intimidated.
      - Try not to be intimidated, teachers WANT you to come and ask questions when you don't understand.
      - If it's helpful to you, have a list of questions to ask, but that isn't necessary.
    - Feeling like you don't have a trusting relationship with an expert you need to talk to.
      - Sometimes we feel like we might not "like" or "know" an expert we need help from.
      - If possible, set these feelings aside and understand that you don't have to have a strong relationship or any relationship with an expert to ask a question or get help.
- How do I know if I need to Ask an Expert.
  - There are many signs that it might be helpful to talk to an expert.
    - Here:
      - Low score on an exit ticket.
      - Not being able to fill in your concept map.
      - Having a question about something.
      - That general "feeling" that you don't understand or you feel lost during a lecture.
      - Struggling to apply knowledge.
        - Example: You learned about if…, then… hypothesis statements but struggled to write your own for your paper airplane experiment.
    - School:
      - Low score on quiz or test.

- Looking at your notes and not understanding something in them.
- Struggling to apply knowledge. Ex. I have notes on how to solve this math problem but I can't seem to do it.

<u>Create Flash Cards</u>

- Review Owning Knowledge.
  - Flash cards are a part of "Owning" new knowledge. **(Slide)**
  - Owning knowledge means that we understand the knowledge, have organized it into our existing knowledge, memorized it, and can now apply it in new circumstances.
  - One part of owning knowledge is memorizing it. Memorizing knowledge allows us to recall it more easily and apply it to future learning.
  - Flash cards are a way to memorize knowledge.
  - Flash cards are another tool we have in our toolbox that supports our learning. **(Slide)**
- Create flash cards.
  - Review locations to look to create flash cards (lecture notes, concept maps, etc.)
  - Review expectations for creating flash cards. **(Slide)**
  - Goal is to create a minimum of five flash cards.
  - Remember while you are looking over your notes to create flash cards if questions come up you will have time to ask an expert during study hall.
- Give students five minutes to create flash cards.

<u>Study Hall & Ask an Expert</u>

- Review Purpose of Study Hall:
  - Taking time to study is another tool for owning your knowledge. (Slide)
  - Study hall is a time and place that is set aside for you to start owning your knowledge by studying independently or with a partner using your study tools- flash cards.
- Review Next Steps from previous day:
  - Return the previous day's Next Steps to each student.
  - Ask students to read over the next step they wrote for themselves.
  - Today is a new day. With our growth mindset we can decide to work hard today if we didn't yesterday or to continue working hard if we did yesterday so that we can be successful in understanding the Science Discovery Process.
- Options for Study Hall:
  1. Study individually or in pairs using flash cards.
  2. Ask a Expert – talk to an expert about a question or concept you are struggling with.
  3. A combination: Start by asking and expert then using time to study on your own or with a partner.
- Ask an Expert:
  - Introduce all "experts" that will be available to work with students during study hall.
  - If you want to talk with an expert simply approach them where they are sitting and introduce yourself, if you don't already know them, and then ask for help!
- Independent Study Time:
  - Give students 10-15 minutes to study hall time.

Data and Next Steps

- Review Question Set.
  - Each day we will end Study Hall with a short set of questions.
  - We will answer the questions independently.
  - This is not a test. It's a tool for you to understand what you know and don't know yet.
- Complete Question Set.
  - (Hand out Question Set Day 4 to each student and let students work ~ 5 minutes.)
- Grade Question Set.
  - Each of you will assess your own Question Set.
  - (Share answers to questions.)
- Review Data Analysis.
  - Look at how you did without judgement. There isn't a good or bad score – this is data.
  - The data tells you what you know and what you don't know.
  - Growth Mindset means we can all learn through hard work. If there are things you don't know yet, you can make it a point to study them tomorrow and improve.
- Review Next Steps
  - Let's take this data and create a next step for ourselves for tomorrow.
  - Next steps should be short and specific. **(Slide)**
  - Turn over your Question Set and write ONE next step for tomorrow – be sure your next step is short and specific.
- (Collect Next Steps so they can be returned to students the next day.)

Day 5: Observational Study vs. Controlled Experiment

- Process Reflection:
  - 0:00 – 0:10 Independent Work
  - 0:10 – 0:15 Pair
  - 0:15 – 0:20 Share
- Science Discovery Process Lecture:
  - 0:20 – 0:30 Science Discovery Process Lecture
  - 0:30 – 0:35 Create Notes Independently
  - 0:35 – 0:45 Pair-Share Note Sets
- Paper Airplane Lab:
  - 0:45 – 0:50 Paper Airplane: Run Investigation & Collect Evidence
  - 0:50 – 1:10 Students Run Investigation & Collect Evidence
- Study Hall
  - 1:10 – 1:25 Concept Maps as a Study Tool
  - 1:25 – 1:45 Study Hall & Ask an Expert
  - 1:45 – 1:55 Data and Next Steps

Process Reflection

Independent Work
- Give students ten minutes to work on their own concept map.

Pair
- Students to pair up and share their concept maps.

Share
- Facilitate a group discussion using the Science Discovery Process poster.
  - What connections have students made to the SDP and today's research.

Science Discovery Process Lecture

Science Discovery Process Lecture
- Investigate.
  - Science Discovery Process – Continue with Investigate. **(Slide)**
  - Focus on "Design Investigations".
- Observational Study vs. Controlled Experiment
  - Two types of research – Observational Study and Controlled Experiment
    - Define an Observational Study: an investigation which examines a subject in their natural environment without changing or altering anything.
      - Example:
        - Question: Do bears sleep the same amount all year?
        - Investigation: a scientist sets up a camera to observe a bear den and everyday records the time the bear leaves the den (wakes up) and the bear returns to the den (goes to sleep).

- Here the scientist changes nothing – they are simply observing and gathering evidence: the amount of time a bear sleeps.
- Observational studies are often referred to as "monitoring".
    - Monitoring refers to watching and observing something.
    - Example:
        - Question: Is climate change effecting the desert ecosystem in Baja?
        - Investigation: a scientist could set up transects in the desert to catalogue the types of plants and animals that make up the desert ecosystem, then come back on a yearly basis and repeat that investigation to see if anything changes – that would be considered monitoring.

- Define Controlled Experiment: an investigation which assigns the subjects to different groups, in each group all the factors are kept the same except for one variable factor that the scientist manipulates.
    - Example:
        - Question: Does studying vocabulary help student do better on a math test?
        - Hypothesis: If students study math vocabulary before a test, then they will score higher on the test than students who don't.
        - Investigation: Four classes from the same math teacher are each given two hours to study for an upcoming quiz.
            - Two of the classes are given flash cards with common math vocabulary that will appear on their quiz. They are told to study the flash cards for 30 minutes of the two-hour study time. (Experimental Group)
            - Two of the classes study for two hours without vocabulary flash cards. (Control Group)
            - Quiz scores for each class will be collected.
    - Here the scientist is manipulating the availability of flash cards to study with.

- Application.
    - Do a think-pair-share with the below examples – is this an observational study or controlled experiment?
        - Example #1:
            - Question: Does eating strictly organic food have on overall effect on health?
            - Investigation: The researcher found 200 individuals, where 100 of them have eaten organically for the past three years, and the other 100 haven't eaten organically in the past three years. They then give each subject an overall health assessment.
        - Observational Study. The scientists did not manipulate anything but simply collected data from an already existing group of people.

        - Example #2:

- Question: Does Fish Food A or Fish Food B help fish grow faster?
- Investigation: A scientist takes 16 fish that are all four centimeters long when measured from mouth to the fork of their tail. All of the fish are kept in the same tank. Half the fish are fed 2 oz of Fish Food A at 8AM and 3PM, the other half of the fish are fed 2 oz of Fish Food B at 8AM and 3PM. All fish are measured (in centimeters) every four days from mouth to tail fork for three months.

▪ Controlled Experiment: The type of food is being manipulated.

▪ Example:
- Question: Are increasing ocean temperatures impacting the size of bluefin tuna?
- Investigation: A scientist goes out on a fishing boat from 7AM-12PM two days every month for six years. She sets two lines in the water with 12 cm herrings as bait on each line. Any Bluefin Tuna that is caught is brought aboard and measured (in meters) from mouth to tail fork and from first dorsal fin to the tip of the pelvic fin, and then released back into the ocean. All other fish are not measured and immediately released.

▪ Observational Study: The scientist isn't manipulating anything they are simply catching fish and collecting data.

<u>Create Notes as an Individual</u>

- Remind students why taking notes is important.
- Today you will practice taking notes individually. You will have five minutes to look at the information on the slides and create a set of notes for yourself. After that you will compare notes with a partner, and we will discuss as a group.
- Some questions to ask yourself as you create your notes (**Slide**):
  - What is the main topic today?
  - What are some important pieces vocabulary/definitions/ideas/examples that you think you should capture?

<u>Students create a set of individual notes</u>

<u>Pair-Share Note Sets</u>

- In a moment you will work with a partner to compare your notes.
  - Go line by line.
    - Check mark: If you and your partner have the same note (does NOT need to be in the same order) talk about why you thought it was important.
    - ? mark: If you have a note your partner doesn't.
  - Look at ? marks. Ask your partner why they thought that note was important to include, then decide if you want to add it to your notes and do so.
- (Have students partner up and review notes.)

- If time allows have students share out some notes they created and explain why they thought, they were important.
    - Allow students to add to their notes if they want based on what is shared.

Paper Airplane Lab

**Teaching Note: Communicate with additional adults and mentors who are helping to monitor the runways. Their goal is to make sure everyone is being respectful AND no bad science is happening (i.e., Students doing extra trials (because it's fun), not counting a trial because they didn't throw it right – they must record the data as is (this will be an outlier and we will talk about it later), etc.*

Paper Airplane: Run Investigation & Collect Evidence

- Ask student to identify if their paper airplane investigation is an experiment or observation.
- Today you will run your investigation and collect evidence.
- Based on the evidence you want to collect that you decided on yesterday you and your partner need to design a data collection sheet.
    - You've seen several of these during our field research.
    - You need to make sure you collect all important data to accept or reject your hypothesis.
        - Remember that evidence collection needs to be clear and consistent.
        - Remember you must have space to collect evidence for all your replicates.
- Datasheet:
    - Evidence collection sheet will be created in your science notebook.
    - Once your data collection sheet has been approved by an adult you can go to one of the runways to gather evidence.
    - Once your data collection sheet has been approved no more changes can be made! You cannot decide to change your airplane design, your number of replicates, etc. even if you don't like what the data looks like!
        - Sometimes we get unexpected data and that's okay. As scientists it is important to follow through with your investigation without changes, because we may learn something unexpected and that is just as important as proving a hypothesis correct.
    - While you are waiting to get your datasheet approved you may also be building your TWO test paper airplanes.
- Review expectations for investigation:
    - Be respectful:
        - All scientists need to collect data, so take turns.
        - Do not cross the runway when other scientists are gathering evidence.
    - Be curious:
        - Ask other scientists about the investigation they are doing and the data they are collecting – by talking to other scientists you can often get great ideas for your own investigation!
    - Be safe:
        - Do not throw a paper airplane if someone is on the runway collecting their paper airplane.

- Collecting evidence:
  - You and your partner will approach the runway with your experimental and your control planes. You will:
    - You will throw each one, remember be consistent – how are you holding the plane each time, how much force are you using, etc.
    - Collect your data.
    - Pick up your planes and move to the back of the runway line.
  - Repeat this until you have all the replicates you decided on.

<u>Students Run Investigation & Collect Evidence</u>

- If students finish early encourage them to Be Curious! and watch the other scientists at work.
- (If there is not enough time for all students to collect all their evidence assure them that they can finish the next day.)

Study Hall

<u>Concept Maps as a Study Tool</u>

- Owning Knowledge.
  - Concept maps are a part of "Owning" new knowledge and are another tool we have in our toolbox that supports our learning. **(Slide)**
  - We have been working on our concept maps every day during process reflection because one of the best ways to take knowledge from knowing to owning is to identify relationships between ideas and linking them together.
  - Science tells us that understanding these relationships and making a visual representation of those connections can help you understand things at a much deep level and make it easier for you to remember and retrieve the knowledge later.
- Studying with a Concept Map:
  - Take time to look over your concept map – try to remember your main ideas and the connections between ideas.
  - Cover up a bubble with your hand and see if you can remember what was in the bubble and the ideas connected to that bubble.
  - Turn your concept map over at some point and try to visualizing it in your mind. What parts of it do you remember?
    - Spend more time looking over the sections you don't remember.
  - Finally, you can take a blank concept map (show students where these are) and try to fill it in and see what you remember and what you don't.
    - We are going to practice this today.
- Independent Study Time:
  - Give students five minutes to study their concept maps independently.
- Test Concept Map Knowledge:
  - Give each student a blank "Science Discovery Process Concept Map" on 11 x 17" paper and let them try to fill in as much of it as they can remember.
    - You will not be able to fill in all Science Discovery Process bubbles yet – we are building up to this.
      - Focus on: Make a Difference, Explore and Wonder, and Investigate bubbles.

- You may decide to add new connections and remove some of the ones on your concept map- and that's okay. You can chose to write down different questions or observations – that's all okay too.
- (Turn Science Discovery Process poster around so it can't be seen.)

Study Hall & Ask an Expert

- Review Purpose of Study Hall:
  - Taking time to study is another tool for owning your knowledge. (Slide)
  - Study hall is a time and place that is set aside for you to start owning your knowledge by studying independently or with a partner using your study tools- flash cards and concept maps.
- Review Next Steps from previous day:
  - Return the previous day's Next Steps to each student.
  - Ask students to read over the next step they wrote for themselves.
  - Today is a new day. With our growth mindset we can decide to work hard today if we didn't yesterday or to continue working hard if we did yesterday so that we can be successful in understanding the Science Discovery Process.
- Options for Study Hall:
  1. Study individually or in pairs using concept map and/or flash cards.
  2. Ask a Expert – talk to an expert about a question or concept you are struggling with.
  3. A combination: Start by asking and expert then using time to study on your own or with a partner.
- Ask an Expert:
  - Introduce all "experts" that will be available to work with students during study hall.
  - If you want to talk with an expert simply approach them where they are sitting and introduce yourself, if you don't already know them, and then ask for help!
- Independent Study Time:
  - Give students 10-15 minutes to study hall time.

Data and Next Steps

- Complete Question Set.
  - (Hand out Question Set Day 5 to each student and let students work ~ 5 minutes.)
- Grade Question Set.
- Review Data Analysis.
- Review Next Steps
- (Collect Next Steps so they can be returned to students the next day.)

Day 6: Examine Results through Trends & Outliers

- Process Reflection:
  - 0:00 – 0:15 Review Analyze Data, Communicate, and Make a Difference
  - 0:15 – 0:20 Independent Work
- Science Discovery Process Lecture:
  - 0:20 – 0:30 Science Discovery Process Lecture
  - 0:30 – 0:35 Create Notes Independently
  - 0:35 – 0:45 Pair-Share Note Sets
- Paper Airplane Lab:
  - 0:45 – 0:50 Paper Airplane: Examine Results through Trends & Outliers
  - 0:50 – 1:05 Students Examine Results through Trends & Outliers
  - 1:05 – 1:10 Share Results, Trends, and Outliers
- Study Hall
  - 1:10 – 1:20 Create Flash Cards
  - 1:20 – 1:40 Study Hall & Ask an Expert
  - 1:40 – 1:55 Data and Next Steps

Process Reflection

Analyze Data, Communicate, and Make a Difference

- See Whale Shark Field Research Protocol

Independent Work

- Give students ten minutes to work on their own concept map.

Science Discovery Process Lecture

Science Discovery Process Lecture

- Analyze.
  - Science Discovery Process – Analyze. **(Slide)**
  - Focus on "Examine Results & Trends and Outliers".
- Examine results
  - Define Examine Results: Looking over the collected data and organizing it in a way that makes it understandable.
    - Once scientists have run their investigation it is time to start analyzing the data they collected.
    - There can be a lot of data which can sometimes feel overwhelming. One way to make data feel less overwhelming is by taking averages.
  - Define average: a number that is a representation of a data set.
    - Review finding the average of something: add all the values and then divide by the number of values.
    - Example:
      - Question: Are boys or girls taller in Ms. Smith's 1st grade classroom?
      - Data set (on slide)

    - Get an average for the girls and the boys (have all students do this together).
- Define <u>Trend</u>: patterns or similarities in the data.
    - Equate to social media.
        - When something is "trending" it's because a lot of people are mentioning it on social media. Same with data – if a lot of your results are starting to fall into certain patterns or common numbers, that's what we call a trend.
    - Example **(Slide):**
        - Observations: Some of the plants in my mom's garden are short and some are tall.
        - Question: I wonder if fertilizer can affect how tall it will grow?
        - Hypothesis: If a plant gets fertilizer, then it will grow taller.
        - Investigation: Take six plants that are the same height and put them next to each other where they all get the same amount of sun each day. Give plant #1, 2, and 3 fertilizer. Give plants #4, 5, and 6 – no fertilizer.
        - Evidence: Measure the heights of all plants in centimeters (to the nearest tenth of a centimeter) from the soil to the highest point on the plant every other day for 30 days.
        - Replicates: 3
        - Data set (on slide):
            - Trends:
                - Trend 1: all plants are growing taller.
            - Average: (do the math)
                - Trend 2: the plants that were given fertilizer (#1-3) grew taller.

- Define <u>Outlier</u>: a data point that falls outside the normal range.
    - Should you remove outliers from your data set? – No.
        - They are part of the data collected and should not be removed.
        - Outliers can often be very interesting and it can be worth trying to figure out why they may have occurred.
    - Example **(Slide):**
        - Observations: Some of the plants in my mom's garden are short and some are tall.
        - Question: I wonder if fertilizer can affect how tall it will grow?
        - Hypothesis: If a plant gets fertilizer, then it will grow taller.
        - Investigation: Take six plants that are the same height and put them next to each other where they all get the same amount of sun each day. Give plant #1, 2, and 3 fertilizer. Give plants #4, 5, and 6 – no fertilizer.
        - Evidence: Measure the heights of all plants in centimeters (to the nearest tenth of a centimeter) from the soil to the highest point on the plant every other day for 30 days.
        - Replicates: 3
        - Data set (on slide):
            - Outlier: Plant #3 grew much taller than then the others.

        - What possible explanation: Possibly a bird was coming over an pooping in this plant on a regular basis providing it with additional nutrients.

- Application.
    - Do a think-pair-share with the below examples:
    - Example #1 **(Slide):**
        - Observations: Sometimes water shot out of a water gun goes further than other times. People shoot water out of their water guns at different angles.
        - Question: I wonder if the angle of the water gun effects how far the water will go?
        - Hypothesis: If I create a greater angle to the floor with my water gun then, the water will shoot further.
        - Investigation: Fill 28 of the same water guns with 30 mL of water. With four of the water guns, create an angle of 15 degrees to the floor and shoot the water. With four of the water guns, create an angle of 30 degrees to the floor and shoot the water. Continue with four guns for 45-, 60-, 75-, and 90-degree angles with the floor. With the last four water guns, create an angle of 0 degrees to the floor and shoot the water.
        - Evidence: Pull the water gun trigger for three seconds and measure the distance in meters the furthest droplet of water goes for each water gun.
        - Replicates: 4
        - Data set (on slide):
            - Trends:
                - What trends do you see?
                - Take the averages using math.
            - Outlier:
                - Which of these is an outlier? Why do you think that?
                - What could have caused this to happen?
    - Example #2 **(Slide):**
        - Question: Does Fish Food A or Fish Food B help fish grow faster?
        - Investigation: A scientist takes 16 fish that are all four centimeters long when measured from mouth to the fork of their tail. All of the fish are kept in the same tank. Half the fish are fed 2 oz of Fish Food A at 8AM and 3PM, the other half of the fish are fed 2 oz of Fish Food B at 8AM and 3PM. All fish are measured (in centimeters) every four days from mouth to tail fork for three months.
        - Data set (on slide)
            - Take averages.
            - Trends?
            - Outliers?
                - Possible explanation?

<u>Create Notes Independently</u>

- Remind students why taking notes is important.

- Today you will practice taking notes individually. You will have five minutes to look at the information on the slides and create a set of notes for yourself. After that you will compare notes with a partner, and we will discuss as a group.
- Some questions to ask yourself as you create your notes (**Slide**):
    - What is the main topic today?
    - What are some important pieces vocabulary/definitions/ideas/examples that you think you should capture?
- Give students ~ 5 minutes to create their own notes.

Pair-Share Note Sets

- In a moment you will work with a partner to compare your notes.
    - Go line by line.
        - Check mark: If you and your partner have the same note (does NOT need to be in the same order) talk about why you thought it was important.
        - ? mark: If you have a note your partner doesn't.
    - Look at ? marks. Ask your partner why they thought that note was important to include, then decide if you want to add it to your notes and do so.
- (Have students partner up and review notes.)
- If time allows have students share out some notes they created and explain why they thought, they were important.
    - Allow students to add to their notes if they want based on what is shared.

Paper Airplane Lab

Paper Airplane: Examine Results through Trends & Outliers:

- Looking for trends and outliers. **(Slide)**
    - You and your partner will look at the evidence you collected yesterday from your investigation and look for trends and outliers.
- Listed on the board are the three things you and your partner will each need to have in your science notebook by the end of Lab time today. **(Slide)**
    - Find averages and record them
    - Find trends and record them in full sentences in your notebook.
    - Look for and identify outliers in your data, record if you have any or none.
        - If you find an outlier – try to remember if anything occurred during that trial.

Students Examine Results through Trends & Outliers:

- As students work, walk around to each pair, and be sure they are able to take averages and find trends and outliers.
- (If one group finishes early have them copy their data to the white board so that the group can discuss their data using the same questions.)
- Tomorrow during our field research, we will focus on looking for trends, pattern, and outliers in the data, consider how many replicates are being done, what kind of evidence is being gathered, and what the hypothesis is, while continuing to ask question and make observations.

Share Results, Trends, and Outliers:

- Review the data set on the board.
    - Ask other students to find trends and outliers.
- Tomorrow during our field research, we will focus on looking at results and within those results looking for trends and outliers. We will continue to look at all the other parts of the Science Discovery Process as well.

Study Hall

Create Flash Cards

- Review Owning Knowledge.
    - Flash cards are a part of "Owning" new knowledge. **(Slide)**
    - Owning knowledge means that we understand the knowledge, have organized it into our existing knowledge, memorized it, and can now apply it in new circumstances.
    - One part of owning knowledge is memorizing it. Memorizing knowledge allows us to recall it more easily and apply it to future learning.
    - Flash cards are a way to memorize knowledge.
    - Flash cards are another tool we have in our toolbox that supports our learning. **(Slide)**
- Create flash cards.
    - Review locations to look to create flash cards (lecture notes, concept maps, etc.)
    - Review expectations for creating flash cards. **(Slide)**
    - Goal is to create a minimum of five flash cards to add to your collection.
    - Remember while you are looking over your notes to create flash cards if questions come up you will have time to ask an expert during study hall.
- (Give student 7-8 minutes to create flash cards.)

Study Hall & Ask an Expert

- Review Purpose of Study Hall:
    - Taking time to study is another tool for owning your knowledge. (Slide)
    - Study hall is a time and place that is set aside for you to start owning your knowledge by studying independently or with a partner using your study tools- flash cards and concept maps.
- Review Next Steps from previous day:
    - Return the previous day's Next Steps to each student.
    - Ask students to read over the next step they wrote for themselves.
    - Today is a new day. With our growth mindset we can decide to work hard today if we didn't yesterday or to continue working hard if we did yesterday so that we can be successful in understanding the Science Discovery Process.
- Options for Study Hall:
    1. Study individually or in pairs using concept map and/or flash cards.
    2. Ask a Expert – talk to an expert about a question or concept you are struggling with.
    3. A combination: Start by asking and expert then using time to study on your own or with a partner.

- Ask an Expert:
    - Introduce all "experts" that will be available to work with students during study hall.
    - If you want to talk with an expert simply approach them where they are sitting and introduce yourself, if you don't already know them, and then ask for help!
- Independent Study Time:
    - If you are studying using flash cards- make sure you are using ALL your flash cards not just the new ones. We are building on our knowledge.
    - (Give students 10-15 minutes to study hall time.)

<u>Data and Next Steps</u>

- Complete Question Set.
    - (Hand out Question Set Day 6 to each student and let students work ~ 5 minutes.)
- Grade Question Set.
- Review Data Analysis.
- Review Next Steps
- (Collect Next Steps so they can be returned to students the next day.)

Day 8: Inform Hypothesis and Propose Explanations

- Process Reflection:
  - 0:00 – 0:10 Independent Work
  - 0:10 – 0:15 Pair
  - 0:15 – 0:20 Share
- Science Discovery Process Lecture:
  - 0:20 – 0:35 Science Discovery Process Lecture
  - 0:35 – 0:45 Pair-Share Note Sets
- Paper Airplane Lab:
  - 0:45 – 1:00 Students Inform Hypothesis & Propose Explanations
  - 1:00 – 1:10 Share Hypothesis and Explanation
- Study Hall
  - 1:10 – 1:20 Study with a Concept Map
  - 1:20 – 1:40 Study Hall & Ask an Expert
  - 1:40 – 1:50 Data and Next Steps
  - 1:50 – 1:55 Prep Notebooks for field research tomorrow

Process Reflection:

Independent Work

- (Students will be reflecting on Sea Turtle Monitoring from the previous night.)
- Give students ten minutes to work on their own concept map.

Pair

- Students to pair up and share their concept maps.

Share

- Facilitate a group discussion using the Science Discovery Process poster.
  - What connections have students made to the SDP and last night's research.

Science Discovery Process Lecture

Science Discovery Process Lecture

- Taking Notes During the Lecture
  - Explain that students will take notes DURING the lecture today.
  - Do the best you can. We will have time to compare notes and fill in anything that is missing after the lecture.
  - (Pause throughout the lecture to give students some time to take notes.)
- Analyze.
  - Science Discovery Process – Analyze. **(Slide)**
  - Focus on "Inform Hypothesis and Propose Explanation".
- Inform Hypothesis:
  - Means to accept or reject your hypothesis.

        - A hypothesis should be accepted if the evidence collected supports the hypothesis.
        - A hypothesis should be rejected if the evidence collected does NOT support the hypothesis.
    - Rejecting a Hypothesis – is okay.
        - We learn just as much from a rejected hypothesis.
        - Scientists NEVER change their hypothesis to match their data, however, if a hypothesis is rejected a scientist may already have an idea of what happened and may immediately begin writing a new hypothesis to test.
- Proposed Explanations:
    - Once a scientist has accepted a hypothesis, they have a <u>tentative</u> explanation for an observation that other scientists can either support or disprove.

    - Example #1 **(Slide):**
        - Observations: Some of the plants in my mom's garden are short and some are tall.
        - Question: I wonder if fertilizer can affect how tall it will grow?
        - Hypothesis: If a plant gets fertilizer, then it will grow taller.
        - Investigation: Take six plants that are the same height and put them next to each other where they all get the same amount of sun each day. Give plant #1, 2, and 3 fertilizer. Give plants #4, 5, and 6 – no fertilizer.
        - Evidence: Measure the heights of all plants in centimeters (to the nearest tenth of a centimeter) from the soil to the highest point on the plant every other day for 30 days.
        - Replicates: 3
        - Data set (on slide):
            - Trends:
                - Trend 1: all plants are growing taller.
            - Average: (do the math)
                - Trend 2: the plants that were given fertilizer (#1-3) grew taller.
        - Inform Hypothesis: Accept Hypothesis because our data supports that plants that get fertilizer, do grow taller.
        - Propose an explanation: Plants use extra nutrients in the fertilizer to grow taller.

    - Example #2 (**Slide**):
        - Observations: Sometimes water shot out of a water gun goes further than other times. People shoot water out of their water guns at different angles.
        - Question: I wonder if the angle of the water gun effects how far the water will go?
        - Hypothesis: If I create a greater angle to the floor with my water gun then, the water will shoot further.
        - Investigation: Fill 28 of the same water guns with 30 mL of water. With four of the water guns, create an angle of 15 degrees to the floor and shoot the water. With four of the water guns, create an angle of 30 degrees to the floor and shoot the water. Continue with four guns for 45-, 60-, 75-, and 90-degree angles

with the floor. With the last four water guns, create an angle of 0 degrees to the floor and shoot the water.
    - Evidence: Pull the water gun trigger for three seconds and measure the distance in meters the furthest droplet of water goes for each water gun.
    - Replicates: 4
    - Data set:
        - Pair-Share:
            - Have students look at data and determine if the hypothesis should be accepted or rejected and to propose and explanation.

<u>Pair-Share Note Sets</u>

- In a moment you will work with a partner to compare your notes. Today it will be especially important for you to work with your partner so that you both have a complete set of notes.
    - Go line by line.
        - Check mark: If you and your partner have the same note (does NOT need to be in the same order) talk about why you thought it was important.
        - ? mark: If you have a note your partner doesn't.
    - Look at ? marks. Ask your partner why they thought that note was important to include, then decide if you want to add it to your notes and do so.
- (Have students partner up and review notes.)
- Look over notes as a group.
    - Have students share out some notes they created and explain why they thought, they were important.
    - Allow students to add to their notes if they want based on what is shared.

Paper Airplane Lab

<u>Students Inform Hypothesis and Propose Explanations:</u>

- Each pair of students will look over their data trends and patterns and decide if they will accept or reject their hypothesis.
    - (Show PowerPoint slide: Accepting or Rejecting Your Airplane Hypothesis.)
    - Have students write:
        - 1) If they accept or reject their hypothesis.
        - 2) Proposed explanation that includes what data lead them to accept or reject their hypothesis.
        - 3) New and different hypotheses they would like to test.

<u>Share Hypothesis and Explanation:</u>

- Pair up pairs (four students total).
    - Have each pair explain what their hypothesis was, if they accepted or rejected their hypothesis and why they did so.
- If time allows have a few pairs of students share their hypothesis and what data lead them to make the decision to accept or reject it.

Study Hall

Study with a Concept Map

- Studying with a Concept Map:
    - Take time to look over your concept map – try to remember your main ideas and the connections between ideas.
    - Cover up a bubble with your hand and see if you can remember what was in the bubble and the ideas connected to that bubble.
    - Turn your concept map over at some point and try to visualizing it in your mind. What parts of it do you remember?
        - Spend more time looking over the sections you don't remember.
    - Finally, you can take a blank concept map (show students where these are) and try to fill it in and see what you remember and what you don't.
        - We are going to practice this today.
- Independent Study Time:
    - Give students five minutes to study their concept maps independently.
- Test Concept Map Knowledge:
    - Give each student a blank "Science Discovery Process Concept Map" on 11 x 17" paper and let them try to fill in as much of it as they can remember.
        - You may decide to add new connections and remove some of the ones on your concept map- and that's okay. You can chose to write down different questions or observations – that's all okay too.
        - (Turn Science Discovery Process poster around so it can't be seen.)

Study Hall & Ask an Expert

- Review Next Steps from previous day:
    - Return the previous day's Next Steps to each student.
    - Ask students to read over the next step they wrote for themselves.
    - Today is a new day. With our growth mindset we can decide to work hard today if we didn't yesterday or to continue working hard if we did yesterday so that we can be successful in understanding the Science Discovery Process.
- Students can choose to study during study hall using flash cards or concept maps.
    - Allow students to have an additional blank concept map if they would like to try and fill on in without looking at theirs.
- Review Ask an Expert and reasons why you might want to talk to an expert.
    - Introduce all "experts" that will be available to work with students during study hall.
    - If you want to talk with an expert simply approach them where they are sitting and introduce yourself, if you don't already know them, and then ask for help!
- Options for Study Hall:
    1. Study individually or in pairs using your concept map or flash cards.
    2. Ask a Expert – talk to an expert about a question or concept you are struggling with.
    3. A combination: Start by asking and expert then using time to study on your own or with a partner.

- Independent Study Time:
    - Allow students to utilize their time.

Data and Next Steps

- Complete Question Set.
    - (Hand out Question Set Day 8 to each student and let students work ~ 5 minutes.)
- Grade Question Set.
- Review Data Analysis.
- Review Next Steps
- (Collect Next Steps so they can be returned to students the next day.)

Prep Science Notebooks

- Tomorrow we will be departing for field research very early in the morning.
- Review Lecture & Prep section of Bird Monitoring Protocol.
- Have students prep their science notebooks for Bird Monitoring.

Day 9: Summarize Data

- Process Reflection:
  - 0:00 – 0:10 Independent Work
  - 0:10 – 0:15 Pair
  - 0:15 – 0:20 Share
- Science Discovery Process Lecture:
  - 0:20 – 0:35 Science Discovery Process Lecture
  - 0:35 – 0:45 Pair-Share Note Sets
- Paper Airplane Lab:
  - 0:45 – 1:05 Students Summarize Data
  - 1:05 – 1:10 Share Data
- Study Hall
  - 1:10 – 1:25 Create Test Questions
  - 1:25 – 1:45 Study Hall & Ask an Expert
  - 1:45 – 1:55 Data and Next Steps

Process Reflection

Independent Work

- Give students ten minutes to work on their own concept map.

Pair

- Students to pair up and share their concept maps.

Share

- Facilitate a group discussion using the Science Discovery Process poster.
  - What connections have students made to the SDP and today's research.

Science Discovery Process Lecture

Science Discovery Process Lecture

- Taking Notes During the Lecture
  - Explain that students will take notes DURING the lecture today.
  - Do the best you can. We will have time to compare notes and fill in anything that is missing after the lecture.
  - (Pause throughout the lecture to give students some time to take notes.)
- Analyze.
  - Science Discovery Process – Analyze. **(Slide)**
  - Focus on "Summarize Data".
  - Summarizing data allows scientist to share their data in a meaningful way. It prevents people from becoming overwhelmed by too much data.
  - Scientists must provide data in a clear and concise way – often times in the form of graphs.
- Graphs

  - Communicate information in a visual way.
  - Can show patterns and visually illustrate relationships in the data.
  - A way to get the point of an investigation across quickly.
- Common types of graphs **(Slide)**:
  - Line
  - Bar
  - Circle
- Graphs should include:
  - x- and y- axis labels (including measurement labels when necessary)
  - Title
  - Data Points

- Example #1 **(Slide):**
  - Observations: Some of the plants in my mom's garden are short and some are tall.
  - Question: I wonder if fertilizer can affect how tall it will grow?
  - Hypothesis: If a plant gets fertilizer, then it will grow taller.
  - Investigation: Take six plants that are the same height and put them next to each other where they all get the same amount of sun each day. Give plant #1, 2, and 3 fertilizer. Give plants #4, 5, and 6 – no fertilizer.
  - Evidence: Measure the heights of all plants in centimeters (to the nearest tenth of a centimeter) from the soil to the highest point on the plant every other day for 30 days.
  - Data set (on slide):
  - Inform Hypothesis: Accept Hypothesis because our data supports that plants that get fertilizer, do grow taller.
  - Propose an explanation: Nutrients in fertilizer allow plants to photosynthesis more quickly than plants that just get nutrients from soil only.
  - Summarize data: Show all three types of graphs.
    - Which type of graph best communicates the outcome of your investigation? Ask students to choose a graph and explain their reasoning.

- Example #2 (**Slide**):
  - Observations: Sometimes water shot out of a water gun goes further than other times. People shoot water out of their water guns at different angles.
  - Question: I wonder if the angle of the water gun effects how far the water will go?
  - Hypothesis: If I create a greater angle to the floor with my water gun then, the water will shoot further.
  - Investigation: Fill 28 of the same water guns with 30 mL of water. With four of the water guns, create an angle of 15 degrees to the floor and shoot the water. With four of the water guns, create an angle of 30 degrees to the floor and shoot the water. Continue with four guns for 45-, 60-, 75-, and 90-degree angles with the floor. With the last four water guns, create an angle of 0 degrees to the floor and shoot the water.
  - Evidence: Pull the water gun trigger for three seconds and measure the distance in meters the furthest droplet of water goes for each water gun.
  - Data set (on slide):
  - Inform hypothesis: Reject our hypothesis because our data does not support our hypothesis.

- Propose an explanation: Water goes further the greater the angle between 0 degrees and 45 degrees but begins to decrease between 45 and 90 degrees, so a 45 degree angle is the greatest for shooting water.
- Summarize data: Show all three types of graphs.
  - Pair-Share:
    - Which type of graph best communicates the outcome of your investigation? Why?

Pair-Share Note Sets

- In a moment you will work with a partner to compare your notes. Today it will be especially important for you to work with your partner so that you both have a complete set of notes.
  - Go line by line.
    - Check mark: If you and your partner have the same note (does NOT need to be in the same order) talk about why you thought it was important.
    - ? mark: If you have a note your partner doesn't.
  - Look at ? marks. Ask your partner why they thought that note was important to include, then decide if you want to add it to your notes and do so.
- (Have students partner up and review notes.)
- Look over notes as a group.
  - Have students share out some notes they created and explain why they thought, they were important.
  - Allow students to add to their notes if they want based on what is shared.

Paper Airplane Lab

Students Summarize Data:

- Each pair of students will create a line and a bar graph, then choose the best graph of the two that represents their investigation and clearly communicates the outcome. (**Slide**)
  - Each graph must include the following:
    - 1) Title
    - 2) Labels on the x and y axis
    - 3) Data points

Share Data:

- Pair up pairs (four students total).
  - Have each pair show their graphs and have the other pair try to summarize what the data was telling them.
  - Students should see if the graph they chose clearly communicates the outcome of their investigation and if not, what they can do to improve their graph.

Study Hall

Create Test Questions

- Creating test questions.

  - Another way to study is to try and think of test questions a teach might ask you based on your flash cards, concept maps, or notes and then answer them.
  - Today we are going to focus on short answer type questions. When we say short answer, we mean questions that require 2-3 sentences (not 1-2 words).
  - Example: A scientist wants to test the hypothesis: If a plant gets more light, then it will grow taller. Describe an investigation that a scientist could set up to test this hypothesis. Include information about the type of data you would collect and the number of replicates.
    - Using their science notebook do a think-pair-share with students to answer this question.
- Practice creating test questions.
  - Have students look over their notes and try to come up with 1-2 short answer test questions.
- Create a bank of test questions.
  - Have students share 3-5 short answer test questions.
    - Be sure to modify student example as necessary so that they are good test questions.
    - (Write the test questions on the board.)
  - These are good questions that you should all want to be able to answer.
    - Let's create a flash card to we can be sure we study these types of questions.
    - (Have students copy each question onto an index card the opposite side will remain blank b/c the answers are longer.)

<u>Study Hall & Ask an Expert</u>

- Review Next Steps from previous day:
  - Return the previous day's Next Steps to each student.
  - Ask students to read over the next step they wrote for themselves.
  - Today is a new day. With our growth mindset we can decide to work hard today if we didn't yesterday or to continue working hard if we did yesterday so that we can be successful in understanding the Science Discovery Process.
- Options for Study Hall:
  1. Study individually or in pairs – begin by preparing answers to the short answer questions on the board.
  2. Ask a Expert – If you aren't sure how to answer the questions on the board talking with an expert is a great idea! If you think you know how to answer the questions and simply want to check your answers, that's another great way to utilize an expert!
  3. A combination: Start by asking and expert then using time to study on your own or with a partner.
- Ask an Expert:
  - Introduce all "experts" that will be available to work with students during study hall.
- Independent Study Time:

- (Give study hall time.)

Data and Next Steps

- Complete Question Set.
  - (Hand out Question Set Day 9 to each student and let students work ~ 5 minutes.)
- Grade Question Set.
- Review Data Analysis.
- Review Next Steps
- (Collect Next Steps so they can be returned to students the next day.)

Day 10: Communicate:

- Process Reflection:
  - 0:00 – 0:10 Independent Work
  - 0:10 – 0:15 Pair
  - 0:15 – 0:20 Share
- Science Discovery Process Lecture:
  - 0:20 – 0:30 Science Discovery Process Lecture
  - 0:30 – 0:40 Pair-Share Note Sets
- Paper Airplane Lab:
  - 0:40 – 1:10 Students Prepare Communicate Presentation & Practice
- Study Hall
  - 1:10 – 1:20 Study with a Concept Map
  - 1:20 – 1:40 Study Hall & Ask an Expert
  - 1:40 – 1:55 Data and Next Steps

Process Reflection

Independent Work
- Give students ten minutes to work on their own concept map.

Pair
- Students to pair up and share their concept maps.

Share
- Facilitate a group discussion using the Science Discovery Process poster.
  - What connections have students made to the SDP and today's research.

Science Discovery Process Lecture

Science Discovery Process Lecture
- Let students know they will try to take notes DURING the lecture today.
  - Remind students to use the bullet point format.
- For the rest of our research days we will focus on Communication with a focus on "Sharing Your Work with Others".
  - (Show Science Discovery Process poster.)
- Communication
  - Why is it important?
    - Scientists have a responsibility for sharing what they learn with others.
      - When scientist share what they have learned it allows other to evaluate the information for themselves.
      - Scientists may chose to repeat an experiment to confirm the results or they may try to build on the findings to learn something else.

        - When scientists share their research with the wider scientific community it can lead to new ideas and connections that can take the research even further.
        - Often science research can help make the world a better place by improving human lives or solving problems that face our planet- those ideas need to be communicated.
    - Example:
        - A scientist has observed an increase in the number of paint manufacturing plants in their hometown. Many of the chemicals used to make paint are toxic and the scientists wonders if any of these chemicals are leaking into the environment. The scientist decides they want to research the question: Are the increasing number of paint manufacturing plants impacting the local drinking water supply?
        - The scientist decides to take water samples from all the wells in town and test for five heavy metals that are often found in paint.
        - Who would be interested in this scientist's work?
            - People drinking the water, the companies creating the paint, EPA, local water district, etc.
        - Why do you think it would be important for scientists to communicate what they learn from their testing?
    - How to Communicate:
        - As scientists it is important to be able to communicate your work to people in a way that they can understand it.
        - To do this scientists should:
            - Be clear about what they have learned.
            - Use the language that is familiar to the audience and on a level that will be able to engage with.
            - Share a visual representation of their data (graph, chart, etc.)
            - Explain how what they learned could be used to make a difference.

<u>Pair-Share Note Sets</u>

- In a moment you will work with a partner to compare your notes. Today it will be especially important for you to work with your partner so that you both have a complete set of notes.
    - Go line by line.
        - Check mark: If you and your partner have the same note (does NOT need to be in the same order) talk about why you thought it was important.
        - ? mark: If you have a note your partner doesn't.
    - Look at ? marks. Ask your partner why they thought that note was important to include, then decide if you want to add it to your notes and do so.
- (Have students partner up and review notes.)
- Look over notes as a group.
    - Have students share out some notes they created and explain why they thought, they were important.
    - Allow students to add to their notes if they want based on what is shared.
- Remind students of how far they have come over the two weeks in their ability to take notes from a lecture.

- They have gone from having the notes given to them and copying them after the lecture to creating their own set of notes DURING the lecture.
- This is a great tool to have in your toolbox for high school and college. During lectures you can take a set of notes to help you remember the main ideas and important points!

Paper Airplane Lab

<u>Students Prepare Communicate Presentation & Practice</u>

- Tomorrow during this time you and your partner will communicate what you learned from your paper airplane investigation.
- Today you will have time to put together and practice a short presentation.
- Your presentation must include the following:
  - Question
  - Hypothesis
  - Investigation Design
  - Evidence
    - Trends/Patterns and Outliers
    - A visual representation of your evidence
    - How your evidence informed your hypothesis
  - Making a Difference
    - How what you learned could be used to make a difference.
- You and your partner will be given a paper to fill out about all of the above.
  - Use your science notebook notes from the paper airplane labs to help you.
  - When you have finished filling it out, raise your hand and a staff member will review it with you.
- Review Communication Skills:
  - Once your presentation has been approved you and your partner will practice sharing the information with others.
  - When sharing your presentation, you will want to use your communication skills which are another growth mindset tool to support learning.
    - Being able to clearly communicate with other people is an important skill that will be valuable throughout your life.
    - Speaking in front of people can feel uncomfortable for some people.
    - These tools are things you can focus on when you need to speak in front of people – either simply introducing yourself, giving a presentation in class, etc.
  - You have already been practicing some of these skills during our community building time.
    - You have been practicing speaking with a strong voice to introduce yourself.
    - You have been practicing speaking slowly and clearly and taking up space when you were giving personal thank yous for our departing mentors.
  - Those same skills will be important when you present you research tomorrow. Today when you practice focus on two communication skills:
    - Taking up space – standing with legs slightly apart and back straight
      - Watch out for having your head down and staring at your paper.

- You shouldn't be reading directly from the paper, the paper will be a reminder.
- Using a strong voice – speaking loudly enough for everyone to hear
- The things you have to say are important- let people hear them!

- Staff members will be around to help you practice your presentation and give you feedback.

- Hand out "Student Communication Presentation" document (1/pair of students).

Study Hall

<u>Study with a Concept Map</u>

- Studying with a Concept Map:
  - Take time to look over your concept map – try to remember your main ideas and the connections between ideas.
  - Cover up a bubble with your hand and see if you can remember what was in the bubble and the ideas connected to that bubble.
  - Turn your concept map over at some point and try to visualizing it in your mind. What parts of it do you remember?
    - Spend more time looking over the sections you don't remember.
  - Finally, you can take a blank concept map (show students where these are) and try to fill it in and see what you remember and what you don't.
    - We are going to practice this today.
- Independent Study Time:
  - Give students five minutes to study their concept maps independently.
- Test Concept Map Knowledge:
  - Give each student a blank "Science Discovery Process Concept Map" on 11 x 17" paper and let them try to fill in as much of it as they can remember.
    - You may decide to add new connections and remove some of the ones on your concept map- and that's okay. You can chose to write down different questions or observations – that's all okay too.
    - (Turn Science Discovery Process poster around so it can't be seen.)

<u>Study Hall & Ask an Expert</u>

- Review Next Steps from previous day:
  - Return the previous day's Next Steps to each student.
  - Ask students to read over the next step they wrote for themselves.
  - Today is a new day. With our growth mindset we can decide to work hard today if we didn't yesterday or to continue working hard if we did yesterday so that we can be successful in understanding the Science Discovery Process.
- Students can choose to study during study hall using flash cards, concept maps, or test questions.
  - Allow students to have an additional blank concept map if they would like to try and fill on in without looking at theirs.
- Review Ask an Expert and reasons why you might want to talk to an expert.

  - Introduce all "experts" that will be available to work with students during study hall.
  - If you want to talk with an expert simply approach them where they are sitting and introduce yourself, if you don't already know them, and then ask for help!
- Options for Study Hall:
  4. Study individually or in pairs using your concept map or flash cards.
  5. Ask a Expert – talk to an expert about a question or concept you are struggling with.
  6. A combination: Start by asking and expert then using time to study on your own or with a partner.
- Independent Study Time:
  - Allow students to utilize their time.

<u>Data and Next Steps</u>

- Complete Question Set.
  - (Hand out Question Set Day 10 to each student and let students work ~ 5 minutes.)
- Grade Question Set.
- Review Data Analysis.
- Review Next Steps
- (Collect Next Steps so they can be returned to students the next day.)

Day 11: Communicate

- Process Reflection:
  - 0:00 – 0:10 Independent Work
  - 0:10 – 0:15 Pair
  - 0:15 – 0:20 Share
- Paper Airplane Lab:
  - 0:20 – 0:40 Practice Paper Airplane Presentation
  - 0:40 – 1:00 Student Presentations
  - 1:00 – 1:10 Paper Airplane Presentation to Whole Group
- Study Hall
  - 1:10 – 1:25 Create Test Questions
  - 1:25 – 1:45 Study Hall & Ask an Expert
  - 1:45 – 1:55 Data and Next Steps

Process Reflection:

Independent Work

- (Students will be reflecting on their work at the Museo.)
- Give students ten minutes to work on their own concept map.

Pair

- Students to pair up and share their concept maps.

Share

- Facilitate a group discussion using the Science Discovery Process poster.
  - What connections have students made to the SDP and today's trip to the Museo.

Paper Airplane Lab

Practice Paper Airplane Presentation

- Students practice their presentation from the previous day with a focus on:
  - Taking up space – standing with legs slightly apart and back straight.
    - Watch out for having your head down and staring at your paper.
    - You shouldn't be reading directly from the paper, the paper will be a reminder.
  - Using a strong voice – speaking loudly enough for everyone to hear
    - The things you have to say are important- let people hear them!
  - Staff members will be around to help you practice your presentation and give you feedback.

Student Presentations

- Students will be giving their presentation to one group and then listening to that group's presentation.
  - Please show your visual data to the people you are sharing your presentation with.

    - You can just show them the graph or chart you have on your paper.
- When you are listening to someone else's presentation remember to be your best self.
    - Review all parts of being your best self as they relate to listening to another person's presentation.
- When the other group is done giving their presentation each person will give one piece of positive feedback.
    - What was one thing you liked or admired about their presentation?
- When you give your presentation give it 100% effort.
    - Take up space and speak in a strong voice.
- Pair up groups and have them rock-paper-scissors for which group presents first.

Paper Airplane Presentation to Whole Group

- Invite 2-3 groups up to share their presentation with the whole group.
- Encourage students to have a growth mindset and push themselves if they are normally nervous about presenting in front of a group.

Study Hall

Create Test Questions

- Review creating test questions.
    - Remind students that creating test questions for themselves is another study skill to help prepare for an exam.
    - Today we are going to focus on writing a few more short answer type questions. When we say short answer, we mean questions that require 2-3 sentences (not 1-2 words).
- Practice creating test questions.
    - Have students look over their notes and try to come up with 1-2 short answer test questions.
    - These must be different from the last questions they wrote.
- Create a bank of test questions.
    - Have students share 3-5 short answer test questions.
        - Be sure to modify student example as necessary so that they are good test questions.
        - (Write the test questions on the board.)
    - These are good questions that you should all want to be able to answer.
        - Let's create a flash card to we can be sure we study these types of questions.
        - (Have students copy each question onto an index card.)

Study Hall & Ask an Expert

- Review Next Steps from previous day:
    - Return the previous day's Next Steps to each student.
    - Ask students to read over the next step they wrote for themselves.

    - Today is a new day. With our growth mindset we can decide to work hard today if we didn't yesterday or to continue working hard if we did yesterday so that we can be successful in understanding the Science Discovery Process.
- Options for Study Hall:
    1. Study individually or in pairs – flash cards, concept maps, using questions from the board, etc.
    2. Ask a Expert – If you aren't sure how to answer the questions on the board talking with an expert is a great idea! If you think you know how to answer the questions and simply want to check your answers, that's another great way to utilize an expert!
    3. A combination: Start by asking and expert then using time to study on your own or with a partner.
- Ask an Expert:
    - Introduce all "experts" that will be available to work with students during study hall.
- Independent Study Time:
    - (Give study hall time.)

<u>Data and Next Steps</u>

- Complete Question Set.
    - (Hand out Question Set Day 9 to each student and let students work ~ 5 minutes.)
- Grade Question Set.
- Review Data Analysis.
- Review Next Steps
- (Collect Next Steps so they can be returned to students the next day.)

Question Sets

Name _____

Question Set Day 2

1. Define hypothesis:

2. What skill is a scientist using when she listens to the sounds that whales makes?
   a) making observation
   b) interpreting data
   c) making a hypothesis
   d) drawing conclusions

3. Which of the following hypotheses is written correctly?
   a) If a tennis ball is frozen, it won't bounce as high as one that is not frozen.
   b) Frozen tennis balls will not bounce as high.
   c) If I freeze a tennis ball, then it will not bounce as high.
   d) If I heat up a tennis ball it will bounce high.

4. Define observation:

5. A cycle designed to help you answer questions and make a difference:
   a) Experiment
   b) Observation
   c) Process Reflection
   d) Science Discovery Process

---------- STOP HERE ----------

Next Steps Day 2
Be short and specific.

Name _____

Question Set Day 3

1. The process of obtaining information by using the senses is called a/an
   a) Conclusion
   b) Observation
   c) Hypothesis
   d) Science Discovery Process

2. A scientist observes that many students study with music on. It makes him wonder: Do students who study with music score better on exams? His hypothesis is: Students who study with music will score better on exams. He sets up the below investigation: Ten students study for a social studies exam in the same room for two hours with music on. Ten students study for the same social studies exam in the same room for two hours with no music. He will collect their test scores and compare them.

   Which is the experimental version of the investigation?
   a) The room they are studying in.
   b) Students who study with music on.
   c) Students who study without music on.
   d) The social studies exam.

3. Define hypothesis:

4. Which step comes after Explore and Wonder in the Science Discovery Process?

5. Define question:

---------- STOP HERE ----------

Next Steps Day 3
Be short and specific.

Name _____

Question Set Day 4

1. Define evidence:

2. A scientist testing the effects of a chemical on apple yield sprays an orchard with the chemical. A second orchard does not receive the chemical. In the fall, the number of apples harvested from each forest is counted.

   In order for this experiment to be valid scientifically, both orchards must

   a) Receive the same amount of sunlight
   b) Receive the same amount of water
   c) have the same species of apple tree
   d) all of the above

3. A scientist has a parent with high blood pressure. The scientist wonders, can I develop high blood pressure medication to help my parent? After two years in the lab, she develops a pill for high blood pressure. She must test the medicine to see if it works. She sets up the below investigation: she finds 100 people with blood pressure reading of 135 or higher (systolic), 50 of those people will take her new medication every day, at 9AM, and 50 of those people will take a sugar pill (which has no medicine in it) every day at 9AM. Everyone will have their blood pressure checked once a week by a nurse for six months. Her hypothesis is: If the medicine is effective, then the people who take the medicine should have reduced blood pressure and the blood pressure of the people who took the sugar pill should stay the same.

   Which is the control version of the investigation?

   a) The blood pressure reading of 135 or higher
   b) The group taking the medicine.
   c) The group of all 100 people.
   d) The group taking the sugar pill.

4. Using the above scenario from Question 3:

   What is the evidence being collected?

   a) The 100 people with a blood pressure reading of 135 or higher
   b) The blood pressure readings collected weekly by a nurse for six months.
   c) The 50 people taking the medicine and the 50 people taking the sugar pill.
   d) The medicine.

5. In the Science Discovery Process which of the below are part of INVESTIGATE (circle <u>all</u> that apply):

   a) Ask Questions
   c) Gather Evidence

b) Make Hypothesis

d) Make Observation

Next Steps Day 4

Be short and specific.

Name _____

Question Set Day 5

1. A scientist who wants to study the effects of fertilizer on plants sets up an experiment. Plant A gets no fertilizer, Plant B gets 5 mg. of fertilizer each day, and Plant C gets 10mg. of fertilizer each day. Which plant is the control group?

   A) Plant A
   B) All of them
   C) Plant B
   D) Plant C

2. A scientist observes that many students study with music on. It makes the scientist wonder: Do students who study with music score better on exams? The scientist's hypothesis is: Students who study with music will score better on exams. The scientist sets up the below investigation: Twenty students from the same social studies class will study for an upcoming unit exam in the same room for two hours. Ten of the students will study with music on using headphones. Ten students will study with no music. The scientist will collect the test scores (percent out of 100) on their social studies unit exam on Friday and compare them.

   Which is the evidence they are gathering?

   a) Test scores on the social studies unit exam.
   b) Students who study with music on.
   c) Students who study without music.
   d) The social studies teacher for the class

3. Define hypothesis:

4. A scientist was interested to see if drinking tea before bed effected a person's ability to fall asleep. The scientist took a group of 50 adults and randomly divided them into two groups. One group was told to drink tea every night for a week, while the other group was told not to drink tea that week. The scientists then recorded what time each group fell asleep for two weeks. Is this an example of:

   a) An experiment
   b) An observational study

5. The players on Real Madrid wear white jerseys with blue lettering and gold symbols. This is an example of:

   a) A hypothesis
   b) An observation
   c) A question
   d) An Investigation

Next Steps Day 5

Be short and specific.

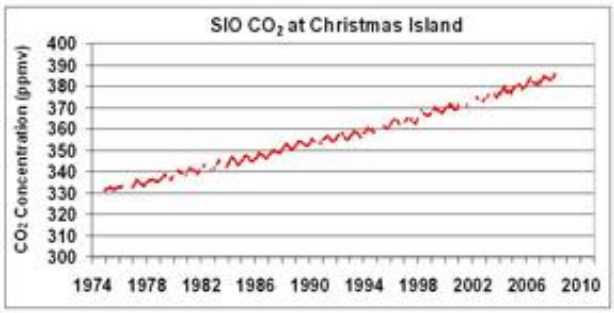
Name _____

Question Set Day 6

1. Victoria grows the same bacteria in 20 petri dishes. She puts 10 of the dishes in a container with a normal atmosphere. She puts the other 10 in a container where the oxygen level is double the normal level. She labels the first group "A" and the second group "B." Which describes the groups?

   A) Group A is the control group; Group B is the experimental group.
   B) Group A is the experimental group; Group B is the control group.
   C) Group A is the hypothesis; Group B is the theory.
   D) Group A is the variable; Group B is the observation

2. The data shown on the graph represents atmospheric CO_2 measurements collected over a period of 36 years. Based on this graph, what trend can you identify about CO_2 in the atmosphere?

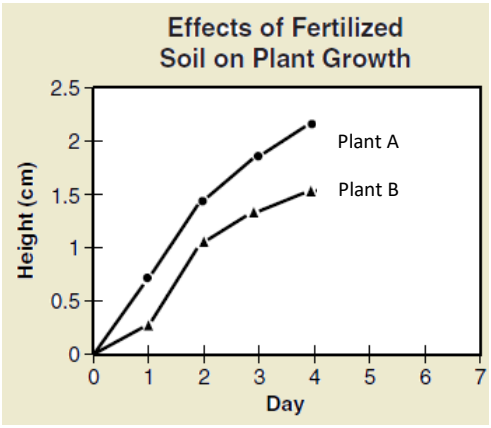


A) Concentrations of CO2 in the atmosphere are decreasing.
B) Concentrations of CO2 in the atmosphere are increasing.
C) Concentrations of CO2 in the atmosphere fluctuate widely.
D) Concentrations of CO2 in the atmosphere remain constant.

3. Define outlier:

4. The line graph shows the heights of plants grown in fertilized and unfertilized soil. Based on this information, what will most likely occur on day five?

   A) Neither plant will grow.
   B) Plant A should increase about 0.5 cm in height.
   C) Plant B should increase about 1 cm in height.
   D) Plant A should increase about 2 cm in height.



5. A bird watcher sees an unusual bird at a feeder. He carefully notes on the bird's color, shape, and other physical features and draws a sketch of the bird in a notebook. What part of the Science Discovery Process did this person just do?

   a) A hypothesis c) A question

b) An Investigation

d) An observation

Next Steps Day 6

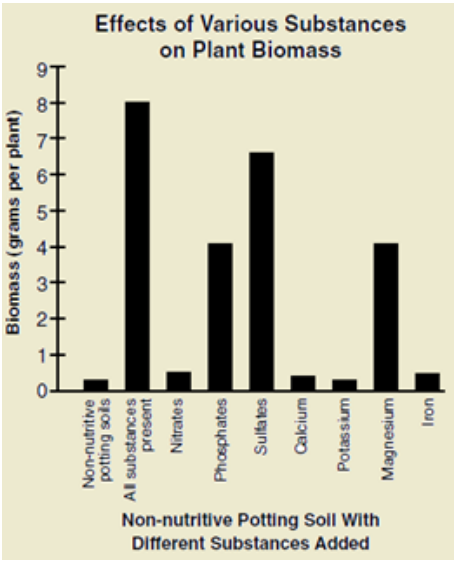
Be short and specific.

Name _____

Question Set Day 8

1. In an experiment, the control group is

   A) is the only group with trends and outliers.
   B) the group that controls the experiment.
   C) the group that stays the same.
   D) the group that is tested last.



2. Based on the graph to the right, which of the below statements is true:
   a) You would accept the hypothesis: If you add sulfates to the soil then the biomass of your plants will increase.
   b) You would reject the hypothesis: If you add sulfates to the soil then the biomass of your plants will increase.

3. Look at the data table below. Explain which piece of data is an outlier and why do you think that it is an outlier.

	Distance Flown		**Distance Flown**
Control	5.5 m	Experimental	11.3 m
Control	4.2 m	Experimental	10.9 m
Control	5.3 m	Experimental	11.1 m
Control	4.8 m	Experimental	10.5 m
Control	9.2 m	Experimental	10.8 m
Control	3.9 m	Experimental	11.6 m

4. Define hypothesis:

5. Which two are parts of "Investigate" in the Science Discovery Process.
   a) Make Observations and Ask Questions
   b) Build Knowledge About our World and Inform Hypothesis
   c) Examine Results and Look for Trends & Outliers
   d) Make a Hypothesis and Gather Evidence

Next Steps Day 8

Be short and specific.