Paula deDiego Lesson Plan Draft

Human Influence on Ecology

Grade Level: 9 - 12

- Background
- his lesson focuses on symbiosis and ecological relationships. Students will investigate the many ways that species that live in close proximity to each other might interact in an ecosystem, whether via competition or predation or through an ongoing symbiotic relationship such as mutualism, commensalism, or parasitism. Segments drawn from the *Nature* episode "The Secret Lives of Sharks and Rays" and an online interactive featuring the malaria parasite will be used to provide specific examples of these interactions. The students will discover that all ongoing ecological relationships, even parasitic or predatory ones, have evolved over long periods of time and are integral to the maintenance of the balance and stability of an ecosystem.
- The lesson then moves to a discussion of the ways that ecosystems can be thrown out of balance, often as a result of human action. A video segment showing the barbaric practices of the shark fin harvesting industry is used as a case in point of a human behavior that places a species in peril. Students will brainstorm ideas for restoring the relationship between sharks and humans to a healthy balance and will view an optimistic video segment featuring the ecotourism industry. As a culminating activity, students will select a case study for which to formulate an “Ecosystem Action Plan.” They will research an ecosystem thrown out of balance by human action and will prepare a presentation for the class describing the problem and suggesting three possible actions that could be taken to rectify the imbalance.
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- Content standards
- Massachusetts
- Strand: Life Science (Biology)
- Evolution and Biodiversity
- 17. Ecosystems have changed through geologic time in response to various influences.
- Living Things and Their Environments
- 10. Organisms can cause changes in their environment to ensure survival, which may affect the ecosystem.
- Strand: Earth and Space Science
- Materials and Energy Resources
- 2.2 Effects on the environment and on the carbon cycle of using renewable and nonrenewable resources.
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Objectives

- Define and describe the possible ecological relationships between species that coexist in an ecosystem

- Classify specific interspecies relationships as mutualistic, commensal, or parasitic
- Understand that ecological relationships evolved over time and are integral to maintaining the balance and stability of ecosystems
- Name factors that can throw ecosystems out of balance
- Describe human actions that have contributed to ecosystem imbalance and species decline (MPA)
- Suggest remedial actions to ameliorate human-caused imbalances in ecological relationships (MPA)
- In an aquatic ecosystem, discover how MPA's effect species populations inside and surrounding the area.
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- Materials
- Shark and Turtle QuickTime Video www.teachersdomain.org/resource/nat08.living.eco.ecos.turtle
- Unlikely Travel Companions QuickTime Video www.teachersdomain.org/resource/nat08.living.eco.ecos.travcom
- Sharks and Fishermen QuickTime Video www.teachersdomain.org/resource/nat08.living.eco.humimp.fishmen
- Collapse of Sharks QuickTime Video www.teachersdomain.org/resource/nat08.living.eco.humeco.collapse
- Sharks in Our Future QuickTime Video www.teachersdomain.org/resource/nat08.living.eco.humeco.future

Part I: Introductory Activity

1. Clear some room on the classroom whiteboard or on a sheet of posterboard. Review students' knowledge of different ecological relationships by asking them to generate a list of types of interactions that might exist between different species living close to each other. Write these on the board (for example, Species A might eat Species B, Species A might use Species B's discarded shell for shelter, etc.) NOTE - the list should focus on interactions between different species, not between members of the same species.

2. Ask the students if they can recall a definition for "symbiosis" *(symbiosis is a long-term interaction between different species that interact in close proximity)*. Write the following on the board in three rows: +,+; +,0; and +,-. These symbols represent the three main types of symbiosis. Ask the students if they remember the term for a symbiotic relationship that benefits both species? *(mutualism, +,+)*. What about one that benefits one species while the other species is not affected? *(commensalism, +,0)*. Finally, what about a symbiotic relationship that benefits one species and harms the other? *(parasitism, +,-)*.

3. As a class, see if you can classify the interactions that the students brainstormed in Step 1 as mutualistic, commensal, parasitic, or none of the above. Once you have identified the symbiotic relationships that the students thought of, point out that additional ecological relationships NOT generally considered to be symbiotic include predation *(not a long-term relationship as one species is eaten)* and competition *(not considered to be a direct interaction between species as the focus is a fight over an external resource)*.

Part II: Learning Activity #1

1. Distribute the Ecological Relationships Student Organizer to each student. Tell your students that they will be watching several video segments that capture ecological relationships between ocean species. They will be making predictions about the relationships between the species and will check their predictions with the information given in the videos.

2. Frame the first video segment by telling the students that they will see a tiger shark and a loggerhead turtle interacting in the waters near the Bahamas. Ask your students to silently make a prediction about the relationship between these two animals and to mark it in the appropriate box of the "Ecological Relationships" organizer.

3. Provide your students with a focus for media interaction by asking them to check their prediction as they watch the segment. Play segment 1: Shark and Turtle QuickTime Video for the students.

4. Follow up with the students by asking them to name the ecological relationship between the shark and the turtle *(predation)*. Have the students fill in this information on their organizer. Ask the students if anything surprised them about this segment *(accept all answers)*.

5. Frame videos 2 and 3 for your students by explaining that the next segments will show many pairs of oceangoing species interacting. The list of interacting species pairs can be found on the "Ecological Relationships" organizer. Ask the students to silently predict the relationship they expect to see between each interacting pair of species and to note it on the organizer.

6. Provide your students with a focus for media interaction by asking them to check their predictions as they watch the segment. Play segment 2: ERROR: Meta lookup for URI 'https://tdcms.teachersdomain.org/meta_lookup/resource/' failed. nat08.living.eco.ecos.travcom for the students. Give the students a few minutes to fill in the "actual relationship" column in the organizer after viewing the segment, noting the name of the relationship and the description of the behavior observed. You may need to play the video twice for students to record all the information.

7. Play segment 3: Sharks and Fishermen QuickTime Video for the students, asking them to fill in the last row on their organizer. Follow up the segments by reviewing the relationships using the ERROR: Meta lookup for URI 'https://tdcms.teachersdomain.org/meta_lookup/asset/nat08_doc_ak1symstra.' failed. Ask the students to explain if the actual relationships were different than the ones the students predicted.

Part III: Learning Activity #2

1. Ask the students to name the types of ecological relationships that were seen between different species in the video segments *(predation, competition, mutualism, commensalism)*. Ask: What type of symbiotic relationship was NOT seen in these segments? *(parasitism)*. Remind the students that parasitism is a symbiotic relationship between two species living together that provides a net gain for one species and a net loss for the other species. It is different from

predation in that the relationship is prolonged and ideally does not end in the death of the host - the parasite requires its host to remain alive in order for the parasitic relationship to continue — but it may make the host very sick.

2. Ask the students if they can name any examples of parasitic relationships between species *(answers will vary, but some examples include intestinal worms and mammals - for example the tapeworm and the cow; cuckoo birds and other bird species; and fleas and dogs/cats).*

3. Explain that one example of a human parasite is the protozoan that causes the disease malaria. These protozoans, of the genus *Plasmodium*, are especially interesting in that they have two species that act as their hosts, not just one. Ask if the students know how malaria is transmitted to humans? *(The disease is transmitted by mosquitoes).* Point out that it is not the mosquito itself that is the parasite - it is the protozoan that is transmitted from one animal or person to another via the mosquito's saliva. The mosquito is a vector - an organism that transmits disease but does not cause it.

4. Have the students form groups of 3-4, each with a computer. Tell the groups to visit the Malaria web site from nobelprize.org. Distribute a Malaria Student Organizer to each group. Give the students approximately 15 minutes to play both the "Mosquito" and the "Parasite" games on the site. Provide the students with a focus for media interaction by asking them to try to successfully complete each of the two challenges and to answer the questions on the Malaria Student Organizer when they are finished.

5. When the groups have finished playing the games, review the "Malaria Student Organizer" as a class *(Teacher Answer Key is provided).*

6. To reinforce the learning gained in the online game, project the Life Cycle of a Malaria Parasite interactive tour, and walk through each stage to help the students understand the parasitic relationship between thePlasmodium protozoan, the mosquito, and the human.

Part IV: Learning Activity #3

1. Review the types of ecological relationships studied thus far *(predation, competition, mutualism, commensalism, parasitism).* Explain that these relationships have evolved over a long period of time between species that coexist. Even the relationships that are detrimental to one species (i.e. predation, parasitism) are integral to the maintenance of ecological balance. But threats to this stability can occur when dramatic events or shifts in behavior throw an ecosystem out of whack. Ask the students to name some examples of events and behaviors that may be dramatic enough to threaten the stability of a particular ecological niche *(answers will vary but may include human actions, climate change, pollution, and the like).*

2. Frame segment 4: Collapse of Sharks QuickTime Video for the students by explaining that the video they are about to see will show an ecological relationship that has been thrown out of balance. Provide the students with a focus for media interaction by asking them to explain how the relationship between human and sharks has changed over time. Play segment 4 for the students.

3. Review the focus - How has the relationship between humans and sharks changed? *(When humans fished for sharks for subsistence and on a small-scale basis, there was no threat to the continued survival of sharks. With the recent dramatic increase in shark fishing that has resulted from the demand for shark fins and shark cartilage, shark populations worldwide are in danger of collapse).*

4. Lead a brainstorming session about possible ways that the collapse of shark populations can be averted. As a class, come up with a list of different strategies that might help rectify the situation seen in the video, restoring ecological balance and preventing the collapse of shark populations.

5. Frame segment 5: ERROR: Meta lookup for URI 'https://tdcms.teachersdomain.org/meta_lookup/resource/ nat08.living.eco.humeco.future' failed. by telling the students that the video will demonstrate one strategy that is being undertaken to restore the balance in the human-shark relationship. Provide students with a focus for media interaction by asking them to explain how this strategy is helping to solve the problem. Play segment 5 for the students.

6. Review the focus - How is ecotourism helping to restore shark populations? *(Ecotourism, an industry that provides opportunities for tourists to pay for the privilege of diving with sharks to observe them in their natural environment, demonstrates that living sharks are just as valuable as dead sharks. Sharks do not need to be killed, and their fins sold, for communities to benefit financially from them. Encouraging this practice helps maintain a healthy population of living sharks.)*

Part V: Learning Activity #4

Case Studies *http://mpa.gov/helpful_resources/case_studies.html*

This collection of case studies represents a cross section of the different types of sites listed in the Marine Managed Area Inventory on this Web page. The case studies examine the history behind a site's designation as a marine managed area, discuss the techniques used to manage the site's resources, and identify major management issues facing the site. The case studies include two national marine sanctuaries, one managed for its biological value and one for its cultural resources, a national estuarine research reserve, and an experimental fisheries management area. Eventually, case studies for each type of federally managed site and different varieties of state and territorial sites will be included.

Thunder Bay National Marine Sanctuary

Florida Keys National Marine Sanctuary

South Slough National Estuarine Research Reserve

Oculina Experimental Closed Area

A special feature of each case study is a narrated slide show that captures the beauty, uses, and management issues associated with each marine protected area. Click on the camera icon ( ) to view the slide show for a specific case study.

Thunder Bay National Marine Sanctuary

View slide show.

The waters and bottom lands of Lake Huron's Thunder Bay were designated as a national marine sanctuary in 2000 to protect the many shipwrecks of the region. In petitioning the state and federal governments to protect this area, residents of the nearby city of Alpena, Michigan recognized the cultural value of these vessels that represent a significant collection of maritime history. However, loss of local control of the area was also a concern of many citizens. These concerns helped to forge a unique management partnership for the newest national marine sanctuary.

Florida Keys National Marine Sanctuary

View slide show.

The Florida Keys island chain supports an offshore marine ecosystem that is the most extensive living coral reef in the United States and the third largest barrier reef in the world. The beauty and climate of this region has attracted explorers, settlers, and tourists for centuries. With them came damage to reefs, seagrass beds, water quality and fisheries of the region. A groundswell of public sentiment for protecting the archipelago's offshore reefs culminated in 1990 when an act of Congress designated 2800 square nautical miles of state and federal waters as a national marine sanctuary. Innovative management techniques, such as marine zoning, are at work in the Keys, helping to protect and restore its natural resources.

(top)

South Slough National Estuarine Research Reserve

View slide show.

The South Slough of Oregon's Coos Bay estuary benefited from a wave of public sentiment supporting environmental stewardship when it was first designated a national estuarine research reserve in 1974. Some areas surrounding the estuary had been heavily logged at the time, and some wetland areas had been diked. However, supporters of the reserve envisioned the area reverting to a more pristine and natural condition, offering enhanced protection to marine and estuarine species. Since the creation of the reserve, management plans have sought to restrict the most intensive commercial uses and restore natural processes, while ensuring that South

Slough is available for public recreational use.

Experimental Oculina Research Reserve

View slide show.

A unique and fragile ivory tree coral—*Oculina varicosa*—characterizes the Experimental Oculina Research Reserve (EORR), located fifteen to thirty miles off the east coast of Florida. The habitat was once associated with extraordinarily-rich biodiversity. By the early 1990s, however, this deep-sea coral habitat was virtually decimated in many places, probably the result of destructive and unchecked fishing practices, though other causes have been implicated as well. Currently, the EORR is closed to fishing and other activities as scientists attempt to reestablish the Oculina habitat and replenish the fisheries.

Part VI: Culminating Activity

1. Form groups or pairs of students. Explain that each group will be investigating a case study of an aquatic ecosystem thrown out of balance by human action. Their task is to research the case and formulate an action plan outlining three possible actions that humans could take to restore the ecosystem to balance, and one possible action that the class could make during this school year.

2. Distribute the Ecosystem Action Plan to each group or pair and go over the instructions as a class.

3. Provide the class with a list of case studies they may select. A few examples are below, but feel free to add your own cases to the list (you may also entertain student ideas for case studies):

- Where have all the wild fish gone? (How is the fishing industry affecting populations of wild fish?)
- What's wrong with a fish farm? (What are the effects of factory fish farming on ocean ecosystem health?)
- Romeo, Romeo, I can't hear you. (What effect are changing undersea sound levels having on ocean species?)

4. Assign a date for class presentations. Provide the students with in-class and homework time to complete their research and plan their presentations.

5. On the assigned date, have each group present its case. Allow for class feedback and discussion. What do the students think of the action plans?

6. After all the groups have presented, ask the class to make a commitment to follow through during the current school term with at least one of the concrete actions outlined by the groups (for example, students might collect signatures on a petition, hold a fundraiser to support a conservation organization, create a video for the school and/or the PTA raising awareness of the

issue, or devote one or more days to volunteering for a conservation effort in your region). Once an action has been decided upon, help students uphold their commitment and enact their plan.

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- Assessment
- Use the Ecosystem Action Plan Assessment Rubric to aid in assessing the presentations.

- Any graphs/charts/student handouts that go along with your lesson plan

Collapse of Sharks

Sharks and their biological cousins, the rays, are among the highest-profile denizens of the deep. But sharks are not the solitary killing machines that popular movies and the press might have us believe. In their marine environment, sharks coexist with numerous other species - many of whom flock to be near the sharks, rather than running from them in fear. In many of these cases, the interaction between two different species mutually benefits each species. But humans, too, have become an increasingly important player in the lives of sharks - and as they are increasingly hunted for their fins, sharks are actually becoming more endangered than they are dangerous. The impact on the marine ecosystem that would result from the disappearance of sharks would be devastating, but there is still time to save these magnificent creatures, and the ecosystems that depend on their existence.

Questions:

- Why are shark populations in danger of collapse?
- How has the relationship between sharks and humans changed over time?
- What might happen if the shark fin trade continues unchecked?

Shark and Turtle

- How does the turtle protect itself?
- What relationship is held between the tiger shark and the loggerhead turtle?

Sharks and Fishermen

- How have sharks become trained to follow fishermen?
- Describe how the following species pairs interact in the video segment: fishermen/fish; sharks/fish; sharks/fishermen.

Sharks in Our Future

- Describe the type of tourism seen in this clip.
- What benefit do these businesses provide to: sharks? To local populations? To tourists?
- How might these businesses help prevent the collapse of shark populations?

Unlikely Travel Companions

- List three ways in which being near a shark might be beneficial to a fish.
- What is one way that a shark might benefit from a fish (other than as prey)?
- Classify each shark-fish relationship shown in this video segment as commensalism, mutualism or parasitism.

Please also include:
Grade Level 9 – 12

Six 45 minutes sessions

Advanced preparations: Download video clips and add links to a folder for quick access

For each student:

- Ecological Relationships Student Organizer

For each group (3-4 students):

- Malaria Student Organizer
- Computer with Internet access
- Ecosystem Action Plan

For the teacher:

- One computer with Internet access for class demonstration
- Answer Key
- Ecosystem Action Plan Assessment Rubric

Web Sites

Malaria games from nobelprize.org

This site provides two games - the mosquito game and the parasite game - to help students understand the transmission of malaria.

Life Cycle of a Malaria Parasite Interactive Tour

This flash-based interactive tour provides a detailed explanation of each stage of the malaria parasite's life cycle.

Case Studies http://mpa.gov/helpful_resources/case_studies.html

- Materials

- Shark and Turtle QuickTime Video
  www.teachersdomain.org/resource/nat08.living.eco.ecos.turtle
- Unlikely Travel Companions QuickTime Video
  www.teachersdomain.org/resource/nat08.living.eco.ecos.travcom
- Sharks and Fishermen QuickTime Video
  www.teachersdomain.org/resource/nat08.living.eco.humimp.fishmen
- Collapse of Sharks QuickTime Video
  www.teachersdomain.org/resource/nat08.living.eco.humeco.collapse
- Sharks in Our Future QuickTime Video
  www.teachersdomain.org/resource/nat08.living.eco.humeco.future

CITATIONS:

http://www.teachersdomain.org/collection/k12/sci.life.eco.human/

http://www.teachersdomain.org/resource/nat08.living.eco.humeco.lpsymstra/

Ecosystem Action Plan Assessment Rubric

	Criterion	**Score, from 1-5:** 1= element is missing 2= minimally satisfies 3=partially satisfies 4=mostly satisfies 5= fully satisfies
1.	Is the **threat to the ecosystem** clearly explained?	
2.	Are the **at-risk species** named and their risk clearly described?	
3.	Are the **human causes** of the ecosystem's endangerment clearly explained and described?	
4.	Are the **consequences** that might result if no protective action is taken described at the species level and at the ecosystem level?	
5.	Are at least **three possible actions** named that could help prevent these consequences?	
6.	Is the **first action logical, reasonable, and feasible** (relying on resources currently available, such as current and/or emergent technology)?	
7.	Is the **second action logical, reasonable, and feasible**?	
8.	Is the **third action logical, reasonable, and feasible**?	
9.	Does the group outline at least **one concrete action** that the class might take immediately to make an impact on this issue? Is this action reasonable and feasible during the current school year?	
10.	Overall, does the presentation seem **high quality**? (Is it well organized? Do students speak clearly and project their main points? Do they use visual aids effectively, and respond to questions from the class?)	

Total (maximum: 50) _____

Grade (Total score x 2, maximum= 100)_____

NAME: _____

DATE: _____

Malaria Student Organizer

Mosquito Game:

1. How does the malaria parasite get into a mosquito?

2. How does the malaria parasite get into a human?

3. Which sex of mosquito drinks a blood meal?

Parasite Game:

4. What two places in the human body must the malaria parasite go in order to reproduce?

5. Draw what the malaria parasite looks like before it enters the parts of the human body where it reproduces:

6. Draw what the malaria parasite looks like after it leaves the liver:

7. What is the scientific name of the malaria parasite?

NATURE®

NAME: _____

DATE: _____

ECOSYSTEM ACTION PLAN STUDENT ORGANIZER

Your assignment:

- Select a case study in which human behavior provides a direct threat to an aquatic ecosystem, throwing ecological relationships out of balance and putting one or more species at risk.
- Research the case using classroom and web-based resources.
- Based on your research, prepare a presentation for the class in which you describe the case study and suggest THREE possible actions that could be taken to restore the balance of the ecosystem.

*The presentation should address **all** of the following points:*

1) *What is the threat to the ecosystem? Which species are at risk?*
2) *What human action(s) are causing this threat?*
3) *What are the possible consequences to at-risk species if nothing is done to address this problem?*
4) *Suggest THREE possible actions that humans could take to restore the balance of the ecosystem.*
5) *Suggest one concrete action that your class could take during this school year that would make an impact on this issue.*

SELECTED CASE STUDY:

Notes:

PRESENTATION DUE ON:

_____

NAME: _____

DATE: _____

Ecological Relationships

Interacting Species Pair	Ecological Relationship Prediction (predation, competition, commensalism, mutualism, parasitism)	Actual Ecological Relationship (name and describe)
Clip 1: **Tiger Shark / Loggerhead Turtle**		
Clip 2: **Shark / Jack**		
Clip 2: **Shark / Mackerel**		
Clip 2: **Shark / Shark Suckerfish**		
Clip 2: **Hammerhead Shark / Barberfish**		
Clip 3: **Shark / Fishermen**		