



MARINE CONSERVATION SCIENCE AND POLICY SERVICE LEARNING PROGRAM

Biological interactions result from the fact that organisms in an community interact with each other. In the natural world, no organism is an autonomous entity isolated from its surroundings. It is part of its environment, rich in living and non-living elements, all of which interact with each other in some fashion. An organism's interactions with its environment are fundamental to the survival of that organism and the functioning of the ecosystem as a whole. Sign-mediated interactions in which molecules serve as signs are the characteristic feature of communicative interactions

MODULE 3: OCEAN CONNECTIONS

SECTION 2: SPECIES INTERACTIONS

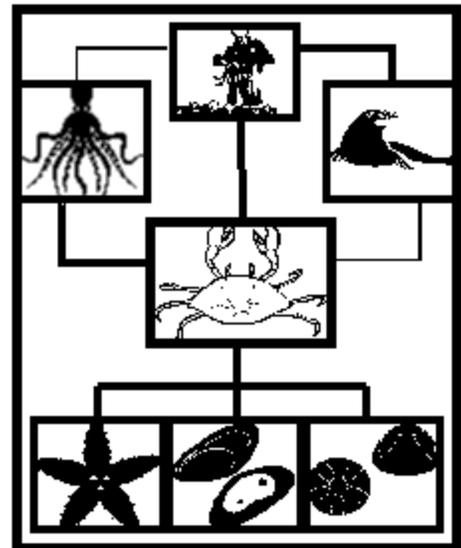
SUNSHINE STATE STANDARDS

SC.912.N.1.1, SC.912.E.7.3, SC.912.N.4.2,
SC.912.L.15.1, SC.912.L.15.3, SC.912.L.15.4,
SC.912.N.L.17.4, SC.912.L.17.8, SC.912.L.17.7

OBJECTIVES

Students will be able to:

- Differentiate between different types of species interactions
- Predict the interactions that occur between organisms
- Describe the effects that interactions among and between populations have on the ecosystem
- Evaluate the relationships that occur between sharks and other organisms
- Explain the role that sharks play in an ocean ecosystem



VOCABULARY

Symbiosis- An interactive association between two or more species living together; the relationship between two organisms

Competition - an interaction between organisms or species, in which the fitness of one is lowered by the presence of another

Symbiont- An organism that lives in a mutually beneficial relationship, or symbiosis with another organism

Host- an organism that harbors a parasite, or a mutual or commensal symbiont, typically providing nourishment and shelter

Commensalism- a relationship between two organisms where one benefits and the other is not significantly harmed or helped

Mutualism- a relationship where both organisms benefit from their associations

Parasitism- a relationship in which one organism benefits, but the other is adversely affected (weakened, sickened, damaged, etc.).

Obligate- restricted to a particular host, substratum or mode of nutrition

Facultative- restricted to a particular host, substratum or mode of nutrition

BACKGROUND

While trophic interactions and abiotic factors, like temperature, light, nutrients, and salinity play a large part in the control of growth, location, and abundance of marine populations, species within a population are also regulated by other factors, including symbiosis, competition, and disease. Every part of the complex web of biotic and abiotic factors fits together to make a system that is balanced and capable of withstanding most changes.



Species in the ocean interact within the ecosystem in a number of ways. These interactions are categorized according to the effect the interaction has on each species, the duration, and the nature of the relationship. Symbiosis is the term most often used to describe two organisms living in close associations. It usually involves a symbiont and a host. In ecological terms, symbiosis can mean more than just a mutually beneficial relationship as the effects of

these species interactions can be classified as having zero effect (0), a positive effect (+), or a negative effect (-) on each organism involved in the association. The basic types of symbiosis include neutralism (0,0), amensalism (-,0), commensalism (+,0), synnecrosis (-,-), mutualism (+,+), and parasitism (-,+). Symbiotic relationships include those associations in which one organism lives on another (ectosymbiosis, such as a remora attached to a shark), or where one partner lives inside the other (endosymbiosis, such as zooxanthellae in corals). These relationships may also be either obligate, i.e., necessary for the survival of at least one of the organisms involved, or facultative, where the relationship is beneficial but not essential for survival of the organisms.



Neutralism describes a relationship between two species, where they have no effect on each other. True neutralism is extremely unlikely and impossible to prove. Since this type of interaction is rare, its usage is often extended to situations where interactions are merely insignificant or negligible. Amensalism is a relationship in which one organism is harmed or inhibited while the other is unaffected. In synnecrosis, interactions between organisms are detrimental to both participants, often resulting in death. This type of competition is rare and

necessarily short-lived, as evolution selects against it.

Commensalism describes a relationship between two organisms where one benefits and the other is not significantly harmed or helped. Commensal relationships may involve one organism using another for transportation or for housing, or it may also involve one organism using something another created, after its death. Examples include hermit crabs using gastropod shells to protect their bodies and barnacles attaching themselves to other animals, such as turtles or whales, in order to gain access to nutrient-rich waters.



The term mutualism describes a relationship where both organisms benefit from their associations. Most mutualisms are facultative, meaning the partners can successfully live apart. However, some mutualisms are so intimate that the interacting species can



no longer live without each other; they have a mutually obligate interdependence. In the mutualism that occurs between corals and zooxanthellae, the coral provides the zooxanthellae with shelter and inorganic nutrients, while the zooxanthellae provide a source of food for the corals through photosynthesis. Another example of mutualism exists between clownfish and sea anemones. Anemones have dangerous stinging tentacles, to which the clownfish are unaffected by; by living

within the anemone's tentacles, the clownfish is offered protection from predation. In return, the clownfish cleans the anemone and scares away its predators, like butterfly fish.

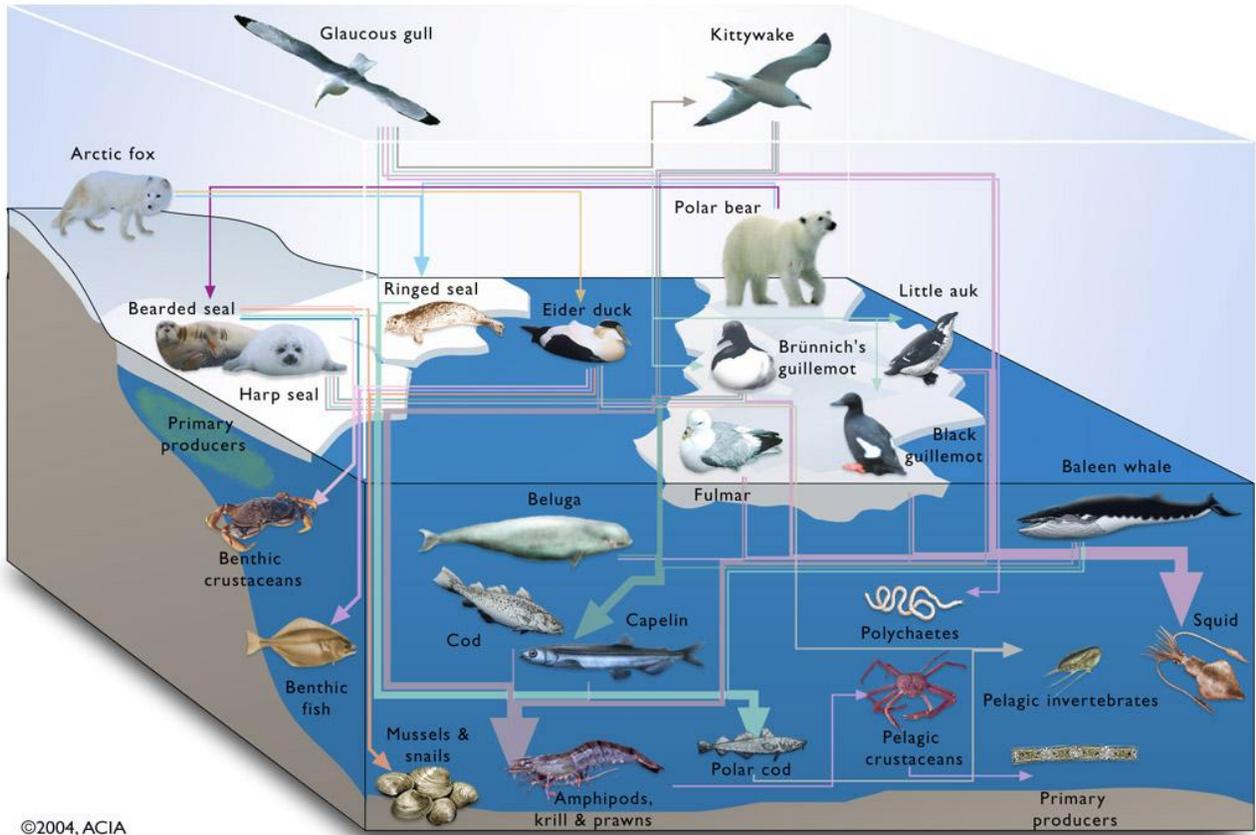
In a parasitic relationship one organism benefits, but the other is adversely affected (weakened, sickened, damaged, etc.). Ectoparasites live on the outside of the host and endoparasites live on the inside of the host. With parasitism, the parasite lives off of the host and when it has collected enough nutrients to survive and reproduce it leaves the host. In parasitoid relationships, the host is usually overcome by the organism and eventually dies. One interesting marine parasite is the Sacculina barnacle. This barnacle begins its life floating in the ocean until it hitches a ride on a crab, sneaking inside the crab's shell to make that its home. Once attached, the barnacle sends root-like tendrils throughout the crab's body that allow the barnacle to draw nutrients from the crab. The crab will forgo its own needs as it searches for more food to replace the nutrients lost to the barnacle. It won't molt, grow reproductive organs and attempt to reproduce, or re-grow appendages, as all those activities require too much energy.



Further complicating species interactions are the population interactions in marine ecosystems that must also be considered. Competition among species plays an important role in ecological regulation. Mortality, growth, and the ability to reproduce are all related to the number of organisms in a particular environmental niche. When population densities become too high, organisms must compete for the limited resources; mortality increases, growth decreases, and

the ability to reproduce is inhibited. When that competition occurs between two or more populations, it is described as interspecific competition; if this struggle occurs between organisms within the same population, it is known as intraspecific competition.

In spite of the scientific organization and categorization of food webs described earlier, they remain incredibly complicated. Energy and matter flow between species in many ways and the abundance of species is always changing. Biotic and abiotic factors work together to regulate the survival of species. Additionally, because resource availability and predation play a major role in ecological regulation, species must constantly adapt to their environment.



ACTIVITY : ECO-RELATIONS

Predict the relationships between different organisms in the ocean ecosystem.

DURATION: 1 hr

MATERIALS

- Eco-Relations Worksheet
- Books, magazines or other resources with shark information
- Access to library or computers with internet access

PROCEDURE

1. Review students' knowledge of different ecological relationships.
 - Ask them to generate a list of different types of interactions that might exist between different species living close to each other.
 - Write these interactions on the board.
 - Interactions should include both interspecific and intraspecific interactions
2. Ask for a student to define "symbiosis".
 - Write the following on a board in 3 columns: "+ +", "+ 0", and "+ -".
 - Students should be able to recognize what each of these symbols represent (mutualism, commensalism, and parasitism or predation, respectively).
3. Distribute the Eco-Relations worksheet to each student.
 - Ask students to complete the first column of the worksheet; they will make predictions about the relationships between the two species listed. .
 - Next, students should conduct research on each pair of organisms to discover the nature of their relationship. They must write the actual relationship in the third column.
4. Ask for volunteers to share their predictions and their final answers.
 - Were the actual relationships different from the ones they predicted?
 - Why did they make their initial predictions?
 - Did any of the relationships surprise them? Why?
5. As an extension, students can choose one of the pairs to conduct a research project on, that can then be presented to the class.

ECO - RELATIONS

Relationships between organisms that coexist have evolved over a long periods of time. Even the relationships that are detrimental to one species are integral to the maintenance of ecological balance.

Can you accurately predict the relationship between 2 organisms?

Interacting Species Pair	Ecological Relationship Prediction and Reasons Why (predation, competition, commensalism, mutualism, parasitism)	Actual Ecological Relationship (name and describe)
Tiger Shark / Loggerhead Turtle		
Shark / Jack		
Shark / Mackerel		
Shark / Remora		
Hammerhead shark / Barberfish		
Shark / Fisherman		

ACTIVITY : KNOW YOUR PLACE

Examine the role that sharks play in the ecosystem.

DURATION: Homework assignment or In-class timed writing

MATERIAL

- Writing prompt

PROCEDURE

1. Review the information learned about the ocean ecosystem and species interaction discussed throughout this module.
2. Lead a class discussion about sharks and how they contribute to the balance within the ecosystem. Some guiding questions may include:
 - Do they have a major role?
 - If so, what is that role?
 - How do sharks interact with other species?
 - What would happen if there are no sharks?
 - Are there other organisms that play similar roles to sharks?
 - Do their roles change within different ecosystems?
3. Give students the following prompt:

Writing Assignment

Describe how sharks contribute to the ocean ecosystem. Be sure to include details about their position in the food chain or web, their ecological niche, and to illustrate some of their important species interactions.

ACTIVITY: SPECIES INTERACTIONS

DURATION: 50 minutes

OBJECTIVES

- To understand relationships and interactions between species.
- To understand the difference between a fundamental niche and a realized niche.
- To learn about the various species interactions from their classmates through the jigsaw activity
- To understand the importance of putting definitions into their own words.
- To understand the importance of examples in biology classes.
- To realize what the various roles are that animals/organisms play in ecosystems.
- To understand that they also have roles in the world
- To understand the importance of listening and learning from others.
- To understand the relationships of these interactions to them and life around them.

MATERIALS

- Worksheets/handouts for the stations.
- Vocabulary list for the day.
- List of home groups.
- List of station groups.
- Directions worksheet.
- Quiz.
- Handout, directions, and quiz for the special needs student.

TEACHER TASKS

- Make the separate worksheets for each station.
- Make the vocabulary sheets for each student.
- Make a list of who will be in each home group, and also who will be in each station.
- Make a worksheet that gives the directions for the jigsaw activity.
- Make a quiz on the species interactions.
- Make extra handouts, directions, and quiz for the special needs student.

PROCEDURE

Part One: (7 minutes)

- Ask the class to think back to last week when we were talking about the various forms of producers and consumers that are in the world (ex: herbivores, carnivores, etc.) and how they all fit into the food webs.
- Remind them that the levels of the food webs are called trophic levels, and then introduce another term that can be used to mean the same thing as trophic levels, which is called Feeding levels.
- Go on to talk about how each species has a functional role in an ecosystem, which is called a niche.
- Tell them that there are two main types of niches:
- The first is called a Fundamental Niche. This is a niche that might prevail when there is no competition or other factors that could constrain the species/organisms acquirement and use of resources.
- The second type is called a Realized Niche which can shift in large and small ways over time as individuals of the species respond to a variety of changes.

Transition:

- Since we have been talking about the various roles that species play in the environment/ecosystems, we need to look at how the different species interact with one another and what roles they play in these interactions.

Part Two: (25 minutes)

- Now, tell the class that they are going to participate in the jigsaw cooperative learning activity dealing with species interactions.
- Split them into 5 pre-designed groups.
- After they are in their groups, tell them that they are in their Home groups.
- Now give them the directions for the jigsaw activity so they can follow along as you explain to them what they will be doing.
- For this activity they are each going to be selected to go to one of five stations. At these stations, they will be given the proper materials to read in order to understand two different types of species interactions (each group will have two to learn).
- While at these stations, they are instructed to read over the definitions and examples for both of the interactions that have been given to them.
- After reading the definitions and examples, they should talk quietly with their station group to decide on how to put these definitions into their own words so that they will be able to explain them to their Home groups. They will also be told to take notes on the items they go over in their groups because they will not be allowed to take the papers back to their Home groups.
- Let them know that I will be around to answer any questions they may have.
- They will also be instructed to brainstorm and come up with at least one other example for each of their two interactions in order to better explain the terms to their groups.

- After about ten minutes (or when everyone has a good grasp on the information at their stations), I will instruct them to pile up the materials I had given to them so that I can collect them.
- They will then be sent back to their Home groups where they will have around 15 minutes (longer if necessary) to take turns explaining the two terms each of them had learned to the other group members.
- They will be encouraged to put ideas into their own words to better explain these concepts.
- They will also be told to take notes on what each of the Home group members has to say about the interactions they learned about because they will be responsible for knowing the information (so everyone should try to do a good job explaining and listening).
- Students will be encouraged to add any extra feelings or thoughts to other's explanations in order to better clarify topics and help each other understand more thoroughly.
- I will make sure that all of the Home group members have a good grasp on the information before continuing with the lesson, but not waiting too long because there is still assessment on what they have learned.
- The students will then be instructed to put all of their notes away to get ready for a short quiz on the material.

ASSESSMENT/EVALUATION (12 minutes)

- Give a short quiz where the students will have to explain in their own words and also give an example of 4 species interactions in which they learned from other group members (not ones that they learned at their stations).
- The quiz will have a list of all the names of the species interactions given at the top of the sheet for them to choose from.
- The quiz will be worth 20 points.
- After the quiz is over, they will be instructed to turn their papers over.
- Once everyone has finished, they will turn in their papers.
- If they feel that they did poorly, they will be given a chance to redeem themselves by telling me about 2 species interactions and examples of them in depth (ones that they did not learn at their stations) to regain 2 points to add on to their grade. I will only add these points on if the student did poorly on the quiz.

CONCLUSION

- I will ask if there are any questions on any of the species interactions.
- I will ask if they understand the various roles species play in the world and why each role is important and also why the different roles come together and species interact
- I will ask if they understand their roles in life.
- I will randomly ask the students questions on what they have learned to test their knowledge.

GROUP STATIONS HANDOUTS

Group One:

1) Commensalism—ecological interaction in which one species benefits and the other is neither armed nor helped

a) Example:

i) Birds use tree branches for roosting sites.

(1) The trees get nothing but are not harmed.

2) Mutualism—symbiotic association in which both partners benefit.

a) Example:

i) Clownfish and sea anemone.

(1) The tentacles around the mouth of the sea anemone will be used to eat many fish, but not the clownfish.

(2) The clownfish swim out and capture food, then return to the tentacles (which protect them from predators) and the sea anemone will eat food scraps that fall from the mouth of the fish.

Group Two:

1) Interspecific Competition—ecological interaction in which individuals that belong to the same population compete for a share of resources in their habitat.

a) Disadvantages flow both ways.

2) Predation—an ecological interaction in which one organism feeds on another.

a) An interaction that directly benefits the predator, and directly hurts the prey.

b) Depends on factors:

i) Carrying Capacity:

(1) Rates of reproduction for predator and prey populations.

(2) Responses of the population of predators to increased prey density.

ii) Examples:

(1) Spiders that prey upon insects.

(2) Canadian lynx and snowshoe hare.

Group Three:

1) Parasitism—type of predation in which the predator feeds on but usually does not kill a larger organism.

a) An interaction that directly benefits the parasite, and directly hurts the host.

b) Example:

i) Ticks that suck the blood of deer.

2) Symbiosis—ecological interaction in which two or more species live together in a close, long-term association.

a) Positive benefits flow both ways.

Group Four:

1) Intraspecific competition—ecological interaction in which individuals that belong to the same population or species compete for a share of resources in their habitat.

a) Can be fierce.

i) More intense than Interspecific competition.

ii) Why?

(1) Because the requirements of two species might be similar, but they never can be as close as they are for individuals of the same species.

b) Sometimes individuals have equal access to a required resource, but some are better than others at exploiting it.

c) Competition tends to reduce the supply of a shared, limited resource.

d) In some cases, individuals control access to a resource and partially or completely prevent others from using it regardless of its scarcity or abundance.

2) Competitive Exclusion—theory that two or more species that require identical resources cannot coexist indefinitely.

a) Testing with paramecium.

Group Five:

1) Resource Partitioning—of two or more species that compete for the same resource, a sharing of the resource in different ways or at different times, which allows them to coexist.

a) The subdividing of some category of similar resources that lets competing species coexist.

b) Differences in adaptations allow for this to happen.

2) Obligatory—some forms of mutualism.

a) The individuals of one species cannot grow and reproduce in the absence of intimate dependency with individuals of another species during the life cycle.

b) Example:

i) The interaction between yucca plants and yucca moths.

ii) Each plant of this genus (Yucca) can be pollinated only by one species of the yucca moth genus.

VOCABULARY LIST

1) Feeding Levels- the trophic levels.

2) Niche- functional role of a species in an ecosystem.

a) Sum total of all activities and relationships in which individuals of a species engage as they secure and use the resources required to survive and reproduce.

b) Two Types:

i) Fundamental Niche- one that might prevail in the absence of competition and other factors that could constrain its acquirement and use of resources.

ii) Realized Niche- shifts in large and small ways over time, as individuals of the species respond to a mosaic of changes.

3) Species Interactions

- a) Commensalism- ecological interaction in which one species benefits and the other is neither harmed nor helped.
- b) Mutualism- symbiotic association in which both partners benefit.
- c) Interspecific Competition- ecological interaction in which individuals that belong to the same population compete for a share of resources in their habitat.
- d) Predation- an ecological interaction in which one organism feeds on another.
- e) Parasitism- type of predation in which the predator feeds on but usually does not kill a larger organism.
- f) Symbiosis- ecological interaction in which two or more species live together in a close, long-term association.
- g) Intraspecific Competition- ecological interaction in which individuals that belong to the same population or species compete for a share of resources in their habitat.
- h) Competitive Exclusion- theory that two or more species that require identical resources cannot coexist indefinitely.
- i) Resource Partitioning- of two or more species that compete for the same resource, a sharing of the resource in different ways or at different times, which allows them to coexist.
- j) Obligatory- some forms of mutualism.
 - i) The individuals of one species cannot grow and reproduce in the absence of intimate dependency with individuals of another species during the life cycle.

DIRECTIONS TO JIGSAW ACTIVITY

-You are all going to participate in the jigsaw cooperative learning activity dealing with species interactions.

-You will be split into 5 pre-designed groups. These groups will be considered your Home groups.

-For this activity you are each going to be selected to go to one of five stations. At these stations, you will be given the proper materials to read in order to understand two different types of species interactions (each group will have two to learn).

-While at these stations, you will be instructed to read over the definitions and examples for both of the interactions that have been given to you.

-After reading the definitions and examples, you should talk quietly with your station group to decide on how to put these definitions into your own words so that you will be able to explain them to your Home groups. You should also take notes on the items you go over in your groups because you will not be allowed to take the papers back to your Home groups.

-I will be around to answer any questions you may have.

-You should also brainstorm and come up with at least one other example for each of their two interactions in order to better explain the terms to your groups.

-After about ten minutes (or when everyone has a good grasp on the information at your stations), I will instruct you to pile up the materials I have given to you so that I can collect them.

-You will then be sent back to your Home groups where you will have around 15 minutes (longer if necessary) to take turns explaining the two terms each of you had learned to the other group members.

-You are encouraged to put ideas into your own words to better explain these concepts.

-You should also take notes on what each of the Home group members has to say about the interactions they learned about because you will be responsible for knowing the information (so everyone should try to do a good job explaining and listening).

-You will be encouraged to add any extra feelings or thoughts to other's explanations in order to better clarify topics and help each other understand more thoroughly.

-After all of the Home group members have a good grasp on the information, you will then be instructed to put all of your notes away to get ready for a short quiz on the material.

QUIZ (20 PTS.)

Symbiosis Interspecific Competition Obligatory

Mutualism Intraspecific Competition Parasitism

Predation Competitive Exclusion Commensalism

Resource Partitioning

I. Explain in your own words and also give an example of 4 species interactions in which you learned from other group members (not ones that you learned at your stations).
--Use the list of terms at the top of the page and pick 4 of these terms to describe.

1. _____

2. _____

3. _____

4. _____

TECHNOLOGY INTEGRATION

1. If I had one computer that was a teacher station connected to the Web with large screen projection capability, I would be able to show various power-point slides to the class of various information for their vocabulary words and also of pictures and examples that I had found on the internet. I would also be able to search online during class to look up anything that the class had questions on for which we were discussing. Another idea would be that I could type out various ideas that we brainstorm during class and project them onto the screen instead of using a regular chalkboard. I would also be able to give notes, directions to the activity, and any other valuable information on the screen instead of in handouts.
2. If I had a cluster of six computers in my classroom with each computer connected to the web and a computer-to-student ratio of 1:4, I would have the students broken up into groups in which they would work together to research the ideas that we are discussing in the class. Instead of having the groups look through encyclopedias, handouts, and magazines at their stations, I would have them all do their research online to come up with a clear idea of the items I have given them. They could then all work together to come up with conclusions on their topics which they could type out and print to take back to their home groups.
3. If I had a lab reserved for my class with one computer per student, each connected to the Web, I would still split them up into their home groups, but I would change the part where I would normally have them split off into their separate stations. I would still have the list of their station groups that they would split up into, but to make it different, I would have them work on their own researching their station's topics, and then I would allow them to collaborate to come up with a more complete idea on the items they are learning about. They will then be allowed to type up their summaries on their topics and print them out to take back to discuss with their home groups.

RESOURCES

<http://teachers.net/lessons/posts/3036.html>

http://en.wikipedia.org/wiki/Biological_interaction

http://www.wcupa.edu/aceer/amigos/cd/species_interactions.htm

http://wps.prenhall.com/esm_freeman_biosci_1/7/1958/501279.cw/index.html

<http://www.actionbioscience.org/biodiversity/simberloff.html>