Pre-lab homework Lab 9: Community Interactions

Lab Section: ____________________  Name: ____________________

In lab this week we will work on developing an understanding of community interactions. Prior to lab answer the following questions to help you be prepared for the lab

1. When scientists talk about communities of organisms they have a meaning that is a little different then when you think of the community of people you live with. What do scientists mean by a community of organisms and how is that different from a community of people?

2. Do help us keep track of the huge number of different of interactions that are apparent in the world around us scientists have developed four categories of interactions. Complete the following table filling in the blank spaces to see what those categories are.

<table>
<thead>
<tr>
<th>Type of interaction</th>
<th>Effect on pop 1</th>
<th>Effect on pop 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Beneficial (+)</td>
<td>Beneficial (+)</td>
</tr>
<tr>
<td>Commensalism</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Beneficial (+)</td>
<td>Harmful (-)</td>
</tr>
<tr>
<td></td>
<td>Harmful (-)</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: The categories of community interaction

4. In lab today we will examine three of the four different types of interactions. Which interaction are we not examining? Give one example of this type of interaction that you know about and explain how it fits into this category.
Lab 9: Community Interactions

Lab Section: ____________________________  Name: ____________________________

GOALS: After successfully completing this lab a student will be able to:

- Describe in general terms ways that different species in a community can interact.
- Explain how interactions can cause changes in a species morphology or behavior.
- Identify types of community interactions from specific examples.

Introduction:

In ecology a community is a group of populations of different species in the same area. There are a huge number of ways that these different populations interact so ecologists use categories of interactions based on the effects on each species to help them discuss specific examples of interactions. There are four commonly used categories, Mutualism, Commensalism, Exploitation (sometimes called Preditor/Prey interactions), and Competition. Which category an interaction falls into depends on the effects on the two different species as illustrated by Table 1.

<table>
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<th>Type of interaction</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Mutualism</td>
<td>Beneficial (+)</td>
<td>Beneficial (+)</td>
</tr>
<tr>
<td>Commensalism</td>
<td>Beneficial (+)</td>
<td>Neutral (0)</td>
</tr>
<tr>
<td>Exploitation</td>
<td>Beneficial (+)</td>
<td>Harmful (-)</td>
</tr>
<tr>
<td>Competition</td>
<td>Harmful (-)</td>
<td>Harmful (-)</td>
</tr>
</tbody>
</table>

**TABLE 1:** The four categories of community interactions.

Community interactions often have large effects on the populations that are part of the interaction. For example.

Remember that what we are doing here is grouping organisms together based on common characteristics. This should remind you of the tree identification lab you completed last week.
**Exercise 1. Mutualism**

Mutualism is an interaction where both species receives some benefit from the interaction. This type of interaction can often lead to a very strong association between different species of organisms. In many cases the mutualism becomes so complete that the two organisms are described as living in symbiosis, an association where the two organisms are living together continuously.

**A: Mutualism in Clover:** Many plants find their growth limited by the lack of nitrogen they can find in the soil around them. This is why many gardeners use a fertilizer containing nitrogen (and this is why those fertilizers can increase growth – often dramatically). This is especially odd considering that the most common gas in the atmosphere is nitrogen (N\(_2\)). In the wild some plants have figured out an interesting trick to acquire nitrogen and it involves a mutualistic relationship with a bacteria (*Rhizobium sp.*) living inside structures called root nodules.

**Observation of Root Nodules:**

1. Examine the clover roots on display in the lab and draw them in the space below. Be sure to note the number of nodules and their size.
2. Next examine the demonstration slide set up to show you the bacteria found inside these nodules.

| Clover roots (w/nodules) | Bacteria isolated from nodules |

**QUESTIONS on mutualism in clover:**

1. Do the nodules on the younger part of the root system (farther away from the base of the plant) seem to be smaller? Why do you think this is?
QUESTIONS on mutualism in clover continued:

2. Do you think all the bacteria are the same species? What evidence do you have that supports your answer?

3. A mutualistic relationship is one where both species benefit. What is the benefit to the plants? (hint: it is in the description above) What do you think is the benefit to the bacteria? (hint: you will need to guess based on your observations)

B: Mutualism in Lichen: Lichen are a common sight in most biomes. Actually this organism isn’t a single organism at all but rather two different organisms, a fungus and an algae, living in a mutualistic relationship. There are a huge number of different types of lichens and so, as is often the case, scientists place the lichens into different categories. This time the categories are based on the physical appearance of the lichens. The three categories are: **Crustose** lichens, that grow as a tight “crust” adhering to rocks, twigs, walls, almost any surface; **Foliose** lichens, that grow out as flat leaf-like structures tightly attached to what they are growing on only at the base; and **Fruticose** lichen, that are also attached only at the base but grow more tube or twig-like. The mutualistic nature of the lichens is really only apparent if you examine them with a microscope. Then you can see two distinct types of cells, the long thin cells of the fungus (called hyphae) and the usually smaller and rounder cells of the algae. For this lab you will examine both the entire lichen and the microscopic structure using a prepared slide.
**Observation of Lichens:**

1. Examine the full lichens on display in the lab and draw them in the space below. Be sure to distinguish between the three different types of lichen.
2. Next examine the prepared slide of a lichen – try to identify the two different organisms present on the slide

<table>
<thead>
<tr>
<th>Crustose Lichen</th>
<th>Foliose Lichen</th>
<th>Fruticose Lichen</th>
</tr>
</thead>
</table>

**Prepared slide of lichen (at what magnification? \( \rightarrow \) \( \times \))**

**QUESTIONS on mutualism in lichen:**

1. Is there a major difference in size of the three different types of lichen? Why do you think this is?
QUESTIONS on mutualism in lichen continued:

2. A mutualistic relationship is one where both species benefit. What is the benefit to the algae? What do you think is the benefit to the fungus? (hint: you will need to guess based on your knowledge of the types of organisms present)

3. The cells of the organisms that make up lichen are still distinct. What problems do your think this causes lichens during reproduction?

C: Mutualism in Termites: Termites are often thought of as a pest because of the destructive nature of their colonies in homes. Actually these social organisms are key decomposers of dead trees in many ecosystems. Some of the main components of a tree’s wood are chemical compounds that are indigestible to all animals (including termites!). So how are these termites able to decompose trees if they can’t digest most of the compounds in the wood? With the help of mutualistic organisms that live inside their digestive tracts. There is actually a small community of organisms that live inside termites and, of course, they interact in complicated ways. We will look at this interaction in two different ways. First we will watch a short video that shows living termites and the contents of their digestive tracts. Then we will examine prepared slides of termite flagellates (many of the internal species move using cellular structures called flagella and so are called flagellates).
Observation of termite mutualism:

1. Watch the video, pay special attention to the way that organisms inside the termites are specially adapted to that environment.
2. Next examine the prepared slide of termite flagellates. Try to identify as many different types of organisms as you can.

Prepared slide of termite flagellates (at what magnification? \( \rightarrow \) _______ X)

QUESTIONS on mutualism in termites:

1. Think about the video you watched on the organisms found inside termites. Do you think these organisms are usually found in the environment outside of termites? Why/Why not?

2. When you examined a prepared slide of termite flagellates how many different organisms did you find? Why do you think there are this many organisms?
QUESTIONS on mutualism in termites continued:

3. A mutualistic relationship is one where both species benefit. What is the benefit to the termite? What do you think is the benefit to the organisms inside the termite? (hint: think about the information you learned from the video)

4. In this relationship the termite actually digests some of the flagellates found inside it. In this case there is some harm to the internal guest of the termites. Why do you think scientists classify this as a mutualistic relationship if some of the organisms are being harmed?

Exercise 2. Commensalism

Recall that commensalisms is an interaction where one species receives some benefit but the other species is unaffected by the interaction. Some ecologists don’t think that truly commensalistic relationships exist, arguing that all relationships have either some benefit to the “neutral” species (and so would be a mutualistic relationship) or some harm (and so would be classified as exploitation). We will use the term since it is common in ecology and will help us to think about the nature of some relationships.

A: Lichens as examples of commensalisms: We have already examined lichens as examples of a mutualistic association between fungus and algae but they also serve as a good example of commensalisms. This is because lichens are often found growing on other organisms, usually plants. In this case the plant that the lichen grows on is not harmed, the lichens get nutrients from
the surrounding environment and don’t need to steal from their host. While the lichens have a place to grow and are generally better able to find light and other resources because of their location. Organisms that grow on plants but don’t harm them are called **epiphytes**, and represent a special type of commensalisms.

**Observation of lichen commensalism:**

1. Examine the tree branch covered with lichens. Try to pay attention to the number of different types of lichens (see if you can identify them as crustose, foliose, or fruticose).

**QUESTIONS on commensalism:**

1. Guess how many different species of lichen (or moss) are on the branch you observed?

2. What kind of community relationship do these different species have? Why do you think they have this relationship? (hint: which of the four categories seems most likely? Now describe how the different species are interacting in a way that puts them in this category.)

3. What percentage of the branch was covered by epiphytes?

4. The scientists that claim there is no such thing as commensalisms would look for evidence of either mutualism or exploitation in this relationship. How could this be a mutualistic relationship?

How could this be an exploitation relationship?
Exercise 3. Exploitation

Exploitation is an interaction where one species receives some benefit from the interaction while the other is harmed. This type of interaction is seen in predator prey interactions where one species, the predator, kills and eats the other gaining a clear advantage at the cost of the other. In other cases the organism that benefits may not kill the other organism at all but just harm them in some small (or large) way. In this case we often describe the relationship as parasitism, with the organism that benefits called the parasite and the organism that is harmed the host. Many examples of parasitism involve very complex relationships with multiple species serving as a host during different stages of the life cycle of the parasite. This is especially common in a group of parasites, called internal parasites, which complete their life cycles inside the bodies of other organisms.

A: Parasitism by Plasmodium. One of the most deadly diseases of the tropics is malaria. This disease, that kills over 1 million people a year, is caused by an infection with a protistan parasite called Plasmodium. This parasite has a complex life where it cycles between two different host species, one a mosquito and the other a human. Starting as a group of specialized cells called sporozites found in the salivary glands of a female mosquito the parasite migrates into a human host when the mosquito injects its saliva as part of its feeding on the humans blood (making the mosquito a parasite that transmits another parasite!). Once inside the human these sporozites migrate to the liver where they infect the human host and reproduce asexually, these cells are now called merozoites. After some period of time (usually 1-2 weeks) these cells are released from the liver and infect red blood cells where they reproduce asexually and continually infect new red blood cells but they also produce gametes (specialized reproductive cells) that circulate in the blood until they are picked up by a mosquito. Once in the mosquito reproductive cells infect the intestine where they produce sporozites and start the process all over again.

Observation of Plasmodium:

1. Examine the prepared slide of Plasmodium

Prepared slide of Plasmodium (at what magnification?) \( \rightarrow X \)
QUESTIONS on parasitism in *Plasmodium*:

1. One of the traits of parasitism is that the parasite doesn’t kill its host (at least not initially). What advantage is there to a parasite to not kill its host?

2. Using the information on the previous page fill in the diagram of the life cycle of the plasmodium:

   - Sporozoites found in __________
   - Transferred to humans by ________
   - Once in human host - cells infect the ___________
   - A new cell type, the __________ migrates to red blood
   - Gametes are transferred to __________ and eventually become __________.

3. What advantage do you think this complicated life cycle has for the *Plasmodium*?

4. What disadvantage can you think of?
**B: Parasitism in Tapeworms:** Another group of parasites that infect humans and many other vertebrates is the Tapeworm (Class Cestoidea). Tapeworms, like *Plasmodium* that causes malaria, have multiple hosts and depending on the species may be found in beef, pork, or rabbits as an intermediate host before it infects humans. In this life cycle the parasite reproduces in humans so humans are called the primary host. The other species that serves to pass the parasite from one human to another is called the intermediate host. Humans can be infected by tapeworms when they eat meat that contains cysts. These cysts pass into the digestive tract where the tapeworm hooks onto the host using a specialized structure called the **scolex**, located at one end of its body. The scolex consists of hooks and suckers that can embed into the wall of the small intestine and hold the tapeworm in place as it reproduces. Just behind the scolex is a short neck region where the tapeworm grows. Behind this are short sections of tapeworm called **proglottids**, that are the reproductive structures of the tapeworm. As these mature they become full of eggs and then break off and are shed in the feces of the infected individual. If this feces contaminates the water or food of the intermediate host then the tapeworm eggs can develop into cysts in the muscle tissue of the intermediate host.

**Observation of Tapeworm:**

1. Look over the whole tapeworm mounted in fluid and estimate the number of proglottids.
2. Examine the prepared slide of a tapeworm and make three sketches in the space below. Pay careful attention to the scolex, and examine a proglottid high up on the body (near the scolex – where they are not fully mature) and lower down near the end of the “tape”.

The Scolex

Immature proglottid

Mature proglottid
QUESTIONS on parasitism of Tapeworm:

1. Tapeworms have no digestive system (and in fact no way to “eat” at all since they have no mouth). How are they able to get the nutrients they need?

2. How many proglottids did you estimate there were on the tapeworm displayed in the lab? Does this seem like a lot to you? Why/Why not?

3. Think about the life cycle of these worms and of the plasmodium parasite you looked at previously. Both organisms have more than one host species and in fact this is common with many different groups of parasites. What do you think is an advantage of having more than one host?

4. The parasites we have discussed here are very specific in their choice of host. For example the plasmodium parasite is only transmitted by one type of mosquito and different species of tapeworms are found only in one type of intermediate host. Other parasites, primarily those that are external like mosquitoes and leeches, are much less picky about their hosts. Why do you think internal parasites are so much choosier about their hosts?