Sunday Academy 2014-2015
Candyland Ecology

Description:

All living organisms need a particular set of resources (physical, chemical, or biological) to survive (termed their ecological **niche**) and, very often, they have special **adaptations** to better acquire some resources over others. If we understand how these adaptations affect the way an organism uses resources we can predict how organisms will respond to different scenarios (i.e., changing habitats, predation). To demonstrate these concepts we will investigate how different types of "organisms" feed on a special set of prey items (candy!).

Objectives:

By the end of the activity students should be able to:

1. Describe the concept of the ecological niche
2. Predict the resource needs of a biological organism given a description
3. Predict the outcome of species interactions over resources
4. Predict how changing resource availability will affect the outcome of species interactions
5. Make and interpret a graph
6. Calculate an average

Standards covered:

HS-LS1-2 Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

HS-LS2-1 Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales

HS-LS2-2 Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

HS-LS2-7 Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity

Session Organization

11:00 - 11:30	Cultural connection and general organization
11:30 - 12:00	Background information
12:00 - 12:30	Lunch
12:30 - 1:15	Activity 1
1:15 – 2:00	Activity 2
2:00 - 2:30	Activity 3
2:30-3:00	Wrap up/surveys

Materials

Participants should be arranged into groups of 3-4. Each **group** should have:

1 – Image set

1 - Instruction packet

4 – Sheets of Graph paper

Markers or colored pencils

1 - Calculator

25 pieces each of 5 types of candy that vary in size such as:

- *Tic Tac* *Skittles/ M&M's* *Peanut M&M's*
- *Jelly Beans* *Hershey's kisses* *Gumballs*
- *Gummy Bears*

Each member should select one mouthpart from a set of various Mouthparts

- *Tweezers* *Eyedroppers* *Tongue depressors*
- *Plastic forks (3 ways: regular, 2 prong wide, 2 prong narrow)*
- *Plastic spoon* *Plastic Knives*

1- Plate

3-4 Cups

Agenda:

1. **Background information (0.5 hour)**
   a. Divide the group into small groups of 3-4 people (suggest count-off)
   b. Handout a set of images (bear, wolf, eagle, plant, grasshopper) and ask the participants to list –
      a. What resources each needs to survive (prompt – physical, chemical, biological)
      b. What other types of organisms this one interacts with
   c. Discuss responses and introduce the concept of the **niche –** every organism has a defined set of resource needs and they are usually better at acquiring some resources over others
   d. Example – we can all eat candy – but some of us like some types better than others. If you walked into a candy store how many would pick snickers or twizzlers? It would work better if we put a snickers and a twizzler in a room than two twizzler people
   e. We are going to investigate these ideas and the predictions we can make from them today with "mouthparts" and "food resources" – aka candy
   f. Have the groups gather their supplies

2. **Activity 1 – Defining your niche (45 min)**
   a. Hypothesize which prey each predator will be efficient at eating
   b. Each mouthpart will belong to one animal that feeds by gathering one prey (Candy) at a time and placing the prey in the stomach (Cup). The predators will feed for three minutes on the prey, but can only eat one prey at a time (cannot put multiple candies on mouthpart at one time).
   c. Count the number of each type of prey eaten during the time period and record
   d. Repeat this process again with the same mouthpart and average the number of each type of prey eaten during the two trials. (Emphasis on experimental design and replicates)
   e. This is repeated for all three mouthparts
   f. Make graph of number of each type of prey eaten for each mouth part. **(3 total bar graphs)** - talk about how to make a graph
   g. Analyze and look at hypothesis

3. **Activity 2 – Predicting species interactions**
   a. Same as above except competition is introduced.
   b. Hypothesis what the effect of competition will have on biodiversity and predator efficiency
   c. Students pick two mouthparts and two members of the group feed at one time.
   d. Perform replicates and average data
   e. Graph and analyze how the competition affected the biodiversity of the prey population and how the predator efficiency changed. **(2 graphs: one for each of the two competing predators)**

4. **Activity 3 - Scenarios: See attached page**
    a. The scenarios can be used as time allows. If ahead of schedule each group could simulate all scenarios. However, if time is lacking each group and choose or be assigned a smaller number of scenarios.
    b. Make new hypothesis on the outcome of biodiversity and predator efficiency based on scenario
    c. Students perform the same protocol for data collection with incorporating the instructions of the varying scenarios/stressors.
    d. Data collection, replicates, make graph(s), analyze data

Wrap Up Discussion

- How do these ideas relate to humans?
- How can humans influence these interactions?
- What are the consequences on biodiversity and predator efficiency in center situations…?
- Trophic cascade ideas
- Thoughts and questions

Discussion Points

Ecology- scientific study of interactions among organism and their environment.

Optimal foraging theory- organisms forage in such a way as to maximize their net energy intake per unit time. (Animals behave in a way to find, capture, and consume food containing the most energy while expending the least amount of energy and time in doing so)

Tragedy of the commons- individuals acting independently and rationally according to each one's self interest, behave in a way that is against the group's as a whole long term best interests due to depleting resources

Competition types:
Asymmetrical- competition affects one organism to a greater extent than another organism
Symmetrical- competition affects all organisms to the same extent.

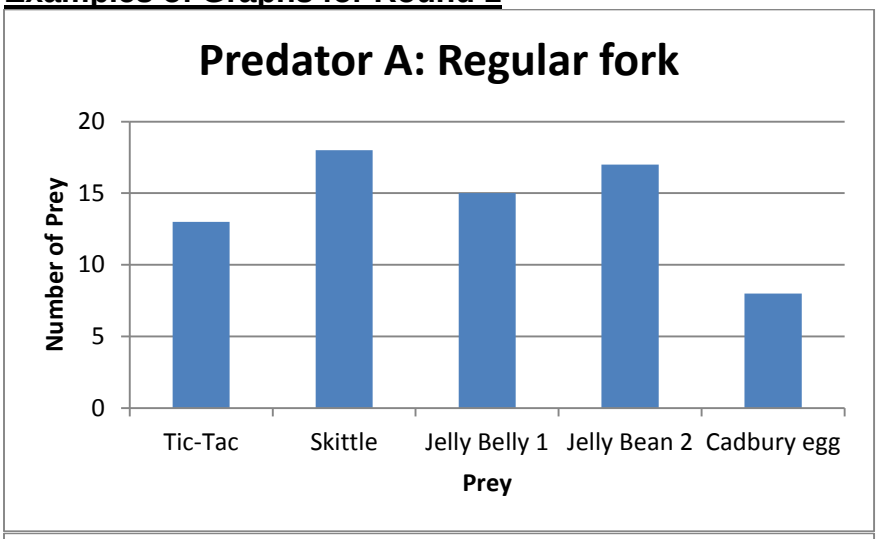
Niche- a position taken by an organism within its community. (May be occupied by different organisms in different localities) To two organisms in the same community can have the same niche

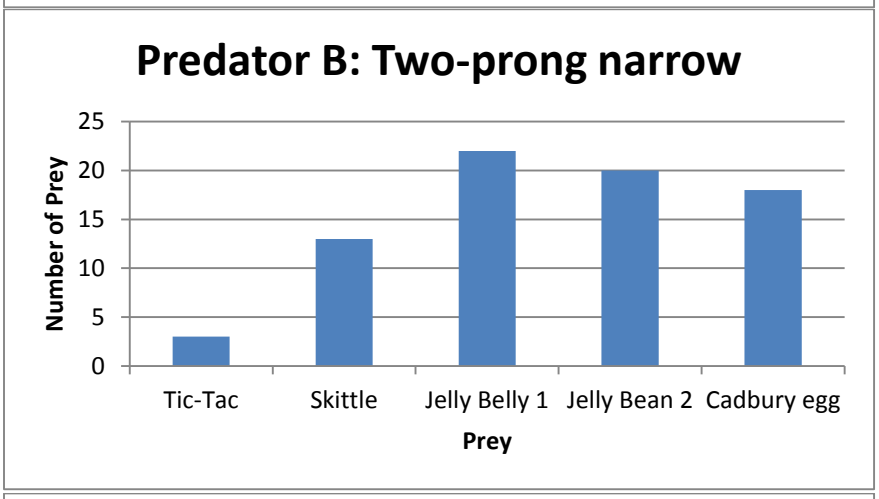
Example of Data Sheet

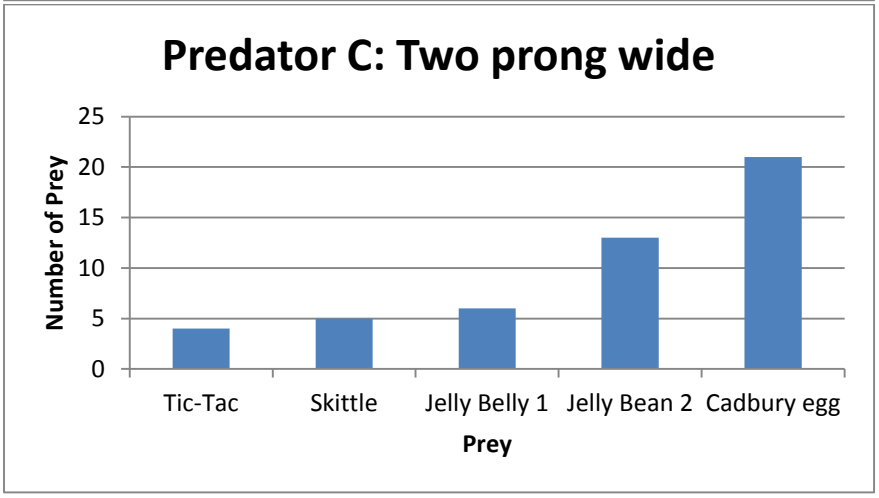
Predator:					
1.	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:
2.	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:
3.	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:
4.	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:

Sample Graphs:

Examples of Graphs for Round 1







Wild Card Scenarios:

Climate change: The Winters get colder and the largest prey are gone. Remove ALL of the largest prey from your trays.

1. Hypothesize how this will affect the predator community in the ecosystem.
2. Feed all three beaks for three minutes.
3. Do this twice, average the values.
4. Graph and explain your results

Invasive species: A new predator gets released into ecosystem. Add a new mouthpart to the community – now you will have four predators feeding together.

1. Hypothesize how this will affect the predator community in the ecosystem.
2. Feed all four beaks for three minutes.
3. Do this twice, average the values.
4. Graph and explain your results

Disease: CWD has been introduced to the island. This parasite affects the structure of the mouthparts of all of the predators in the ecosystem independently of their identity. Each bird must remove one tine from their forks/alter in some way

1. Hypothesize how this will affect the predator community in the ecosystem.
2. Feed all three beaks for three minutes.
3. Do this twice, average the values.
4. Graph and explain your results

Habitat destruction: A CRP/ shelter belt decline is introduced to the ecosystem. This reduced the number of acreage available for the predators. Now each predator must DOUBLE the distance they have to travel in order to feed. (Place stomach (cup) farther from ecosystem (plate)

5. Hypothesize how this will affect the predator community in the ecosystem.
6. Feed all three beaks for three minutes.
7. Do this twice, average the values.
8. Graph and explain your results

Introduction Handout

What does each organism below need to be able to survive?

What does each organism below interact with?

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Materials and Supplies:

Each group should gather:

Four sheets of Graph paper

Markers or colored pencils

A calculator

A plate

One cup for each group member

25 pieces each of 5 types of candy that vary in size such as:

- *Tic Tac* *Skittles/ M&M's* *Peanut M&M's*
- *Jelly Beans* *Hershey's kisses* *Gumballs*
- *Gummy Bears*

Each member should select one mouthpart from a set of various Mouthparts

- *Tweezers* *Eyedroppers* *Tongue depressors*
- *Plastic forks (3 ways: regular, 2 prong wide, 2 prong narrow)*
- *Plastic spoon* *Plastic Knives*

Activity One: ***Defining your niche***

1. Predict which prey item each predator will be MOST and LEAST efficient at eating. These will form the **hypotheses** that we will test today.

Mouth Part	Most efficient	Least efficient

Each mouthpart belongs to one animal that feeds by gathering one prey (candy) at a time and placing the prey in the stomach (cup). Dropped items DO NOT count toward the collection.

2. Collect all of the candy onto one plate. Each mouth part will **feed on this plate for three minutes**, by "eating" one prey at a time. Do not put multiple candies on the mouthpart at one time.

   Label the columns in the following table with the types of "prey" across the top, going from **smallest to largest**.

   Count **the number of each type of prey** (candy) eaten and record in the table below (make additional sheets as needed)

Predator:					
1.	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:
2.	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:

3.	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:
4.	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:

Repeat this process again with each mouthpart and **average** the number of each type of prey eaten during the two trials.

Using a sheet of graph paper, **make bar graph of number of each type of prey eaten for each mouth part**. The prey type should go on the horizontal (x) axis and average number of prey consumed on the vertical (y) axis.

3. Did your results support or refute your hypothesis from the first table? Why or why not?

Activity Two: ***Predicting species interactions***

- Same as above except competition is introduced.
- Hypothesis what the effect of competition will have on biodiversity and predator efficiency
- Students pick two mouthparts and two members of the group feed at one time.
- Perform replicates and average data
- Graph and analyze how the competition affected the biodiversity of the prey population and how the predator efficiency changed. (2 graphs: one for each of the two competing predators)

4. What effect will competition have on biodiversity and predator efficiency?

Predator:					
1.	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:
2.	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:

5. Did your results support or refute your hypothesis from question 4? Why or why not?

Activity Three: *Special Scenarios*

- Scenarios: See attached page
- The scenarios can be used as time allows. If ahead of schedule each group could simulate all scenarios. However, if time is lacking each group and choose or be assigned a smaller number of scenarios.
- Make new hypothesis on the outcome of biodiversity and predator efficiency based on scenario
- Students perform the same protocol for data collection with incorporating the instructions of the varying scenarios/stressors.
- Data collection, replicates, make graph(s), analyze data

6. What effect will the various scenarios have on biodiversity and predator efficiency?
   Climate Change:
   Invasive Species:
   Disease:
   Habitat Destruction:

Climate Change: Remove Largest Prey

Predator:				
1.	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:
2.	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:
3.	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:
4.	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:

Invasive Species: Add mouth part

Predator:					
1.	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:
2.	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:
3.	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:
4.	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:
5.	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:

Disease: Alter mouthparts

Altered Predator:					
1.	Trial 1	Trial 1	Trial 1	Trial 1	Trial 1

	Trial 2 Average:	Trial 2 Average:	Trial 2 Average:	Trial 2 Average:	Trial 2 Average:
2.	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:
3.	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:
4.	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:

Habitat Destruction: Stomach farther away

Predator:					
1.	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:
2.	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:

3.	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:
4.	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:	Trial 1 Trial 2 Average:

7. Did your results support or refute your hypothesis for each scenario from question 6? Why or why not?