Bay Area Scientists in Schools Presentation Plan

Lesson Name Natural Selection: Clipfish (adapted from UCMP's "Clipbirds" Activity)
Presenter(s) Integrative Biology graduate students
Grade Level 3rd/4th
Standards Connection(s):

3rd Grade Life Science:

3.3.a. Structures of living things help them grow, survive, and reproduce.
3.3.b. There are diverse life forms in different environments.
3.3.d. When environment changes, living things respond (may be able to survive and reproduce or may die or move to a new environment).
3.3.e. Living things can disappear from the Earth, some modern species resemble historic species.

4th Grade Life Science:

4.2.b. Students know producers and consumers (herbivores, carnivores, omnivores, and decomposers) are related in food chains and food webs and may compete with each other for resources in an ecosystem.

Next Generation Science Standards:

3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.
3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. Analyze and interpret data to make sense of phenomena using logical reasoning. (**3-LS4-1**) *Developing and Using Models* Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. Use a model to test interactions concerning the functioning of a natural system. (**4-LS1-2**) *Engaging in Argument from Evidence* Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). Construct an argument with evidence, data, and/or a model. (**4-LS1-1**)	*LS2.C: Ecosystem Dynamics, Functioning, and Resilience* When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die. (secondary to **3-LS4-4**) *LS4.C: Adaptation* For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all(**3-LS4-3**) *LS4.D: Biodiversity and Humans* Populations live in a variety of habitats, and change in those habitats affects the organisms living there. (**3-LS4-4**) *LS1.A: Structure and Function* Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (**4-LS1-1**)	*Cause and Effect* Cause and effect relationships are routinely identified and used to explain change. (**3-LS2-1**),(**3-LS4-3**) *Systems and System Models* A system can be described in terms of its components and their interactions. (**3-LS4-4**) --- *Connections to Nature of Science* Scientific Knowledge Assumes an Order and Consistency in Natural Systems Science assumes consistent patterns in natural systems. (**3-LS4-1**) --- *Systems and System Models* A system can be described in terms of its components and their interactions. (**4-LS1-1**),(**4-LS1-2**)

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Common Core Standards:

ELA/Literacy:

RI.3.3 Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect.

SL.3.4 Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace.

Mathematics:

MP.2 Reason abstractly and quantitatively.

MP.5 Use appropriate tools strategically.

3.NBT Number and Operations in Base Ten

3.MD.B.3 Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in scaled bar graphs.

FOSS Connections:

Grade 3 Module: *Structures of Life*

Investigation 3: *Meet the Crayfish*

Teaser:

To teach students about the study of community ecology, and how changes in one part of a community affects other parts of the community. The key concepts to understand are the use of species richness and species abundance as measures of biodiversity, and the difference between direct and indirect human impacts on ecosystems.

Lesson Description

1. Explain predator/prey relationships, and food chains
2. Define species richness and species abundance. Show the differences between these 2 concepts.
3. Ask the students to think about how the predator community changes when you decrease or increase prey species
4. Play the Clipfish game – simulate the reduction of certain prey species
5. Ask students to summarize what happened during the game. Were the changes in predator richness or abundance a direct, or indirect impact of overfishing?
6. Wrap-up: connect the game to real world examples of both direct and indirect human impacts of humans on predator/prey relationships and food chains. This can include pollution, climate change, overfishing, invasive species, etc.

Lesson Concepts:

- community ecology – (a simple definition) the study of interactions between coexisting species, and how these interactions determine the distribution and abundance of these species.
- species richness and species abundance
- direct and indirect impacts
- predator/prey relationships

- direct vs indirect human impacts through overfishing
- extinction

Vocabulary/Definitions:

- **Predator / Prey**
- **Species**
- **Competition**
- **Natural Selection**
- **Adaptation**
- **Advantage**
- **Reproduction**

Materials:

What will you bring with you?

- 2 Bags of "fish food": unpopped popcorn, lima beans, marbles
- 15 large bulldog binder clips No. 3—2 5/8 inches
- 10 medium-sized bulldog binder clips No. 2—2 1/4 inches
- 15 small-sized bulldog binder clips No. 1—1 1/4 inches
- 30 plastic cups (fish stomachs)
- Plastic sheets to cover the floor

What should students have ready?

- Pencils

Classroom Set-up:

- Students should be seated at their desks for the introduction.
- During the activity students will be broken into 2 groups and seated in 2 circles on the floor/carpeted area.
- A whiteboard or chalk board to graph results with colored markers would be greatly appreciated!

Classroom Visit

1. Personal Introduction: 3 Minutes

We are graduate students from UC Berkeley. We study how organisms interact…(Everyone introduces themselves and says a little bit about what they do.)

Topic Introduction: 10 Minutes

1. Explain predator/prey relationships, and food chains
2. Define species richness and species abundance. Show the differences between these 2 concepts.
3. Ask the students to think about how the predator community changes when you decrease or increase prey species

2. Learning Experience(s): 30 Minutes

Pregame: Brainstorming a predator/prey system

1. Start with a charismatic aquatic predator (Killer whales! Sharks! Seals! Pelicans?)
2. Ask the student to think about what this organism eats.
3. Brainstorm what other organisms eat those same prey.
4. Would certain types of predators prefer to eat types of certain prey? Why? (energy trade-off)

Hands-on activity: Clipfish game

In this game, students will simulate the predation of 3 types of predators on 3 types of prey in normal vs impacted habitats. At first, all habitats (2-3) start out normal, with large abundance of 3 types of prey. Then 1 or 2 of the habitats are impacted by overfishing, or pollution, and 1-2 prey species die out. The remaining habitat is unaffected. The simulation continues for 1-2 seasons, and then students calculate species richness and abundance between the starting and ending seasons for each habitat.

Students should be told not to scoop the food but to pick up food from above inside the clip.

Procedure

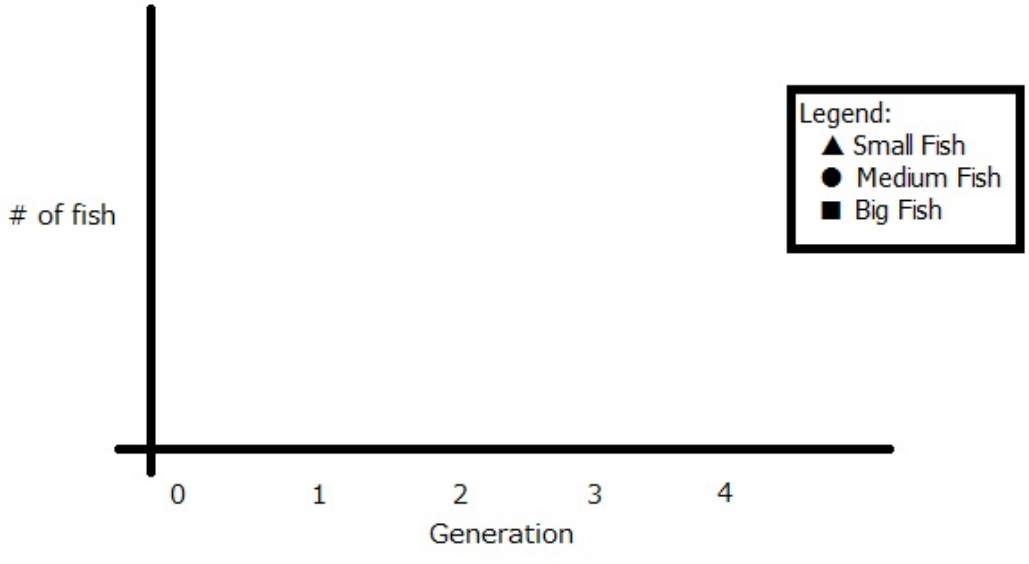
1. From the brainstorming, choose a set of 3 predators and 3 prey.
2. Show the students that each size of clip represents a different predator, and the 3 food items (popcorn, lima beans, marbles) represent the different prey.
3. Ask them to notice how the clips and the food items are different sized (small medium and large).
4. Explain that predators of various mouth sizes usually do just fine, but it takes more food energy to maintain the larger predator than the smaller predator.
5. Display the Food Values in Megacalories poster. Allow students time to apprehend that the various foods have different food values and that fish with different beaks sizes have different needs in order to survive and reproduce. Prompt them to think that different sized predators would want to eat certain types of prey to meet those needs. Pass out a food values worksheet.
6. Divide the class into 2 groups. Within each group, give two students large clips, two students medium clips and two students small clips. Each student/bird also gets a plastic cup to serve as its stomach.
7. Layout the 2 habitats – one to represent the normal environment, the other, the impacted environment. In each habitat, spread a plastic sheet on the ground, and empty a bag of popcorn, lima beans, and marbles on to the sheet.
8. Let the students practice eating. Tell them that in order to eat, they must use the clips in the correct clip mode (demonstrate), eat only 1 item at a time, and they must put all food that is successfully eaten into their stomachs.

9. Return all eaten food to the pile.
10. For the first season, give them 30 seconds to eat all they can. Make sure they do not scrape or shovel the food into their stomachs, as this will badly skew the results.
11. After the feeding frenzy, ask students to calculate the value of the food they ate on their worksheet. If a student doesn't eat enough to survive then he turns in his beak and sits down. If a student ate enough to survive then she continues as part of the population. Each student who ate enough to reproduce gets another bill the same size as her own and selects a student from the audience to be her offspring.
12. A teacher in each group will help calculate and record the number of predators that die, survive, and reproduce to the next season. Calculate species richness (1 = lowest, 3 = highest), and predator abundance (Abundance of predator A = # predator A/ total # predators).
13. Write this number on the Community Structure Poster (or on the board).
14. Now, in the impacted environment, remove both the marbles and popcorn, leaving only lima beans. If using 3 groups, remove only popcorn from one group, remove both marbles and popcorn from the second group, but leave all prey items the same in the third group.
15. Repeat directions 9-12 for one to two more seasons.
16. Have all the students turn in their clips and clean up the mess.
17. Put up the Community Structure Poster. Ask students to describe what happened to predator populations, and what they think caused the changes.

3. Wrap-up: Sharing Experiences

___10____ Minutes

We will help the students graph the results of the game on the board as such:



Ask students to summarize what happened during the game. Were the changes in predator richness or abundance a direct, or indirect impact of overfishing?

How does species richness and abundance compare between the normal and impacted environments? Did any species go extinct? Was this a direct or indirect impact of pollution or harvesting? Keep the discussion going so that students can assemble their thinking that changes in prey abundance can change species richness within a community.

4. Connections & Close: 5 Minutes

What else might kids relate this to from their real-life experience? How can they learn more? Thanks and good-bye! Clean-up.

Total 50 – 60 Minutes

Differentiated Instruction:

English Learners: Repeat directions, if necessary, and physically model how to play the Clipfish game. Write vocabulary words on the board and read words aloud. Vocabulary words can also be visually demonstrated using an illustration or action and redefined in very simplistic terms.

Advanced Learners: Have students calculate the average predator abundance.

Follow-up Possibilities

ELA Activity:
Suggest students write a letter explaining "How we learned about natural selection..."
Send to:
Community Resources for Science
1611 San Pablo Ave Suite 10 B
Berkeley, CA 94702

Reading Connections:
Where Else in the Wild? By David M. Schwartz and Yael Schy – This volume is ideal for introducing a unit on survival strategies or for extended discovery at a classroom station. The adaptations of both predators and prey are included, so the book can also be used for lessons in food webs, habitats, and life cycles. http://www.nsta.org/recommends/ViewProduct.aspx?ProductID=19794

Mathematics Activity:
Have students use the plot graph to form a bar or circle graph. Students calculate mean, median, and mode for values.

Other:
Five Fingers of Evolution (TED-Ed video by Paul Anderson and Alan Foreman)
http://ed.ted.com/lessons/five-fingers-of-evolution

Natural Selection – Peppered Moth Activity (pg. 5) from Bioscience for the Future
http://www.bbsrc.ac.uk/web/FILES/Resources/darwin-2009-activities.pdf#page=5

University of California Museum of Paleontology (UCMP) Clipbirds Activity
http://www.ucmp.berkeley.edu/education/lessons/clipbirds/

Food Values Worksheet

Season 1

Prey	# caught		Megacalories
Marble (Big)		x 10 =	
Lima Bean (Medium)		x 5 =	
Popcorn (Small)		x 2 =	
		Total =	

Survive? Yes/No
Reproduce? Yes/No

Season 2

Prey	# caught		Megacalories
Marble (Big)		x 10 =	
Lima Bean (Medium)		x 5 =	
Popcorn (Small)		x 2 =	
		Total =	

Survive? Yes/No
Reproduce? Yes/No

Season 3

Prey	# caught		Megacalories
Marble (Big)		x 10 =	
Lima Bean (Medium)		x 5 =	
Popcorn (Small)		x 2 =	
		Total =	

Survive? Yes/No
Reproduce? Yes/No

Table 1. Caloric Needs of Predators, in MegaCalories

Predator	MegaCal needed to survive	MegaCal needed to reproduce
Big	**80**	**160**
Medium	**50**	**100**
Small	**25**	**50**

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Community Structure over the Seasons

	Season 1		Season 2		Season 3	
	# individuals	Abundance	# individuals	Abundance	# individuals	Abundance
Big						
Medium						
Small						
	Richness =		Richness =		Richness =	

Richness = 1 species, 2 species, or 3 species
Abundance Big = # Big / Total # Predators

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