Name:_____Date:_____Class:_____

Student Worksheet
(with answers)

Can Small Pollutants (Silver Nanoparticles) Harm Aquatic Organisms

Safety
Wear gloves at all times to prevent contamination.

Introduction

Silver has antibacterial properties. Some people ingest colloidal silver as a health supplement. (Colloidal silver is silver nanoparticles suspended in purified water.) Silver nanoparticles are used in some antibacterial socks. If you wash these socks, some nanoparticles may wash down the drain and could end up in the ocean. Could that affect a marine ecosystem?

Materials
- gloves
- 6 glass specimen vials
- 6 ~1/2 inch round labels
- distilled water
- graduated cylinder
- pipette
- bottle of colloidal silver
- a Sharpie® marker
- California Blackworms
- popsicle stick
- round toothpick
- *Elodea* plant

Question:

How can silver nanoparticles affect marine organisms?

Make a Prediction

*Example: Silver will kill all marine organisms being tested within the first 48 hours of the experiment.*_____

_____

_____

Procedure

1. ***Group member 1:*** Use a graduated cylinder to measure 10 ml distilled water into each of the 2 vials. Label these vials "**C**" for **control.** Use the popsicle stick and toothpick to put 5 worms in one vial. Break off a piece of the aquatic plant and put it in the other vial. The plant should be completely submerged.
2. ***Group member 2:*** Use a graduated cylinder to measure 9.9 ml distilled water into each of the 2 vials. Add 1 drop (~.1ml) of colloidal silver to each vial. Label these vials "**low**" for

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low concentration. Use the craft stick and toothpick to put 5 worms in one vial. Break off a piece of plant and put it in the other vial. The plant should be completely submerged.

3. ***Group member 3:*** Use a graduated cylinder to measure 9.0 ml distilled water into each of the 2 vials. Add 10 drops (~1ml) of colloidal silver to each vial. Label these vials "**high**" for **high concentration.** Use the craft stick and toothpick to put 5 worms in one vial. Break off a piece of plant and put it in the other vial. The plant should be completely submerged.
4. Write your intial observations in the table below and on the next page.
5. Write your lab group's number on the label of each vial.

Record Observations:

	What do the leaves look like? Can you see through them? What color are they? Are they still attached to the stem? List the color of the water, if it's cloudy/clear, and any whether debris is present.		
Elodea **(the marine plant)**	**Day 1 (initial observation)**	**Day 2**	**Day 3**
Control Distilled Water	*Bright green color and clear water.*	*Bright green color and clear water.*	*Bright green color and clear water.*
Colloidal Silver Low Concentration 0.55 ppm	*Bright green color and clear water.*	*Some debris and brown coloring on tips.*	*Some debris and more brown coloring on tips. 2 leaves fell off.*
Colloidal Silver High Concentration 5.5 ppm	*Bright green color and clear water.*	*Some debris and brown coloring on tips.*	*1/2 the plant is brown with lots of debris. 3 leaves fell off.*

To check if the worms are alive, shake the vial lightly for 5–10 seconds, hold it up to the light, and look at it for at least 20 seconds. Please be careful not to drop the vials.

	List the number of worms alive/total number of worms used. What does the water look like? Describe the water's color, if it's cloudy/clear, and whether debris is present.		
California Blackworms	**Day 1 (initial observation)**	**Day 2**	**Day 3**
Control Distilled Water	*5/5 worms alive; clear water*	*5/5 worms alive; clear water*	*5/5 worms alive; clear water*
Colloidal Silver Low Concentration 0.55 ppm	*5/5 worms alive; clear water*	*2/5 worms alive; cloudy water*	*1/5 worms alive; cloudy water*
Colloidal Silver High Concentration 5.5 ppm	*5/5 worms alive; clear water*	*1/5 worms alive; cloudy water*	*0/5 worms alive; cloudy water*

Analyze the Results

1. Was the nano-silver toxic to the plant? Explain which concentration had the most impact.

   Silver seems to be somewhat toxic to Elodea, due to the amount of debris, browning, and leaves falling off. The higher concentration (1 ppm) of the colloidal silver is more toxic than the lower concentration (0.1 ppm).

2. Was the nano-silver toxic to worms? Explain which concentration had the most impact.

   Silver seems to be somewhat toxic to worms especially at the higher concentrations. The colloidal silver at the highest concentration (5.5 ppm) killed off all 5 worms within the first 48 hours of the experiment.

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Draw Conclusions

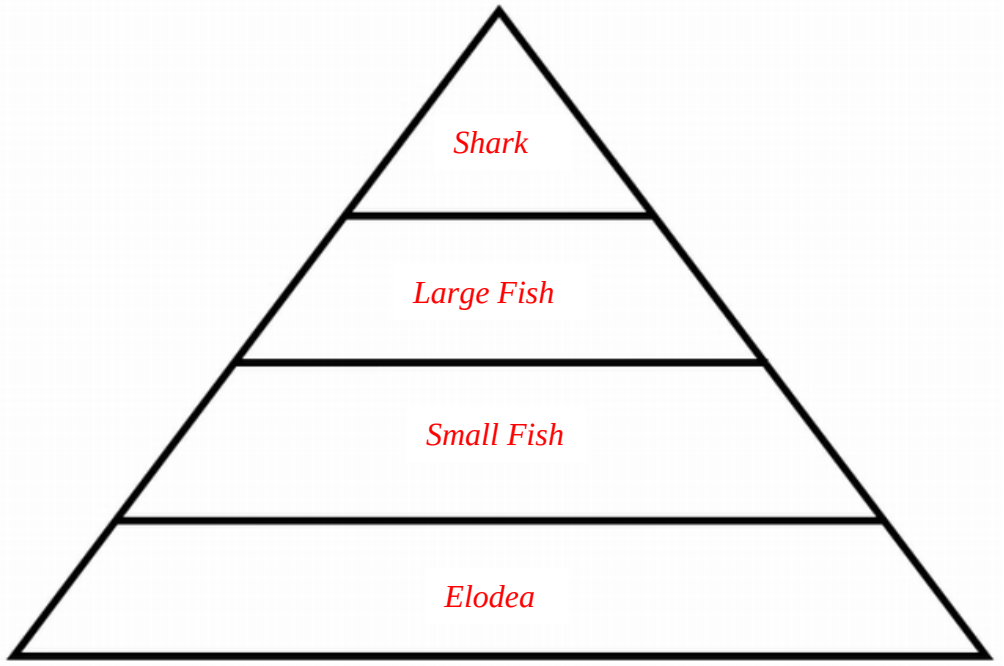
1. What organism is always at the base of a food chain or food pyramid?

   Autotrophs (plants) are always at the base of any food chain or pyramid.

2. Would *Elodea* be considered an autotroph or heterotroph? Explain your answer.

   Elodea would be considered an autotroph because it is a plant and it makes its own food through the process known as photosynthesis. Other fish or small marine organisms may use the Elodea as food.

3. Complete the energy pyramid below using marine organisms. Label each level and draw a small picture of the organism. Please use *Elodea* in your pyramid.



4. Based on your energy pyramid above, what would happen if the Elodea were wiped out by a high concentration of colloidal silver? How might that affect the rest of the trophic levels on the food pyramid?

   Elodea is the producer in the food pyramid and provides the initial source of energy to the small fish; if the Elodea were to be wiped out and the small fish had no other food source, all the other organisms in the energy pyramid would perish.

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5. Draw a food chain that includes the California Blackworms.

Phytoplankton => Blackworms => Small Fish => Large Fish

6. If you were to add Blackworms to your energy pyramid and then exposed those worms to silver, how might that affect the other organisms in the pyramid? Explain your answer.
Depending on the concentration used, if you exposed the Blackworms to the colloidal silver at a high enough concentration, it would wipe the Blackworms out. Additionally, if the fish are consuming the dead or living Blackworms, the silver could also be lethal to them as well. Since the Blackworms are prey organisms, if they are the small fish's only food resource, then it would have a dramatic impact on the ecosystem.

7. Do you think we should be monitoring silver nanoparticles in aquatic environments? Explain your answer. *Answers will vary*

8. Do you think the use of silver nanoparticles should be regulated? Why or why not? *Answers will vary*

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