ENCOUNTERS OF THE WORST KIND: WATER POLLUTANTS AND A LIVING ORGANISM

Name_____ Date_____

INTRODUCTION

The effects of water pollutants on different kinds of organisms are frequently shown on our televisions and in our printed media. However, it is rare that a student has the opportunity to directly view the effects of various water pollutants in the laboratory; this laboratory exercise allows the student to witness a living organism's response to six different water pollutants and then to compare its response to various combinations of these pollutants. Perhaps the student will find that a *relatively harmless* pollutant becomes *very toxic* when mixed with another pollutant? The phenomenon of *positive synergy* warns us that the effects of pollutants can *multiply*—not merely add together—when they are mixed. The second part of this exercise challenges the student to access whether positive synergy is occurring before his/her very eyes.

The living organism used in the exercise, *Turbatrix aceti*, is a rapid swimmer—until the effects of the pollutant(s) take over. Then its ability to maintain *directional motion* is lessened, its coordination begins to fail and it frequently make loops of its long, cylindrical body. When these events occur to the majority of the organisms, the lapsed time is noted and that portion of the exercise is concluded.

Materials: (per team of 2 students)

1 Depression slide
10 ml Distilled water
1 Sterile plastic pipette
1 Compound or dissecting microscope

Common Materials:

1 *Turbatrix aceti* culture		
1 Bottle (A), Silver Nitrate	$AgNO_3$	0.25 M
1 Bottle (B), Mercury (II) Nitrate	$Hg(NO_3)_2$	0.01 M
1 Bottle (C), Nickel Nitrate	$Ni(NO_3)_2$	1 M
1 Bottle (D), Lead Nitrate	$Pb(NO_3)_2$	1 M
1 Bottle (E), Aluminum Nitrate	$Al(NO_3)_3$	1 M
1 Bottle (F), Copper (II) Nitrate	$Cu(NO_3)_2$	1 M

Personal Protective Equipment:

Goggles
Protective gloves

PROCEDURE

I. Assessing the Effects of Six Different Water Pollutants

Safety Precautions: **Although the amount of chemicals used in this investigation is relatively small, be sure to wear protective gloves and goggles throughout the investigation to minimize the risk of any injury.**

Prepare a control by placing two drops of distilled water in a depression on the slides provided. Add one drop of the suspension of the living organism. Use the lowest available power of a compound microscope or use a dissecting microscope to observe the normal movement of this organism. Now place one drop of distilled water in each of the six depressions. To the first depression, add one drop from Bottle A and one drop of the suspension of the living organism. Note the time when this is completed. Use your microscope to observe again the swimming motion of the organism. Record how long it takes the majority of the organisms to lose their ability to swim in one direction and to begin to form coils instead. If this does not happen within five minutes, record a *negative result* for that pollutant. Repeat the above for the other five solutions and record your results in Table 1.

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STUDENT STUDY AND ANALYSIS SHEET

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DATA TABLE 1

Purpose of the Experiment	Drops of Distilled Water	Drops of Toxic Pollutants	Drops of Living Organisms	Time in Minutes Required for Loss of Directional Motion
1. Effect of Toxic Pollutant A	1 Drop	1 (Bottle A)	1 Drop	_____
2. Effect of Toxic Pollutant B	1 Drop	1 (Bottle B)	1 Drop	_____
3. Effect of Toxic Pollutant C	1 Drop	1 (Bottle C)	1 Drop	_____
4. Effect of Toxic Pollutant D	1 Drop	1 (Bottle D)	1 Drop	_____
5. Effect of Toxic Pollutant E	1 Drop	1 (Bottle E)	1 Drop	_____
6. Effect of Toxic Pollutant F	1 Drop	1 (Bottle F)	1 Drop	_____

II. Searching for Positive Synergy Between the Pollutants:

In one of the depressions place on drop of the solution in Bottle B and one drop of the solution in Bottle C. Add one drop of the suspension of living organisms and note the time when this is completed. Now use your microscope to observe how long it takes for the majority of the organisms to lose their ability to travel in one direction. Compare this to the time achieved in the first part of this exercise when only the solution in Bottle B was being used. Repeat using one drop of the solution in Bottle B with one drop of the solutions in each of the following bottles in turn: Bottle D, Bottle E, and Bottle F. Record your results in Table 2.

DATA TABLE 2

Toxic Pollutants Being Combined	Drops of Toxic Pollutant B	Drops of Other Toxic Pollutants	Drops of Living Organisms	Time in Minutes Required for Loss of Directional Motion
1. B & C	1 Drop	1 (Bottle C)	1 Drop	_____
2. B & D	1 Drop	1 (Bottle D)	1 Drop	_____
3. B & E	1 Drop	1 (Bottle E)	1 Drop	_____
4. B & F	1 Drop	1 (Bottle F)	1 Drop	_____

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ANALYSIS

Part I:

(1) Which of the six water pollutants tested was most toxic in regards to making the organism cease its directional motion?

(2) Which solutions showed no toxic effects within five minutes when used alone? _____

Part II.

(3) Which solution showed the phenomenon of positive synergy to the greatest degree when it was combined with the solution in Bottle B? _____

(4) Which other solutions also showed positive synergy to some degree with the solution in Bottle B? _____

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DISCUSSION

(1) Standards for various water pollutants are set to allow regulatory agencies, such as the E. P. A. or State Departments of Environmental Conservation, to issue permits to potential polluters in order to control the amounts of pollutants that can be released into a certain body of water. Ecologically, why is it more important to control such pollutants to prevent toxic effects on lower organisms, represented by the organism used in the exercise, instead of higher organisms such as birds or fish? _____

(2) How does the phenomenon of "biological magnification" complicate the setting of allowable levels of pollutants in an aquatic ecosystem? _____

(3) Why is it important to take the phenomenon of positive synergy into consideration when setting pollution standards for a specific body of water? _____

Suggested Additional Activities:

(1) Test these chemicals on other organisms such as *Daphnia* or a plankton sample obtained from an aquatic ecosystem.

(2) See if chemicals that show no effect in 5 minutes will show an effect at longer time periods. Do this for the chemicals singly and in combinations.

(3) (a) How dilute can the chemicals be and still get an *overnight* effect on different organisms?

(b) How do these concentrations compare to the concentrations that result when these toxic chemicals are released into a specific aquatic ecosystem? (Contact your local water quality regulatory agency for this information.)

(4) Find out from you local water quality regulatory agency the sources of these toxic chemicals in your area.

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5100 WEST HENRIETTA RD. • P.O. BOX 92912 • ROCHESTER, NY 14692-9012