Student name: _____ Date: _____

Toxicity of Copper Ions to Yeast

Think about it…

1. If you want to ban a chemical substance because it is harmful to life, you need evidence to support the claim that the substance is harmful. What type of evidence is best? Why?

   _____

2. Your answer to question 1 probably said something about showing that the substance causes harm, but you may feel that people and/or animals should not be harmed in scientific testing. You might have proposed doing tests on plants instead of animals. An even simpler type of organism to work with than plants is yeast, a type of fungus. Yeast is also inexpensive and easy to get at the grocery store. Even more important to environmental health scientists, yeast has some of the same genes that cause human diseases and these genes can be affected by toxicants.

   The organism most people call "yeast" is common bread yeast. What do you know about bread yeast? What does it need to live and grow? What does bread yeast produce when it grows?

   _____

3. While you could propose a variety of tests for studying a substance's toxicity to yeast, you may want to begin by comparing conditions where yeast grows without a toxicant and conditions where yeast growth may be less with exposure to a toxicant.

   Previous researchers suggest using sealed snack size zipper bags for the tests. They also found that ¼ teaspoon (1 gram) of dry yeast mixed into 20 mL of a sugar solution (25% syrup in water) plus 5 mL water will show evidence of growth in about 15 minutes when placed in a warm water bath. To conduct tests, you might replace some or all of the 5 mL of water with a toxicant solution. Note that for better comparison of reactions, the amount of liquid (syrup solution +water + toxicant) should add up to 25 mL in all tests.

   Dilute copper sulfate solution (0.4 M) makes sense as a test environmental toxicant for yeast because it is used to kill fungi in grapes and other fruit crops. An alternate "toxicant" is 8 grams of calcium chloride, (ice melter) dissolved in 10 mL water. What experiments will help you observe at what level the "toxicant" is harmful to yeast? Hint: you can vary the amounts of water and toxicant solution that you add to the 20 ml of syrup and water.

   _____

4. Outline the test procedure(s) which will allow you to test how a toxicant affects yeast.

5. Use the following pages to organize and summarize your science work.

Student name: _____ Date: _____

Science Research Summary

The investigating scientists are:

_____ _____

_____ _____

Our Question(s) — What we want to find out?

Our Test(s) — How we plan to find out?

We plan the following test:

Our Materials

Our Observations and Data (Results)

We plan to collect the following data:

We organize this data in the following data table to allow us to make a claim:

Student name: _____ Date: _____

Our Claim

From our test (experiment) and data (results) we claim:

Our Evidence

Our claim is supported by the following evidence:

Our Reasoning

Our claim and evidence are linked or supported by the following science reasoning:

Our Readings and Discussions — How do our results fit with what others know or have found out?

Our claim, evidence or reasoning fits because we heard:

Our claim, evidence or reasoning fits because we read:

Our Reflection

After working on this question or test we now know and wonder about:

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The Science Behind Your Investigation

For this investigation, copper sulfate and/or calcium chloride are substituted for more toxic chemical substances that would be less suitable for student investigations. Copper sulfate and calcium chloride are also water soluble, making them easy to add to a sugar-water solution containing yeast.

Copper is a useful metal: copper wires conduct electrical current, and copper surfaces store information in electronic devices. In our bodies and other biological systems copper ions are needed for signals between cells and energy transformations. Copper is an essential nutrient. That means that our bodies cannot make the small (microgram) amount of copper we need—it must come from the food we eat. Despite being an essential nutrient, higher concentrations of copper ions can be toxic. One of the earliest food safety laws was passed in England to outlaw the addition of copper to canned peas or other products to improve their green color.

Copper sulfate is the form of copper used in your investigation. Copper sulfate is the active ingredient in some products to control sewer line blockage, where the copper sulfate is toxic to plant roots that might grow into the small space between pipes. Copper sulfate is also known as an algaecide and fungicide and can be added to ponds to inhibit the growth of fungi and algae. Copper sulfate is also the active ingredient in Bordeaux spray used to control fungi in grapes and other fruit crops. While copper sulfate can be found for these plumbing and agricultural uses in some states, in other states it is outlawed, probably to prevent copper accumulations in natural waters.

Calcium chloride is a food additive is on the GRAS list. GRAS stands for "Generally Recognized As Safe" as a food additive. Small amounts of calcium chloride are added to canned and processed food to preserve the texture of the food—such as crisper pickles or firmer tomatoes. However, calcium chloride, like sodium chloride, can be toxic if the concentration is very high. These high concentrations of salts are toxic to cells by causing dehydration and cell shrinkage. The high concentration of salt causes water to move from inside the cell to outside the cell. Without enough water in the cell, normal cell processes do not occur, causing harm to the cell.