|  |  |  |
| --- | --- | --- |
|  | Activity 1 – A Global Warming Experiment |  |

**Teacher Instructions**

This activity is designed to allow students to make a model and conduct an experiment to help understand whether global warming would raise the sea level by melting ice.

**Objective**

After this activity, students should be able to:

* Model and describe the process of iceberg melt and sea level rise
* Form an hypothesis prior to conducting the experiment

**Materials**

Each group needs:

* A glass of water
* A paper towel
* Ice

**Student or Group Name:**  **Date:**

|  |  |  |
| --- | --- | --- |
|  | Activity 1A Global Warming Experiment  |  |

**Question:** Will melting of the polar ice sheets raise the level of sea water along beaches and coastal cities?

**Procedure:**

1. Fill a tall glass with ice.

2. Set the glass on a dry paper towel.

3. Fill the glass completely to the top without spilling any water and without letting any water overflow. The paper towel should be completely dry.

4. Make a hypothesis (prediction) on what will happen when the ice melts. Record that hypothesis. Will the glass overflow?

**Questions:**

1. Record your hypothesis (prediction) about whether the water would overflow the glass when the ice melted?

2. Did the water overflow? Why or why not?

3. On the basis of this experiment, what would you predict would happen to sea level if the polar ice sheets were to melt?

4. Would the impact on sea level be different if the ice in glaciers or icebergs melted? Why or why not?

|  |  |  |
| --- | --- | --- |
|  | Activity 2 – Recycle City Game |  |

**Teacher Instructions**

This activity can be found on: <https://www3.epa.gov/recyclecity/index.htm>

The Recycle City Challenge tests students’ knowledge of how everyday decisions can cut waste and energy use – at home, school, and throughout their community. Students answer questions in five Recycle City locations and earn tokens for the best responses. The game is available in English and Spanish. From this page, students can also access the Dumptown game, which is set in a polluted town that the students have to clean up. This game tracks costs and benefits of environmental protection. The EPA also has an activities page at: <https://www.epa.gov/students> that offers activities, lesson plans, other online games, and much more.

**Objective**

After this activity, students should be able to:

* Understand how their daily choices affect the environment

**Materials**

* Computer with internet access

|  |  |  |
| --- | --- | --- |
|  | Activity 3 – Local Environmental Health Hazards |  |

**Teacher Instructions**

This activity is designed to allow students to research and recognize environmental hazards in their own area. The website links are specific to Texas, but similar sites exist in all states.

**Objective**

The students will identify local environmental health hazards and brainstorm possible preventions/solutions for the problems.

**Materials**

* Writing paper
* Writing utensil
* Computer with internet access

**Student or Group Name :** **Date:**

|  |  |  |
| --- | --- | --- |
|  | **Activity #3****Local Environmental Health Hazards** |  |

**Procedure:**

Using the websites listed below, identify any environmental problems in your area. Do you have any ideas on what could be done to prevent or solve the problems? Record the problems and possible preventions/solutions below.

**Texas Environmental Concerns:**

Texas Parks and Wildlife: <https://tpwd.texas.gov/landwater/water/environconcerns/>

Texas Air Quality:<https://www.airnow.gov/index.cfm?action=airnow.local_state&stateid=45>, <https://www.tceq.texas.gov/airquality/monops/forecast_today.html>

Texas Commission on Environmental Quality Superfund Sites: <https://www.tceq.texas.gov/remediation/superfund/sites/county>

Cleanups in My Community Map (national map): <https://www.epa.gov/cleanups/cleanups-my-community>

1. Identify any environmental health hazards in your area.

2. What ideas do you have for preventing or solving the problems?

|  |  |  |
| --- | --- | --- |
|  | Activity 4 – A Case for Protecting the Environment |  |

**Teacher Instructions**

The student will write an essay explaining why people should protect the environment and suggests how they can do that while still supplying human needs for food, shelter, and jobs.

**Objective**

This activity is designed to allow students to make careful observations and analyze and integrate them into a coherent essay.

**Materials**

Writing paper, writing utensil

**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Activity 4 – A Case for Protecting the Environment**

**Writing Prompt:**

Dr. Jonas Salk, American physician and microbiologist said, “Eventually we'll realize that if we destroy the ecosystem, we destroy ourselves.”

Write an essay explaining why people should protect the environment and suggest how they can do that while still supplying human needs for food, shelter, and jobs.

Be sure to —

• clearly state your controlling idea

• organize and develop your explanation effectively

• choose your words carefully

• use correct spelling, capitalization, punctuation, grammar, and sentences

|  |  |  |
| --- | --- | --- |
|  | Activity 5 – Antibiotic Resistance |  |

**Teacher Instructions**

This activity is adapted from: <http://www.kbs.msu.edu/2017/01/antibiotic-resistance-lesson/>

This site has an extended lesson plan for more in-depth teaching of this topic.

This activity uses marshmallows and M&Ms to model antibiotic resistance.

**Objectives**

At the conclusion of the lesson, students will be able to:

* Generate a hypothesis and prediction for how antibiotic resistance will change bacterial survival and population dynamics
* Collect data from an experiment and put into a table
* Convert a data table into a figure and draw conclusions about the severity of antibiotic resistance

**Materials:**

* One large bag of small marshmallows
* One bag of M&Ms (need less than marshmallows)
* Toothpicks
* Student handout
* Stopwatch or phone timer

**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Date: \_\_\_\_\_\_\_\_\_\_**

**Modeling Antibiotic Resistance**

**Adapted from:** <http://www.kbs.msu.edu/2017/01/antibiotic-resistance-lesson/>

**Materials**

* Toothpicks
* Mini-marshmallows
* M&Ms
* Stop watch or phone
* Paper

**Procedure:**

Tuesday morning you wake up with a mild sore throat, but you figure it will probably be better in a few days. Unfortunately, you end up staying up really late the next few nights studying for a test and you wake up feeling very sick the morning of the test. You stay home for the day, but you agree to go to the doctor. The doctor prescribes an antibiotic for your sickness, noting that the sickness is due to a bacterial infection.

**1.** Can you ever think of a time when you had to take antibiotics? Does it make sense why your doctor prescribed you antibiotics? Describe that time here.

On the way home from the doctor you pick up your prescription from the pharmacy and immediately take the recommended dose. Now let’s think about what is happening in your body after taking the antibiotic.

The mini-marshmallows represent the bacteria that are causing you to feel sick. Start by putting 25 marshmallows on the paper.

**2.** The toothpick represents the antibiotic your doctor prescribed. Give your antibiotic a name:

***Dose 1***: You now have 5 seconds to pick up as many marshmallows as possible using the toothpick (i.e. kill as many bacteria as possible). One person will time the trial and one person will use the toothpick. Set the timer for 5 seconds and **GO!**

How many marshmallows were you able to grab in 5 seconds? \_\_\_\_\_\_\_

This is representative of how many harmful bacteria were killed by the antibiotic after the first dose.

How many marshmallows are left on the table? \_\_\_\_\_\_\_\_\_\_\_\_\_

This is representative of how many harmful bacteria were not killed by the antibiotic after the first dose.

Record this number in the table below.

Certain bacteria may not have been killed by the antibiotic because the dose was not strong enough, because the antibiotic did not reach them in the body, or because they are resistant to the antibiotic. Many bacteria are naturally resistant to antibiotics and others develop resistance through mutations. *To represent mutated bacteria, take one marshmallow away and replace it with an M&M*. Then to represent asexual reproduction by binary fission in bacteria (dividing in two) double the number of marshmallows and M&Ms!

***Dose 2***: Now it is time for the second dose of antibiotics. This time the antibiotic is stronger and you will have 10 seconds to pick up as many marshmallows and M&Ms as possible with the toothpick.

Switch off who was timing. Set the clock for 10 seconds. **GO!**

Record how many marshmallows and M&Ms are still in the population in the table below. If there are no M&Ms at the end of a dose, a new mutation will arise and you should add one M&M. **Now double the number of marshmallows and M&Ms.**

***Dose 3:*** Apply a third dose of antibiotics that is the strongest yet. This time you have 15 seconds to pick up marshmallows and M&Ms with the toothpick.

Record how many marshmallows and M&M’s are left in the population after the third dose of antibiotics. Repeat for three more trials, but do not extend the time limit any longer as you are already taking the strongest legal dose of antibiotics.

**Data Table**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Dose** | Marshmallows Start | Marshmallows Finish | M&M’s Start | M&Ms Finish |
| Dose 1 | 25 |  | 0 | 0 |
| Dose 2 |  |  | 2 |  |
| Dose 3 |  |  |  |  |
| Dose 4 |  |  |  |  |
| Dose 5 |  |  |  |  |
| Dose 6 |  |  |  |  |

Below, graph the number of marshmallows and M&Ms *at the end of each dose (before doubling)*. Before you begin determine what to plot on the X and Y axes.

X axis: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Y axis: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Label which line in your plot represents non-resistant bacteria and resistant bacteria. Use this information to answer the questions below. For the graph, focus only on how many bacteria are left at the finish of each round.



**7.** What can you conclude about the influence of the antibiotic on the population of bacteria?

**8.** How effective will this same antibiotic be when prescribed to this patient again?

**9.** What is one human practice that increases the prevalence of antibiotic resistance?

**10.** Name one medical treatment that will result in a lower human survival rate if antibiotics cannot kill harmful bacteria anymore?

**11.** What is one way we can work to prevent antibiotic resistance?

|  |  |  |
| --- | --- | --- |
|  | Activity 6 – Acid Rain and Radishes |  |

**Teacher Instructions**

This activity can be found on:

<https://teachers.net/lessons/posts/349.html>

Students conduct a simple experiment to observe the effects of acid rain. This experiment has an easy set up. It involves observing the plants over several weeks. This experiment could be done as a demonstration with only one set up. The experiment calls for the use of a plant mister, but does not give directions for use of mister. Two more plants could be used, one misted with plain water and one misted with acid water. This could show the effect of acid water on the surface of the leaves. These could be compared to the plants that are watered with the plain and acid water.

**Objective**

Students will be able to:

* Understand the effects of acid rain on plants
* Conduct a controlled experiment

**Materials**

* Two containers (with lids) for water
* One tablespoon vinegar
* Two plants
* Spray bottle or plant mister
* Pen or pencil
* Paper for labels

|  |  |  |
| --- | --- | --- |
|   | Activity 7 – Endangered Species Game |  |

**Teacher Instructions**

Overview of this activity can be found on: <https://www.amnh.org/explore/ology/biodiversity/endangered-species-game2>

Instructions for game can be found [here](https://www.amnh.org/explore/ology/biodiversity/endangered-species-game2).

**Objective**

Students will be able to:

* Understand how The Endangered Species Act protects animals and plants

**Materials**

* Game board[**PDF printout**](https://www.amnh.org/ology/features/stufftodo_bio/images/endangeredgame.pdf)
* Scissors
* Tape
* Pair of dice
* Place markers (You can use pieces of colored paper, small plastic animals, or place markers from other games. Each student needs a different marker.)

|  |  |  |
| --- | --- | --- |
|   | Activity 8 – Ecosystem Enigmas |  |

**Teacher Instructions**

This activity is from:<https://cpaws-southernalberta.org/>

In this activity, students learn about the enigmas that occur when we try to manage something as complex as an ecosystem. In small groups, students learn about ecosystem enigmas that arise from human interventions. Students subsequently design an experiment that they would do if they were biologists seeking to disprove or confirm their results. This activity describes the relationships between predator and prey species and their influence on population changes. It concludes with a real-life enigma. There is a detailed teacher instruction sheet provided.

This activity is an older activity and uses “overheads” that can be projected in the classroom.

**Objective**

Students will be able to:

* Understand the complex interactions in ecosystems and how those make it difficult for humans to manage ecosystems

**Materials**

* Images for projection and student discussion
* Student copies of “Why Trees Need Salmon and Bears”

|  |  |  |
| --- | --- | --- |
|   | Activity 9 – Freddie the Fish |  |

**Teacher Instructions**

This activity can be found at:<http://www.texasthestateofwater.org/screening/pdf_docs/FreddieTheFish.pdf>

The teacher will demonstrate the effects of pollution on fish by reading the story of Freddie the Fish as he travels downstream. To make it interactive, use student volunteers to play the part of Freddie and to pour “pollution” into the water.

**Objective**

Students will be able to:

* Understand the various factors that can cause water pollution and observe how pollution affects water quality and aquatic life

**Materials**

* Fish bowl or small aquarium
* A few rocks and a small twig for the fish bowl
* Water
* Stick or rod that reaches across the top of the fish bowl
* A fishing lure that looks like a small fish or small plastic fish
* String
* Small cups to hold:
	+ Dirt
	+ Raisins
	+ Green liquid – use green food coloring, lime powdered drink mix or powder gelatin mixed in water
	+ Pancake Syrup or Soy Sauce
	+ Sand or bits of limestone
	+ Parts of a Styrofoam cup, paper, a broken plastic spoon
* Script for “Freddie Says” cut apart