

Nature vs. Sunscreen: Impact of Sunscreens and Tourism on Marine Systems



<https://weather.com/travel/news/crowded-beaches-world>

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Background

Active ingredients in sunscreens are UV filters, and recent studies have shown that the active ingredients can block UV light on photosynthesizing marine organisms. For example, recent studies found that when sunscreen runs off skin as beachgoers jump in the water, it can settle on top of corals, blocking the UV light. Sunscreens block UV light with chemical UV filters, like oxybenzone, octisalate or octinoxate, and are the most harmful. Mineral UV filters, like titanium dioxide or zinc oxide, are believed to be safer. While both UV filters block sun, scientists believe the concentrated use of chemical-based sunscreen around coral reefs in tourist spots can contribute to coral die-off. These findings have led to Hawaii and Palau to permanently ban the sale and use of sunscreens containing the most harmful chemical UV filters in recent years.

This lesson plan will introduce high school AP Environmental Science students to the concepts of sunscreen runoff and implications it can have to nature. Students will apply sunscreen water to classroom plants, and then explore and draw conclusions on the different ways UV filters can affect plants and corals that are reliant on photosynthesis. This experiential-based learning activity will allow students to consider the ways their daily activities can affect downstream marine life. It should also be noted that this lesson plan is not designed to turn students away from sunscreen use, but rather be mindful of their sunscreen product choice.

This lesson plan is part of the Community Science Initiative at the Duke University Marine Lab, which brings together community science with environmental literacy activities. This program is meant to allow students to explore and discover the impacts marine debris and water quality issues can impact themselves as well as their community.

Finally, this lesson plan is designed to fulfill North Carolina's Earth/Environmental Science Essential Standard, E.En 2.7.3: Explain how human activities impact the biosphere, while also providing for scientific method and hypothesis testing experience.

Introduction Engagement: What Is Sunscreen Runoff?

This introduction activity is designed to introduce the concept of sunscreen runoff and begin discussions over how sunscreen runoff occurs and what it affects in the environment. Students will reflect on their observations from this activity at the end of this lesson plan unit.

Objectives

This activity will allow students to:

- Describe sunscreen runoff
- Hypothesize how sunscreen runoff affects nature

Activity Plan (~20 minutes)

ENGAGE: Demonstration

1. Demonstrate to the class with two filled containers of water.
2. Apply sunscreen lotion from wrist to elbow on both arms until rubbed in. Ask the class how many of them actually wait the suggested time for sunscreen to soak in before entering the water?
3. As sunscreen soaks in for ~5-10 minutes, discuss with the class its purpose:
 - a. Why do we wear sunscreen?
 - b. What does sunscreen contain that prevents sunburn? (*see Appendix for list*)
4. Define new words:
 - a. *UV Filters*: In sunscreens, UV filters are ingredients that absorb or reflect the UV rays that penetrate the skin.
 - b. *Active Ingredients*: Ingredients in sunscreens that are biologically active, producing a biological or chemical effect.
5. Sunscreen Runoff Demonstration:
 - a. Ask class to predict what would happen when you rub sunscreen coated arms and hands under water.
 - b. Rub arms and hands under the water of one of the containers of water.
 - c. Ask class to make observations. For instance:
 - i. Hands and arms turn white, as sunscreen not fully soaked in is exposed to water.
 - ii. Water in the container begins to look cloudy.
 - d. When the container is noticeably cloudy, dry off hands and arms, and begin discussion.

EXPLAIN: Discussion

6. In small groups, discuss:
 - a. What just happened? Why did the water get cloudy?
 - b. Where do you think this type of sunscreen runoff occurs?
 - i. *Show pictures of a crowded beach or pool to help exemplify this.*

Materials

- 2 large clear containers
- Tap water
- Towels
- Sunscreen lotion

Classroom Exploration, Elaboration & Evaluation: UV Filters vs Plants

This activity is designed to reinforce the function of UV filters that are found in sunscreens and introduce the implications it has on life reliant on photosynthesis.

Objectives

This activity will allow students to explore how sunscreen can affect plants. Specifically, they will:

- Recall the purpose of UV filters and active ingredients
- Create and test their predictions on how sunscreen can affect photosynthesis
- Illustrate changes after the experiment
- Quantify the effect of UV filters on plant life

Activity Plan

Day 1 (~30 minutes)

1. Remind students the function of UV filters
2. Ask students to hypothesize how UV filters in sunscreen would impact plant life. Instruct students to write their hypotheses on worksheet.

Set Up

3. Label 1 spray bottle “Treatment”, and the other “Control”.
4. Label 1 plant pot “Treatment”, and the other “Control”.
5. Measure approximately 20 mL, and place into “Treatment” spray bottle.
6. Fill both bottles with tap water to 16 oz.
7. Shake or stir “Treatment” spray bottle to allow the sunscreen to mix in.
8. Spray equal amounts of water onto corresponding plant leaves and base, enough to saturate them.

Day 2-14 (~5 minutes per day)

9. Repeat Step 7-8 every day for 2 weeks, ensuring “Treatment” spray bottle is shaken before spraying. Replenish bottles using previous steps as necessary.
10. Measure plant height and leaf quantity every day. Record in worksheet.
11. Take 1 photo of each plant per day.

Day 15 (~20 minutes)

Analysis

12. Graph change in height and leaf quantity over 2-week period.
13. Compare plants current state to their photos over the course of the experiment. Observe differences in the physical appearance of the Treatment vs. Control plants. Make note in worksheet.
 - a. Any differences in color?
 - b. Have the plants grown?
14. Draw 1 leaf from each plant using colored pencils to demonstrate differences in observations in worksheet.

Discussion

15. Discuss as a group what you think happened. Explain your reasoning on the worksheet.
16. Address questions listed in the worksheet.

- a. What do you think caused the changes you witnessed?
 - i. *Answer: UV filters in the sunscreen blocked UV light from penetrating the leaves, which would allow photosynthesis to occur.*
- b. What other forms of plant or animal life do you think sunscreen runoff can affect?
 - i. *Answer: Plants and corals, which rely on photosynthesis.*
- c. What alternatives are there to reducing use of these types of sunscreens?
 - i. *Answer: Cover up with clothing (i.e. rash guard, UV shirts, etc.) or wear mineral-based sunscreen.*

Materials (per classroom/group/pair depending on break-up)

- Worksheet (Appendix)
- 2 16-oz spray bottles
- 2 potted plants with seedlings (note: ideal classroom plants are Fiddle Leaf Fig or Friendship Plant)
- 1 small bottle of sunscreen lotion
- Water
- Colored pencils

Sunburn-Preventing Ingredients

Chemical UV Filters:

- Oxybenzone*
- Octinoxate*
- Homosalate
- Octisalate
- Octocrylene
- Avobenzone

Mineral UV Filters:

- Titanium Dioxide
- Zinc Oxide

* = Of most concern for toxicity to corals

Sunscreens vs Plants

Definitions:

UV Filters:

Active Ingredients:

Experiment Hypothesis:

If....

Then....

Observations:

Treatment Plant	Control Plant
Physical Appearance Notes	Physical Appearance Notes
Leaf Drawing:	Leaf Drawing:

Analysis:

- What do you think caused the changes you witnessed?
- What other forms of plant or animal life do you think sunscreen runoff can affect?
- What alternatives are there to reducing use of these types of sunscreens?

Quantify:

Data Sheet

Day (MM/DD)	Treatment Plant		Control Plant	
	Plant Height (cm)	Number of Leaves	Plant Height (cm)	Number of Leaves

Graph

Plant Height vs. Time



Leaf Quantity vs. Time

