

SI Environmental Science - Full Discipline Demo

Ultraviolet Radiation and Sunscreen

Final Report - Answer Guide

Institution	Science Interactive University
Session	SI Environmental Science - Full Discipline Demo
Course	SI Environmental Science - Full Discipline Demo
Instructor	Sales SI Demo

Test Your Knowledge

Match each term with the best description.

☛ UV-A	High energy, short wavelength radiation used to sterilize medical equipment and purify water	1
☛ UV-B	Low energy, long wavelength radiation that penetrates deeply into exposed skin	2
☛ UV-C	Measure of how much solar radiation exposure is required to produce sunburn on protected skin compared to unprotected skin	3
☛ SPF	Product applied to the skin to provide protection from ultraviolet radiation	4
☛ Sunscreen	Intermediate energy and wavelength radiation responsible for sunburn and DNA alteration	5

Correct answers:

1 UV-C 2 UV-A 3 SPF 4 Sunscreen 5 UV-B

Categorize each phrase as related to chemical or physical sunscreen agents.

⚡ Avobenzone	⚡ Formulated from organic compounds
⚡ Formulated from inorganic compounds	⚡ Absorbs UV radiation
⚡ Reflects, scatters, or blocks UV rays	⚡ Zinc oxide
Chemical Agent	Physical Agent
1	2

Correct answers:

1 Avobenzone Formulated from organic compounds

Absorbs UV radiation

2 Reflects, scatters, or blocks UV rays Zinc oxide

Formulated from inorganic compounds

Exploration

Prolonged ultraviolet radiation exposure can cause ____.

- ☐ skin burns
- ☐ premature skin aging
- ☐ skin cancer
- ☒ All of the above



____ radiation levels vary based on location and time of year.

- ☐ UV-A
- ☒ UV-B ✓
- ☐ UV-C
- ☐ UV-D

UV-A, UV-B, and UV-C radiation are all included in the determination of SPF.

- ☐ True
- ☒ False ✓

____ is a physical agent in sunscreen that protects against both UV-A and UV-B radiation.

- ☐ Homosalate
- ☐ Octocrylene
- ☒ Titanium dioxide ✓
- ☐ Ecamsule

Exercise 1

Are the active ingredients in the sunscreens you synthesized and the commercial sunscreen you used physical or chemical agents? Do the active ingredients protect against UV-A, UV-B, or both? Reference Data Table 1 and Table 1 in your explanation.

Zinc oxide is the only active ingredient in the synthesized sunscreen as recorded in Data Table 1. Zinc oxide is a physical agent that protects against both UV-A and UV-B as listed in Table 1.

Note to instructors: Commercial sunscreen active ingredients will vary based on the brand selected by students, but answers should be consistent with Data Table 1 and Table 1. The internally tested commercial product contained three active ingredients: Avobenzone, a chemical agent that protects against UV-A; Homosalate, a chemical agent that protects against UV-B; and Octocrylene, a chemical agent that protects against UV-A and UV-B.

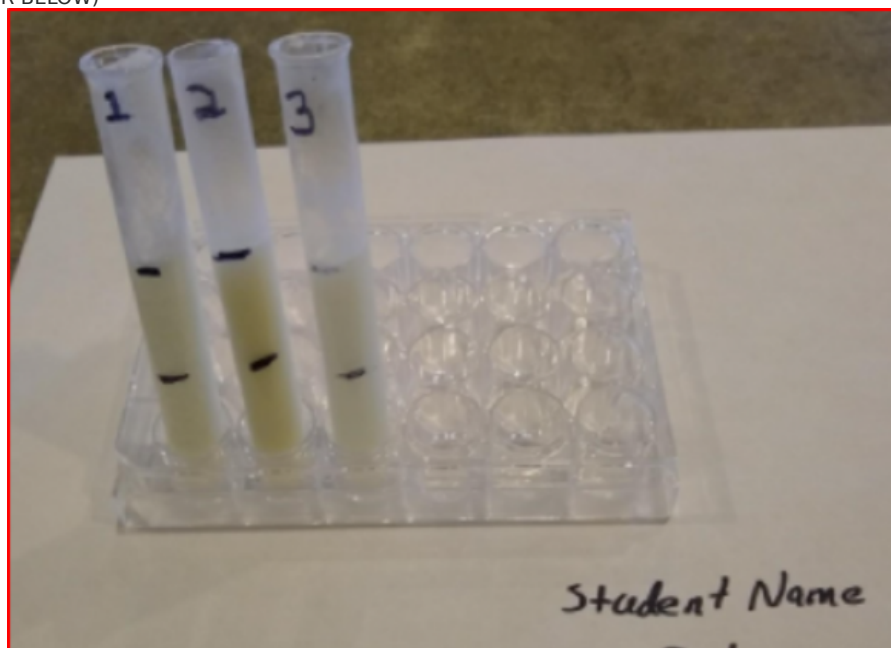
Did the amount of zinc oxide in your synthesized sunscreens determine how well the sunscreens protected against UV radiation? Reference Data Table 1 in your explanation.

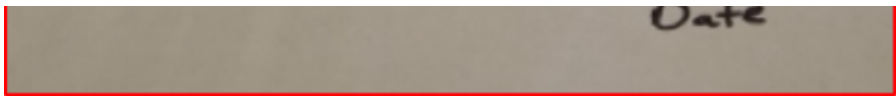
Yes, the synthesized sunscreen containing 0.40 g of zinc oxide provided longer protection from UV radiation than the sunscreen containing 0.20 g by increasing the time required for the beads to turn bright colors as recorded in Data Table 1.

How did the three sunscreens and two controls rank for effectiveness of blocking and/or absorbing UV radiation? Compared to the SPF rating of the commercial sunscreen, would you consider each of the synthesized sunscreens to have higher or lower SPF ratings? Reference your results in Data Table 1 in your explanation.

The controls and sunscreens from least effective to most effective at blocking and/or absorbing UV radiation as reported in Data Table 1: No sunscreen, oil and wax only, sunscreen 1, sunscreen 2, and commercial sunscreen. The SPF ratings for each of the synthesized sunscreens would be considered to be lower than the SPF rating of 50 for the commercial sunscreen since neither blocked UV rays in the test for as long as the commercial sunscreen as recorded in Data Table 1.

Photo 1: Synthesized Sunscreens
(SAMPLE ANSWER BELOW)





Panel 1: Commercial Sunscreen Brand and SPF
(SAMPLE ANSWER BELOW)

Student responses should indicate the brand and SPF of their selected commercial sunscreen. Target Up and Up sport sunscreen lotion SPF 50 was used for internal testing.

DataTable 1: Sunscreen Effectiveness
(SAMPLE ANSWER BELOW)

Test Tube #	Test Substance	Active Ingredients (g or %)	Color Intensity Time 0	Color Intensity Time 5	Color Intensity Time 10	Color Intensity Time 15	Color Intensity Time 20
1S	Synthesized Sunscreen 1	Zinc oxide 0.20 g	Opaque white	Pale pastels	Bright colors	Bright colors	Bright colors
2S	Synthesized Sunscreen 2	Zinc oxide 0.40 g	Opaque white	Pale pastels	Pale pastels	Bright colors	Bright colors
3	Control (oil and wax)		Pale pastel	Bright colors	Bright colors	Bright colors	Bright colors
NS	No substance		Bright colors	Bright colors	Bright colors	Bright colors	Bright colors
4C	Commercial Sunscreen	Avobenzone 3.0%, Homosalate 10.0%,	Opaque white	Pale pastels	Pale pastels	Pale pastels	Bright colors

Competency Review

UV radiation is emitted from ____.

- ☐ the sun
- ☐ tanning beds
- ☐ mercury vapor lighting
- ☒ All of the above

✓

Prolonged exposure to UV-A radiation is associated with ____.

- ☐ sunburn
- ☐ vitamin D synthesis
- ☐ water purification
- ☒ melanoma

✓

A SPF value is the number of minutes an individual can spend in direct sunlight without getting a sunburn when wearing a sunscreen.

- ☐ True
- ☒ False

✓

Chemical agents provide protection by ____ UV radiation.

- ☒ absorbing
- ☐ reflecting
- ☐ scattering
- ☐ blocking

✓

Chemical sunscreen agents include ____.

- ☐ titanium dioxide
- ☐ zinc oxide
- ☒ avobenzone
- ☐ All of the above

✓

Plant oils and wax should be heated prior to adding zinc oxide when synthesizing sunscreen.

- ☒ True
- ☐ False

✓

UV beads placed in a clean test tube without a sunscreen coating immediately turn ____ when exposed to direct sunlight.

- ☐ white
- ☐ black
- ☐ pastel colors
- ☒ bright colors

✓

A synthesized sunscreen with 0.40 g ZnO is more effective than one with 0.20 g ZnO.

- ☒ True
- ☐ False

✓

Extension Questions

Sunglass manufacturers often advertise their products as offering complete UV protection. Apply your knowledge of UV radiation and UV sensitive beads to describe how you would evaluate the complete UV protection claim of a pair of sunglasses. (SAMPLE ANSWER BELOW)

The UV beads would be placed in a container that would only allow sunlight to enter through an opening smaller than the size of a sunglass lens. The sunglass lens would then be positioned over the container opening so that all light entering the container must pass through the lens. The assembly would then be placed in direct sunlight for a predetermined amount of time. The beads

would be observed at intervals for color changes. If the beads remained opaque white throughout the monitoring period, it could be concluded that they provided complete protection.