Lesson 1:
Introduction to Sun Protection

Student Materials

Contents

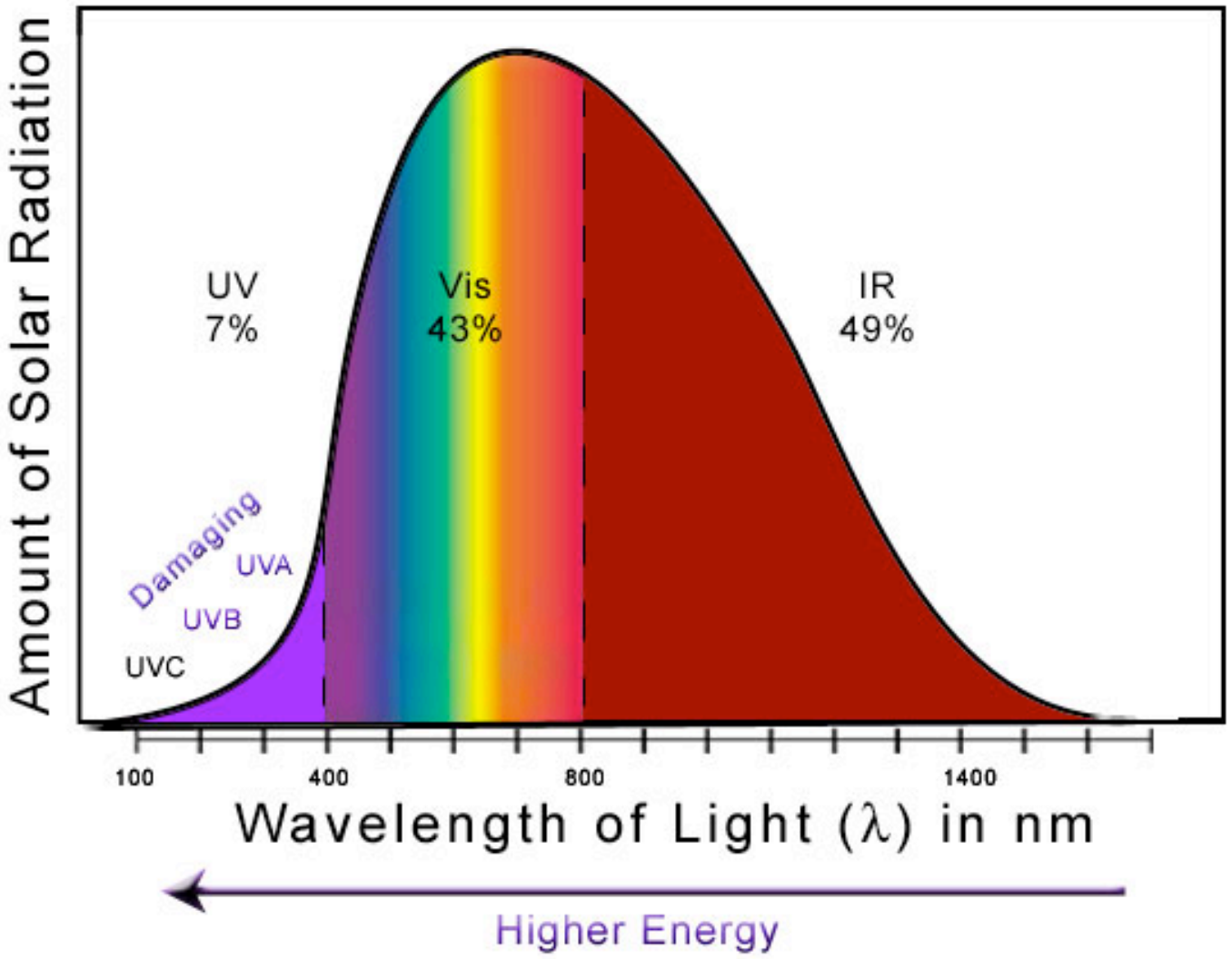
- Summary of Radiation Emitted by the Sun: Student Handout
- Clear Sunscreen Initial Ideas: Student Worksheet
- Ultra-Violet (UV) Protection Lab Activity: Student Instructions & Worksheet

Summary of Radiation Emitted by the Sun: Student Handout

Chart of Different Kinds of Solar Radiation

Radiation Type	Characteristic Wavelength (λ)	Energy per Photon	% of Total Radiation Emitted by Sun	Effects on Human Skin	Visible to Human Eye?
UVC	~200-290 nm (Short-wave UV)	High Energy	~0% (<1% of all UV)	DNA Damage	No
UVB	~290-320 nm (Mid-range UV)	Medium Energy	~.35% (5% of all UV)	Sunburn DNA Damage Skin Cancer	No
UVA	~320-400 nm (Long-wave UV)	Low Energy	~6.5% (95 % of all UV)	Tanning Skin Aging DNA Damage Skin Cancer	No
Visible	~400-800 nm	Lower Energy	~43 %	None Currently Known	Yes
IR	~800-120,000 nm	Lowest Energy	~49%	Heat Sensation (high λ IR)	No

Graph of Radiation Emitted by the Sun by Wavelength



Name_____ Date_____ Period _____

Clear Sunscreen Initial Ideas: Student Worksheet

Write down your initial ideas about each question below and then evaluate how confident you feel that each idea is true. At the end of the unit, we'll revisit this sheet and you'll get a chance to see if and how your ideas have changed.

1. What are the most important factors to consider in choosing a sunscreen?	**How sure are you that this is true?** Not So Sure	Kind-of Sure	Very Sure	**End of Unit Evaluation**
2. How do you know if a sunscreen has "nano" ingredients?	**How sure are you that this is true?** Not So Sure	Kind-of Sure	Very Sure	**End of Unit Evaluation**
3. How do "nano" sunscreen ingredients differ from most other ingredients currently used in sunscreens?	**How sure are you that this is true?** Not So Sure	Kind-of Sure	Very Sure	**End of Unit Evaluation**

Name_____ **Date**_____ **Period** _____

Ultra-Violet (UV) Protection Lab Activity: Student Instructions & Worksheet

Introduction

It is important to protect our skin from damaging UV radiation, but how do we know how well we are protecting ourselves? Is wearing a light shirt at the beach as effective as wearing sunscreen? Is it better protection? Do thicker, whiter sunscreens protect us better than transparent sprays? Can we tell how well something will block UV by looking at its appearance?

Research Question

In this lab you will be investigating the following research question:

- Does the appearance of a substance (its opacity) relate to its ability to block UV light?

Opacity

The *opacity* of a substance is one way to describe its appearance. Opacity is the opposite of how transparent or "see-through" something is; for a completely opaque substance you can not see through it at all. Opacity is a separate property than the color of a substance – for example you can have something that is yellow and transparent like apple juice or something that is yellow and opaque like cake frosting.

Hypothesis

Do you think that UV blocking ability relates to a substance's opacity? Would you expect transparent or opaque substances to be better UV blockers? If you are right, what implications does this have for how you will protect yourself the next time you go to the beach? Write down your best guesses to answer these questions and explain why you think what you think.

Materials

- Assorted white substances varying in opacity (for example: different sunblocks, sunscreens, sungels, glass pieces, white tee-shirts of varying thickness, white tissue paper, white paper of varying thickness, laundry detergent, white paint, white face makeup)
- Eight paper cups
- One micro spoon
- Sunscreen Smear Sheet
- Black construction paper (for judging opacity of white substances)
- UV light source
- UV sensitive bead testers
- UV bead color guide
- Cotton swabs (for apply sunscreen to the Sunscreen Smear Sheet)
- Alcohol wipes (for cleaning sunscreen off the Sunscreen Smear Sheet)

Procedure

Part I: Choose Your Samples

Goal: Choose a group of substances from the ones provided by your teacher that you think will best help you determine if opacity is related to UV blocking.

❒ Obtain eight small paper cups. Obtain a small sample of each of the substances you have chosen. Label each cup with the name of the substance.

Tip: Try to choose substances that vary in their opacity and that you would expect to vary in their blocking ability.

Part II: Judge the Opacity

Goal: To make observations about the appearance (opacity) of the substances you chose, using your eyes as the instruments.

❒ Obtain a Sunscreen Smear Sheet. Place it on top of a black sheet of paper.

❒ Label one square with the name of each substance you are going to test.

❒ Use the micro spoon to measure out the first substance (make sure to use an equal amount of all the other substances).

❒ Then use the cotton swab to smear the substance onto the Sunscreen Smear Sheet, evenly covering a whole square with a thin layer. (For solid substances, just place them on top of the sheet).

❒ How well can you see through the substance to the black sheet of paper?

❒ Use the Opacity Guide on the next page to rank each sample on a 1 to 5 scale.
Use 5 to represent no opacity (you cannot see the substance at all).
Use 1 to represent complete opacity (you can't see any black through the sample).

- ❒ Record your observations into the Data Chart in this packet.
- ❒ Repeat for each of your substances.

Opacity Guide

Part III: Test the UV Blocking

Goal: Use UV-sensitive beads to determine how effective your chosen substances are in blocking UV-light.

- ❒ Obtain 3 UV bead testers:
  - Bead Tester "C1" for Control 1. This bead will always be kept out of the UV light and will show you the lightest color that the bead can be. Keep this in the envelope until you need it.
  - Bead Tester "C2" for Control 2. This bead will always be exposed to the UV light and should always change color to let you know that the UV light is reaching the bead. This bead will show you the darkest color that the bead can reach.
  - Bead Tester "E" for Experimental. Keep this in its envelope so that it is not exposed to any UV light while you are not using it.

Checking Bead Tester C1 and C2

- ❒ Use UV bead color guide to record the initial bead color number (2-10) of C1 on your data chart.
- ❒ Expose C2 to the UV light for 30 sec. and quickly compare it to the UV bead color guide. Record the bead color number (2-10) on your data chart.

Using Bead Tester E with Your Substances

- ❒ To test the UV blocking of a substance, hold Bead Tester E under the square for that substance on the Sunscreen Smear Sheet. (For solid substances, just hold Bead Tester E directly behind them).
- ❒ Expose Bead Tester E (covered by the substance) and Bead Tester C2 (uncovered) to your UV lamp (or direct sunlight) for 30 secs.
- ❒ Take both Bead Testers out of the light, uncover Bead Tester E, and observe any changes to the color of the beads using the UV bead color guide. Record the bead color number (2-10) for both E and C2 on your data chart.
- ❒ Repeat for each of your substances.

Data Chart

Initial C1 Bead Color Number_____ **Initial C2 Bead Color Number_____**

Substance Name (Include SPF if applicable)	Appearance (Describe)	Opacity (1 to 5 rating)	Color of UV bead "E" (2 to 10 rating)	Color of UV bead "C2" (2 to 10 rating)	Observations and Notes

Analysis

Now you need to analyze your data to see if it helps to answer the research question: Does the appearance of a substance (opacity) relate to its ability to block UV light? One of the ways that scientists organize data to help them see patterns is by creating a visual representation. Below you will see a chart that you can use to help you analyze your data.

To fill in the chart, do the following for each substance that you tested:

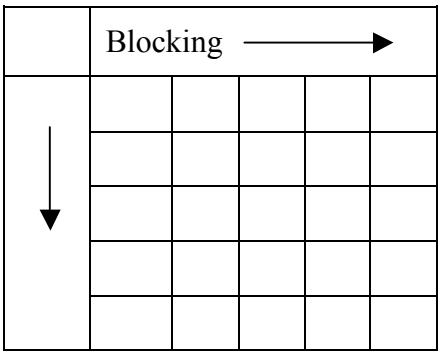
1. Find the row that corresponds to its opacity.
2. Find the column that corresponds to its UV blocking ability.
3. Draw a large dot • in the box where this row and column intersect.
4. Label the dot with the name or initials of the substance.

After you have filled in the chart, answer the analysis questions that follow.

UV Blocking Ability → / Opacity ↓	No Blocking (10)	Low Blocking (8)	Medium Blocking (6)	High Blocking (4)	Total Blocking (2)
5 Fully Transparent					
4					
3					
2					
1 Fully Opaque					

1. Look at the visual representation of your data that you have created and describe it. Note any patterns that you see. Remember that seeing no pattern can also give you important information.

2. What pattern would you expect to see if there is a relationship between the appearance of a substance (opacity) and its ability to block UV light? Draw the pattern by coloring in the grid below.



3. Does your chart match the pattern you would expect to see if there is a relationship between opacity and UV blocking ability?

   ☐ Yes

   ☐ No

   ☐ I'm not sure

4. What does this answer mean in practical terms? What does it tell you about how well you can judge the effectiveness of sun protection by looking at its appearance? How might this affect your sun protection activities?

5. Do you think that increasing the number of substances you tested would change your answer? Why or why not?

6. How confident are you that the answer you came up with is correct? Do you think that increasing the number of substances you tested would change *how sure you are* of your answer? Why or why not?

Conclusions

1. Answer the research question:

☐ Yes, there is a relationship.

☐ No, there is not a relationship.

☐ I'm not sure if there is a relationship.

2. This is how the evidence from the experiment supports my answer: (Make sure to be specific and discuss any patterns you do or do not see in the data.)

3. Identify any extra variables that may have affected your experiment:

4. How could you control for these variables in future experiments?

5. What changes would you make to this experiment so that you could answer the research question better?

6. All experiments raise new questions. Sometime these come directly from the experiment and others are related ideas that you become curious about. What is a new research question that you would want to investigate after completing this experiment?