Protect the Skin You're In

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Summary
This lesson is designed for a high school biology, anatomy, or health class to explore the importance of sun safety in relationship to skin cancer prevention. Students will begin with an inquiry based lab regarding sunscreen effectiveness. After analyzing the relationship between lab results and common student practices regarding sun screen use, students will administer and analyze a simple survey to their peers. This lesson will culminate with students developing and implementing a public service campaign designed to increase student use of sunscreen and sun safety awareness. In order for these activities to be most effective, the students should have prior knowledge of skin cancer. (If a lesson plan addressing skin cancer is needed, an educational module is available at http://www.cdc.gov/EXCITE/skincancer/mod10.htm).

Learning Outcomes

- The student will design and implement a lab to test the effectiveness of sunscreen using the scientific method.
- The student will analyze the results of the lab and draw a conclusion on variables that might impact the effectiveness of various sunscreen products.
- The student will implement and analyze a sun safety survey regarding awareness of this topic in grades 9-12.
- The student will be able to explain the benefit of sunscreen use and other sun safety mechanisms by designing a public service campaign.

Materials

1. White UV beads (available from most craft stores or from http://www.teachersource.com/direct/33410)
2. Petri dishes
3. Sunscreen (type and amounts will vary depending on student designed experiments)
4. Computer with Internet access to research information on skin cancer and sun safety practices
5. Computer with Quick Time, sound, and a projector
6. Poster making supplies

Total Duration
4 hours and 20 minutes (or 5 hours and 15 if optional conclusion is included)

Procedures

Teacher Preparation
Locate the "Choose Your Cover" public service announcements (PSA) available on the web from the Centers for Disease Control and Prevention, and set up the computer/projector. Make copies of the following: Sun Safety Pre/Post test (2 copies per student); the Baked Beads lab student handout (1 copy per student); Sun Safety Survey (10 copies per student).

Web Resource
Title: Cancer-Skin Cancer Materials
URL: http://www.cdc.gov/chooseyourcover/preview.htm#psas
Description: This Centers for Disease Control and Prevention website has multiple public service announcements on skin cancer. The teacher can choose a PSA to show students. These PSAs are intended to raise adolescent awareness of sun safety.

Supplemental Documents
Title: Sun Awareness Pretest
Description: This is the pretest that can be used to assess students' knowledge of sun safety and skin cancer.

Title: Sun Awareness Pretest Answer Key
Description: This is the pretest answer key that can be used to discuss students' responses to the pretest.

Title: Baked Beads
Description: This is the lab guide for designing and implementing an experiment to test sunscreen.

Title: Sun Safety Survey
Description: This is a short multiple choice and fill in the blank survey that asks students about the protective measures they take while in the sun.

Introduction **Duration: 40 minutes**
Begin this lesson by giving students the "Sun Safety Pretest" to assess their prior knowledge of sun safety and the correlation to skin cancer. After completing the pretest, lead a short discussion of skin cancer. If needed, images of skin cancer are available at the "Skin Cancer Module" web resource. Use the skin cancer discussion to transition into skin cancer prevention. Then, show one or more PSA(s) on sun safety, such as "93 Million Miles," to capture students' attention. After students have viewed the PSA(s), go over the correct answers from the pretest with the class and discuss the different responses.

Web Resource
Title: Cancer-Skin Cancer Materials
URL: http://www.cdc.gov/chooseyourcover/preview.htm#psas
Description: This Centers for Disease Control and Prevention website has multiple public service announcements on skin cancer. The teacher can choose a PSA called 93 Million Miles. This is part of the CDC's Choose Your Cover campaign. The purpose is to raise adolescent awareness of sun safety.

Title: Skin Cancer Module
URL: http://www.cdc.gov/EXCITE/skincancer/mod10.htm
Description: This Centers for Disease Control and Prevention website offers educational materials about skin cancer.

Supplemental Documents
Title: Sun Awareness Pretest

Description: This is the pretest that can be used to assess students' knowledge of sun safety and skin cancer.

Title: Sun Awareness Pretest Answer Key
Description: This is the pretest answer key that can be used to discuss students' responses to the pretest.

Step 2 **Duration: 55 minutes**

Now that students have been introduced to the concept of sun safety, they will design an inquiry based lab using UV beads to explore the use of sunscreen and its protective effect. Organize the students into groups of four to five students and distribute the lab guideline sheet "Baked Beads." Have each group brainstorm and make a list of at least 10 research questions about sunscreen (e.g., How much is enough sunscreen? Do more expensive sunscreens work better than less expensive sunscreens? Does the age of the sunscreen make a difference in its ability to reduce sun damage?).

As a class, have each group present their list of research questions to the class. Briefly discuss as a class the different research questions and have each group choose one question to develop into a testable hypothesis. Encourage each group to choose a different question to explore.

Once students have created their hypotheses from the research questions, each group needs to develop a detailed procedure to test their hypothesis. Groups must come to a consensus on the procedure and must have some way to measure their data. This procedure will be shared with the group the following day. Students should then make a list of materials needed and make arrangements to get the amounts and types of sunscreen needed to conduct the experiment the next class period.

Supplemental Document
Title: Baked Beads
Description: This is the lab guide for designing and implementing an experiment to test sunscreen.

Step 3 **Duration: 55 minutes**

Student groups assemble and discuss planned procedures for conducting the experiment to test the hypothesis. Teacher will check each procedure before group begins the experiment. (Allow about 20 minutes.)

Once the teacher has approved all experimental procedures, students may begin to conduct their experiments. Generally, each group will be placing 5-7 UV beads into each of their Petri dishes and applying a thin, even layer of sunscreen (as appropriate based on individual hypotheses) to the outside of the Petri dish. Students then should place the Petri dishes outside in sunny (or shaded) locations as appropriate based on hypotheses for approximately 15-20 minutes.

At the end of the specified time period, students should examine the beads for color changes by holding up the Petri dishes and viewing the beads from the bottom of the dishes. This examination may be done outside, and again after bringing all experimental materials back to the classroom. Students should compare the beads in different Petri dishes for differences in color change to determine whether they found support for their hypotheses.

After conducting their experiments and analyzing their results, student groups will share their results with the class. Each student should do an individual report of the experiment.

Supplemental Document
Title: Baked Beads
Description: This is the lab guide for designing and implementing an experiment to test sunscreen.

Title: Sunscreen Lab Report Format
Description: This is a lab format that can be used to document and summarize student results.

Step 4 **Duration: 55 minutes**

Now that the students have had the opportunity to see how sunscreen can prevent UV exposure, ask students how many of them always use sunscreen when they're out in the sun. For those that do, ask them why they do it. For those that do not, ask them why not. After this discussion, introduce them to the Youth Risk Behavior Surveillance System (YRBSS) questions about sun safety. Have the students complete the Sun Safety Survey (the YRBSS plus some additional questions about sun safety) and tally the results on the board. Then calculate percentage of males and females who responded to each choice for each question (see attached Sample Calculations sheet for explanation of calculations). If desired, do the first few calculations as a class and then divide the remaining questions between groups of 3-4 students. Write the results on the board or project via computer or overhead projector. What types of trends do they see? Is one type of sun protection more common than another? Is the most common form of protection likely to be the most effective? Why might there be differences? Ask students to predict what the responses of their schoolmates would be for each question and why they think so.

Ask students why it is important for adolescents to protect their skin from the sun and why more adolescents do not do so. Tie the UV bead inquiry lab they performed to this discussion. Have the students read the "Skin cancer facts and statistics" webpage from the CDC's Choose Your Cover campaign and discuss the impact of these facts on the students' health and behaviors. This discussion could tie in the PSA the students watched at the beginning of the lesson.

For homework, assign each student to administer the survey to ten other students – they should ideally be from the same school, but must be between 9th and 12th grade. Students may give each individual a separate survey (if copied in advance) or the students may conduct the surveys orally and write down the results. Students should be reminded to administer the survey only to those students who have not already participated.

Web Resources
Title: YRBSS – Youth Risk Behavior Surveillance System – DASH/HealthyYouth
URL: http://www.cdc.gov/healthyyouth/YRBS/index.htm
Description: This is the CDC's homepage for the YRBSS and can provide the teacher with additional background on the survey and its results

Title: Cancer – Skin Cancer Facts and Statistics
URL: http://www.cdc.gov/Chooseyourcover/skin.htm

Description: This site gives a brief overview of the different types of skin cancer, what types of people are most at risk for skin cancer, and that reducing UV exposure reduces skin cancer risk.

Supplemental Documents
Title: Sun Safety Survey
Description: This is a short multiple choice and fill in the blank survey that asks students about the protective measures they take while in the sun.

Title: Sample Calculations
Description: This document uses sample data to show how to calculate percentages for the answer choices for each question. It may be used as a template.

Step 5 **Duration: 55 minutes**

Now that students have administered the surveys, they will analyze the data they have gathered. Have the students divide the completed surveys into male and female piles. Divide the students into groups of 3-4 and give each group an equal number of surveys. Each group will calculate the percentages of their respondents' answers for each question (the same procedure as in Step 4).

Once each group is finished, bring the class back together and combine the data. Place the data on the board or project it from a computer or an overhead project. Ask students to review the data – how does it compare to their predictions? Do any of their results seem surprising? If so, what might be the cause of that difference? Place the class' data from Step 4 (about themselves) next to their peers' data. Is there any difference? Why might that be so?

Ask students how they think their results compare to the national results from the Youth Risk Behavior Survey. Show the students the results from the first two questions on their survey (these were the only sun safety questions on the YRBS). Discuss any differences or similarities and possible causes.

Administer the Sun Safety post-test. When students have completed it, grade the post-test as a class and have the students compare their post-test and pre-test scores. Discuss how much they have learned about UV exposure and sun safety measures, and the need for their peers to learn the same thing. Tell students that they will be sharing this message with their peers via a Public Service Announcement campaign.

Web Resources
Title: MMWR – Youth Risk Behavior Surveillance 2005
URL: http://www.cdc.gov/mmwr/PDF/SS/SS5505.pdf
Description: These are the results for the 2005 YRBS. The results for the two sun safety questions can be found on the right-hand column of page 29 of the document (page 31 if you look at the Adobe page numbers).

Supplemental Documents
Title: Sun Safety Survey
Description: This is a short multiple choice and fill in the blank survey that asks students about the protective measures they take while in the sun.

Title: Sun Safety Posttest

Description: These are the same questions as in the pretest and will provide students with an opportunity to see what they have learned during this lesson.

Title: Sun Safety Post-test Answer Key
Description: These are the answers to the posttest questions.

Conclusion (Optional) **Duration: 55 minutes**
Note: This step may be done as an in-class assignment individually or in groups or as a homework assignment.

Students will brainstorm ideas for posters that will convey the message of using a variety of sun safety measures to protect their peers from UV exposure. Allow students to create the posters. When complete, display student posters in a prominent place in the school.

Assessment

The lab portion of this activity will be based upon assessment of the lab report. Two possible rubrics are provided. Assessment of the survey portion of this activity is based on completion of 10 surveys per individual and will count as a homework grade.

Modifications

Extensions
Survey data: Analyze the survey data by grade level in addition to gender. Additionally, save students' data and compare data from one year to the next. This introduces students to the concept of surveillance.

Campaigns: Instead of, or in addition to, the poster campaign, have students create video or audio commercials they can air for the school (during assemblies, over the P.A. system, etc.). The "Cancer: Skin Cancer Campaign Materials" website has a list of all of CDC's Choose Your Cover campaign materials (radio and television ads, etc.). These can be used as examples of different products students can develop.

UV damage at the cellular level: Allow students to more deeply explore how UV radiation damages DNA. The website, "A Closer Look at Biological Consequences of Ultraviolet Exposure" has more information on this particular topic. Additionally, "The Biology of Sunscreen" is another document that would provide students with more information about UV damage at the cellular level.

UV labs with yeast: Students could carry out similar experiments with sunscreen, using yeast or bacteria instead of UV beads. Many sites offer possible procedures or kits. The website "Using Yeast as an Ultraviolet Light Measurement Tool " is a series of three labs from the Access Excellence project using yeast exposed to UV radiation.

Guest speakers: Invite a dermatologist, a dermatology nurse, and/or a skin cancer survivor to speak to students.

Sunscreen symposium: Elaborate on students' lab reports and allow each group to present their results to each other in a conference format. Consider having students make posters or take pictures of their results.

Web Resources
Title: Cancer-Skin Cancer Campaign Materials
URL: http://www.cdc.gov/Chooseyourcover/preview.htm
Description: This site contains the CDC's Choose Your Cover Campaign media materials.

Title: A closer look at biological consequences of ultraviolet exposure
URL: http://www.phys.ksu.edu/gene/f_5.html
Description: This is an excerpt from the GENE project from Kansas State University. This is taken from the web version of *A Classroom Guide to Yeast Experiments*.

Title: Using Yeast as an Ultraviolet Light Measurement Tool
URL: http://www.accessexcellence.org/AE/AEPC/WWC/1993/using.html
Description: This is a series of three labs from the Access Excellence project using yeast exposed to UV radiation.

Supplemental Document
Title: The Biology of Sunscreen
Source: Chen Ingfei. The Biology of Sunscreen. Discover 2003;24(06).
Description: This is an article from Discover magazine and describes how sunscreen works and also discusses potential DNA repair therapies.

Education Standards

National Science Education Standards
SCIENCE AS INQUIRY, CONTENT STANDARD A:
As a result of activities in grades 9-12, all students should develop

- **Abilities necessary to do scientific inquiry**
- **Understandings about scientific inquiry**

SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES, CONTENT STANDARD F:
As a result of activities in grades 9-12, all students should develop understanding of

- **Personal and community health**
- Population growth
- Natural resources
- Environmental quality
- **Natural and human-induced hazards**
- Science and technology in local, national, and global challenges

Washington State Standards

2. Inquiry: The student knows and applies the scientific ideas, skills, processes of investigation, and the nature of science. Inquiry describes the skills necessary to investigate systems and asks students to understand the nature of science which gives integrity to scientific investigations. Inquiry represents the application of science concepts and principles to the

scientific investigative processes that aims to answer scientific questions about the natural world. These concepts, principles, and processes are expressed in two components:

2.1 Investigating Systems: Develop the knowledge and skills necessary to do scientific inquiry.

2.2 Nature of Science: Understand the nature of scientific inquiry

3. Application: The student knows and applies science ideas and inquiry to design and analyze solutions to human problems in societal contexts.

Scientific design process skills are used to develop and evaluate scientific solutions to problems in real world contexts. The application of an understanding of systems and inquiry is comprised of two components:

3.1 Designing Solutions: Apply knowledge and skills of science and technology to design solutions to human problems or meet challenges.

Georgia State Standards - Biology

SCSh.3 Students will identify and investigate problems scientifically.

- **a. Suggest reasonable hypotheses for identified problems.**
- **b. Develop procedures for solving scientific problems.**
- **c. Collect, organize and record appropriate data.**
- **d. Graphically compare and analyze data points and/or summary statistics.**
- **e. Develop reasonable conclusions based on data collected.**
- **f. Evaluate whether conclusions are reasonable by reviewing the process and checking against other available information.**

SCSh.6 Students will communicate scientific investigations and information clearly.

- **a. Write clear, coherent laboratory reports related to scientific investigations.**
- b. Write clear, coherent accounts of current scientific issues, including possible alternative interpretations of the data.
- **c. Use data as evidence to support scientific arguments and claims in written or oral presentations.**
- **d. Participate in group discussions of scientific investigation and current scientific issues.**

SB2. Students will analyze how biological traits are passed on to successive generations.

- a. Distinguish between DNA and RNA.
- b. Explain the role of DNA in storing and transmitting cellular information.
- c. Using Mendel's laws, explain the role of meiosis in reproductive variability.
- d. Describe the relationships between changes in DNA and potential appearance of new traits including
  - Alterations during replication.
    - Insertions
    - Deletions
    - Substitutions
  - **Mutagenic factors that can alter DNA.**
    - **High energy radiation (x-rays and ultraviolet)**

    - Chemical

e. Compare the advantages of sexual reproduction and asexual reproduction in different situations.
f. Examine the use of DNA technology in forensics, medicine, and agriculture.

Sun Safety Pretest

Protect the Skin You're In
Emily Adams and Tamara Caraballo, CDC's 2006 Science Ambassador Program

Directions: Circle the answer that you think best answers each question or completes each statement.

1. What is the largest organ in the human body?
   a. Liver
   b. Brain
   c. Heart
   d. Skin

2. The most common form of cancer in the United States is
   a. Breast cancer
   b. Colon cancer
   c. Skin cancer
   d. Lung cancer

3. More than 1 million people are diagnosed with skin cancer in the United States each year.
   a. True
   b. False

4. Both UVA and UVB radiation are damaging to the skin.
   a. True
   b. False

5. Exposure to UV radiation is linked to which of the following:
   a. Wrinkles
   b. Weakened immune system
   c. Brown age spots
   d. Skin cancer
   e. All of the above

6. Which type of skin cancer is the most deadly?
   a. Basal cell carcinoma
   b. Squamous cell carcinoma
   c. Melanoma
   d. Benign tumors

7. What are some of the ways that you can prevent sun exposure?
   a. Wearing sunscreen
   b. Staying in shady areas
   c. Wearing sunglasses
   d. Wearing a hat
   e. All of the above

8. What does the SPF number 15 on a bottle of sunscreen mean?
   a. The product will provide 15 minutes of sun protection
   b. The product does not come off in water or with sweat for at least 15 minutes

c. You are protected from sunburn 15 times longer than the time it usually takes for your skin to redden in the sun without sunscreen
d. The product provides total sun protection from sunburn for most individuals
e. a and b are both correct

9. Which item of clothing provides the most protection from the sun's burning rays?
   a. Tank top
   b. T-shirt
   c. Long-sleeved shirt
   d. Bikini

10. People with dark skin don't have to worry about getting skin cancer.
   a. True
   b. False

11. When applying sunscreen, how much is enough?
   a. A squirt the size of a dime
   b. A squirt the size of a quarter
   c. A squirt the size of your palm
   d. Half the bottle

Sun Safety Pretest Answer Key

Protect the skin you're in
Emily Adams & Tamara Caraballo, CDC's 2006 Science Ambassador Program

1. What is the largest organ in the human body?
   c. Skin – The skin is considered to be a body organ, and it covers the entire body surface.

2. The most common form of cancer in the United States is
   d. Skin cancer – According to the American Cancer Society, more than 1 million cases are diagnosed each year.

3. More than 1 million people are diagnosed with skin cancer in the United States each year.
   a. True – see above

4. Both UVA and UVB radiation are damaging to the skin.
   e. True – Although UVB is primarily responsible for causing skin cancer, UVA can cause early aging and is partly responsible for causing skin cancer.

5. Exposure to UV radiation is linked to the following:
   e. All of the above – These rays can damage skin tissue and cause premature aging of the skin which can possibly lead to all of the outcomes listed.

6. Which type of skin cancer is the most deadly?
   c. melanoma – The American Cancer Society estimates that over 7,900 people will die from melanoma in the U.S. in 2006.

7. What are some of the ways that you can prevent sun exposure?
   e. All of the above - The Centers for Disease Control and Prevention reports that young people can have fun outdoors, while still protecting their skin from the sun, by choosing five sun protection options: seeking shade, covering up, getting a hat, wearing sunglasses, and rubbing on sunscreen.

8. What does the SPF number 15 on a bottle of sunscreen mean?
   c. You are protected from sunburn 15 times longer than the time it usually takes for your skin to turn red in the sun without sunscreen, so if you normally burn in ten minutes without sunscreen, then wearing SPF 15 sunscreen theoretically lets you stay in the sun for approximately 150 minutes without burning.

9. Which item of clothing provides the most protection from the sun's burning rays?
   c. long-sleeved shirt - Loose-fitting long-sleeved shirts and long pants made from tightly woven fabric protect best against UV rays

10. People with dark skin don't have to worry about getting skin cancer.
    a. false – People of all skin types can get skin cancer, but people with pale or light colored skin are more at risk of developing skin cancer.

11. When applying sunscreen, how much is enough?
    c. a squirt the size of your palm.

Sources:

Questions #1-10: Saraiya, Mona, MD, MPH, Skin Cancer. CDC's Science Ambassador Workshop, 2006.

Question #2: American Cancer Society. How many people get nonmelanoma skin cancer [online]. 2004 Apr [cited 2006 August 18]. Available from URL:http://www.cancer.org/docroot/CRI/content/CRI_2_2_1X_How_many_people_get_ nonmelanoma_skin_cancer_51.asp?sitearea=

Questions #4-5: Centers for Disease Control and Prevention. Module 6: Ultraviolet Radiation [online]. 2005 Feb [cited 2006 August 17]. Available from URL: http://www.cdc.gov/EXCITE/skincancer/mod06.htm

Question #6: American Cancer Society. How many people get melanoma skin cancer [online]. 2004 Apr [cited 2006 August 18]. Available from URL:http://www.cancer.org/docroot/CRI/content/CRI_2_2_1X_How_many_people_get_ melanoma_skin_cancer_50.asp?sitearea=

Question #7: Centers for Disease Control and Prevention. Choose your cover campaign [online]. 2006 [cited 2006 August 17]. Available from URL: http://www.cdc.gov/chooseyourcover/index.htm

Question #11: Centers for Disease Control and Prevention. Guidelines for school programs to prevent skin cancer. MMWR 2002;51(No. RR-4):[5].

Baked beads – Student Lab Guideline Handout

Protect the skin you're in: Understanding sunscreen effectiveness
Emily Adams & Tamara Caraballo, CDC's 2006 Science Ambassador Program

With your group, brainstorm and make a list of at least 10 possible research questions about sunscreen. (For example-What is enough sunscreen? Do more expensive sunscreens work better? Does the age of the sunscreen make a difference?)

1._____
2._____
3._____
4._____
5._____
6._____
7._____
8._____
9._____
10._____

Next, choose one of the above research questions and develop a testable hypothesis for the question. This should be in an *if/then/because* format.

Hypothesis_____
_____

Clearly state the variable you are testing-_____
Identify the control group-_____
Manipulated variable (independent)-_____
Responding variable (dependent)-_____

Materials List:
1. White UV beads
2. Petri Dishes
3. Sunscreen (to be obtained by students as appropriate for your experiment)

Procedure:
Generally, each group will be placing 5-7 UV beads into each of their Petri dishes and applying a thin, even layer of sunscreen (as appropriate based on individual hypotheses) to the outside of the Petri dish. Students then should place the Petri dishes outside in sunny (or shaded) locations as appropriate based on hypotheses for approximately 15-20 minutes. Specific procedures will vary depending on the hypothesis your group will be testing.

Using this general procedure, your group must design a lab that tests your hypothesis. Reminders:

- list steps and number them
- this experiment needs to be repeatable
- directions must be very clear so that someone else could repeat this experiment exactly as your group did
- data collected must be measurable

Please summarize your group procedure here:

Results-Data & Analysis

Be sure to record your observations as accurately and in as much detail as possible. Record your observations here:

Conclusion:

*Re-state your hypothesis and **summarize** your procedure

*Summarize your results

* Was your hypothesis correct? What problems did you encounter? What was something you learned?

Suggested Lab Report Format

Purpose-must be clearly stated
Background Information-what do you know about the sunscreens you are testing? Label info? Expiration date? Cost? Etc.
Materials-complete list including amounts needed to conduct experiment
Hypothesis-should be in the form of an "If__then__because" statement.
Procedure- steps must be clearly listed.
Data-well organized, neat, units identified
Analysis-
Graph- titled; axis labeled; color coded
Data clearly explained/relationships pointed out (at least one paragraph)
Conclusion-
Paragraph 1-hypothesis restated; procedure **summarized**; procedural problems addressed
Paragraph 2- Address your original hypothesis; new hypothesis that you might propose
Paragraph 3-Experimental errors; corrections; valid results; new questions-there are always new questions

Possible grading rubrics for lab report

Background	1	3	5
Hypothesis (if/then/because)	1	3	5
Materials listed	1	3	5
Procedure flow chart	1	3	5
Results explained in detail	1	3	5
Conclusion-what did you learn; refer back to hypothesis; sources of error; new questions?	1	3	5
Presentation	1	3	5

5=complete; neat; clear; concise
3=partially complete; could be neater; sort of clear; rambles
1=missing; sloppy; confusing; goes nowhere

Category	4	3	2	1	Score
Purpose	Purpose/objectives clearly stated.	Purpose clear/main objectives vague.	Purpose of lab vague.	No purpose stated.	
Experimental Hypothesis	Hypothesis shows relationship between variables and predicted results & is reasonable based on clear study. Phrased in “if...then… because” format	Hypothesis shows relationship between variables and predicted results & is reasonable based general knowledge. Phrased in “if...then… because” format	Hypothesis shows relationship between variables and predicted results & is reasonable based on flawed logic.	No hypothesis has been stated.	
Materials	List complete. Units of measure/amts listed.	List complete. Units of measure/amts not listed.	List incomplete.	No materials list.	
Procedure	Procedure clear & replicable; steps numbered & detailed.	Procedure clear & replicable; not numbered AND/OR lacking detail	All steps outlined but not enough detail to replicate procedure.	Missing several steps AND not enough detail to follow procedure.	
Experimental Design	Well constructed design; tests hypothesis.	Design adequate but leaves some questions unanswered.	Design relevant to hypothesis but not a complete test.	Design not relevant to hypothesis.	
Variables	Variables identified as control, manipulated, responding in detail.	Variables identified as control, manipulated, responding-no detail.	Most variables identified but not all.	Variables not identified.	
Data	Professional looking/accurate. Data shows experiment could be **repeated;** tables/graphs correctly labeled.	Data shows experiment could be **repeated**; tables & graphs correctly labeled.	Data shows experiment could be **repeated** AND/OR tables & graphs correctly labeled.	Data inaccurate or incomplete.	
Analysis	Relationship between variables linked/ trends/patterns analyzed/Predictions made if experimental design revised.	Relationship between variables linked/ trends/patterns analyzed.	Relationship between variables linked.	Relationship between variables not linked.	
Conclusion	Conclusions linked to hypothesis; sources of error; new knowledge	Conclusions linked to hypothesis; new knowledge	Conclusion includes what was learned.	No conclusion or conclusion shows little effort/thought.	
Scientific Concepts	Report shows thorough understanding of scientific concepts.	Report shows understanding of most scientific concepts.	Report shows limited understanding of scientific concepts.	Report shows inaccurate/no understanding.	
Safety	Lab completed with full attention to safety/lab standards. All materials cleaned.	Lab completed with attention to safety/lab standards. All materials cleaned.	Lab completed with attention to safety/lab standards.	Lab completed with no attention to safety/lab standards. Lab unsafe!	
Appearance/ Organization	Report typed; headings present; visually appealing & organized.	Lab is neatly hand written & uses headings. Well organized.	Lab is typed or handwritten but not well formatted.	Lab is hand written; sloppy; multiple erasures;	

Sun Safety Survey

Protect the Skin You're In: Understanding sunscreen effectiveness
Emily Adams & Tamara Caraballo, CDC's 2006 Science Ambassador Program

Directions. DO NOT write your name on this survey. The answers you give will be kept anonymous. Answer the questions based on what you really do.

Based on your own behavior, please answer the following questions by writing the answer that best describes you in the blank:

_____ 1.How often do you wear sunscreen with an SPF of 15 or higher when you are outside for more than 1 hour on a sunny day?
A. Never
B. Rarely (not very often)
C. Sometimes (about half the time)
D. Most of the time (more times than not)
E. Always (as often as I can)

_____ 2.How often do you stay in the shade when you are outside for more than 1 hour on a sunny day?
A. Never
B. Rarely (not very often)
C. Sometimes (about half the time)
D. Most of the time (more times than not)
E. Always (as often as I can)

_____ 3.How often do you wear long pants when you are outside for more than 1 hour on a sunny day?
A. Never
B. Rarely (not very often)
C. Sometimes (about half the time)
D. Most of the time (more times than not)
E. Always (as often as I can)

_____ 4.How often do you wear a long-sleeved shirt when you are outside for more than 1 hour on a sunny day?
A. Never
B. Rarely (not very often)
C. Sometimes (about half the time)
D. Most of the time (more times than not)
E. Always (as often as I can)

_____ 5.How often do you wear a hat that shades your face, ears, and neck when you are outside for more than 1 hour on a sunny day?
A. Never
B. Rarely (not very often)
C. Sometimes (about half the time)
D. Most of the time (more times than not)
E. Always (as often as I can)

_____ 6.How often do you wear sunglasses when you are outside for more than 1 hour on a sunny day?

A. Never
B. Rarely (not very often)
C. Sometimes (about half the time)
D. Most of the time (more times than not)
E. Always (as often as I can)

_____ 7. When you wear sunscreen outside on a sunny day, how often do you apply it and allow it to dry before going outdoors?

A. Never
B. Rarely (not very often)
C. Sometimes (about half the time)
D. Most of the time (more times than not)
E. Always (as often as I can)

_____ 8.When you wear sunscreen outside on a sunny day, how often do you reapply it after leaving the water, sweating, or drying off with a towel?

A. Never
B. Rarely (not very often)
C. Sometimes (about half the time)
D. Most of the time (more times than not)
E. Always (as often as I can)

_____ 9.When you apply sunscreen, about how much do you use at a time?

A. a squirt the size of a dime
B. a squirt the size of a quarter
C. a squirt the size of your palm
D. half of the bottle

_____ 10. In the past 12 months, how many times did you have a red or painful sunburn that lasted a day or more?

A. 0
B. 1
C. 2
D. 3
E. 4 or more

_____ 11. On average, how many hours are you outside between 10 am and 4 pm in the summer on weekends?

A. 30 min or less
B. 1 hour
C. 2 hours
D. 3 hours
E. More than 3 hours

Gender (check appropriate response) : _____ I am male. _____ I am female.

Sample Calculations for Sun Safety Survey

Protect the skin you're in
Emily Adams & Tamara Caraballo, CDC's 2006 Science Ambassador Program

Please note that all data are fictional.

Sample Question: Question #1
How often do you wear sunscreen with an SPF of 15 or higher when you are outside for more than 1 hour on a sunny day?

A) Never
B) Rarely
C) Sometimes
D) Most of the time
E) Always

Compiled results from class:

Question #1 answer choice	# of males who chose this response	# of females who chose this response
A) Never	47	32
B) Rarely	5	22
C) Sometimes	13	16
D) Most of the time	4	7
E) Always	1	3
Total:	70	80

To calculate percentages for each choice:

Question #1 answer choice	# of males who chose this response	% of males who chose this response	# of females who chose this response	% of females who chose this response
A) Never	47	47/70 = 67%	32	32/80 = 40%
B) Rarely	5	5/70 = 7%	22	22/80 = 27%
C) Sometimes	13	13/70 = 19%	16	16/80 = 20%
D) Most of the time	4	4/70 = 6%	7	7/80 = 9%
E) Always	1	1/70 = 1%	3	3/80 = 4%
Total:	70	100%	80	100%

Template for on-screen projection:

Question #1 answer choice	# of males who chose this response	% of males who chose this response	# of females who chose this response	% of females who chose this response
Total:				