

Unit 3 Projects

Inquiry Project

Reflecting on White Roofs (Student textbook page 264)

Pedagogical Purpose

Students design and conduct an inquiry to test their hypothesis on how well white roofs reflect sunlight.

Planning	
Materials	research materials or Internet access BLM A-51 Unit 3 Inquiry Investigation Rubric BLM G-26 Developing a Hypothesis (optional) BLM G-27 How Is an Experiment Like Baking Cookies? (optional) BLM G-28 Experiment Checklist (optional) BLM G-29 Experimental Design Worksheet (optional)
Time	70-100 min in class

Background

White or light colours are significantly better at reflecting solar energy than black or darker colours. Albedo is a measure of the solar radiation that is reflected by a surface. Albedo comes from the Latin term *albus*, which means white. The ideal white surface would have an albedo of 100 percent, which means that all the solar radiation that strikes the surface would be reflected away. An ideal black surface would have an albedo of zero percent, which means that all the solar radiation that strikes the black surface would be absorbed. Albedo is often represented as a number (0.0 to 1.0) rather than a percent. The ideal roof system would have an albedo of 100 percent or 1.0.

Light is composed of all colours. When you divide light using a prism, you see a rainbow of colours. Individual colours can reflect only themselves. So, if you paint something red, it can only reflect red light (light energy in the red wavelength). We see the red light. It is important to remember that the paint is not red; it is the light reflected into our eyes that is red, and so we see red. The same is true for all the other colours. However, white things reflect *all* colours and black things reflect *no* colours (that we can see). The light, in this case, is “trapped” in the paint. If we recall that light is energy, it becomes clear why light things remain cool and dark things heat up.

Skills Focus

- formulate questions and hypotheses
- select appropriate equipment
- work safely with chemicals and equipment
- conduct inquiries and gather data, controlling for some variables
- draw conclusions from data

Activity Notes and Troubleshooting

- You may wish to provide students with **BLM A-52 Unit 3 Inquiry Project Rubric**. Share with students how they will be assessed in this activity before they begin so they know what is expected of them.
- Students touched on this subject on page 251 in topic 3.5. Have them review their notes from that section before proceeding.
- Have students work in small groups for this project.

- If students are unfamiliar with the physics of light or need a refresher, you may wish to review with them how light is comprised of all colours and that white reflects all light while black absorbs all light. Students will study light in detail in Unit 4.
- For Communicate Your Findings question 3, you could have students write a letter to their member of parliament or the Minister of the Environment with their opinion. This would be similar to the letter they will write for Communicate Your Findings question 5 in An Issue to Analyze. You may want to offer students a choice of which letter to write.

Additional Support

- **ELL** English language learners and students who are struggling with designing their investigation or developing a hypothesis will benefit from using **BLM G-26 Developing a Hypothesis**, **BLM G-27 How Is an Experiment Like Baking Cookies?**, **BLM G-28 Experiment Checklist**, or **BLM G-29 Experimental Design Worksheet**.
- **ELL** If possible, save similar completed projects on different topics to show to students as models. Written models are a powerful tool. By observing the format and writing style of the model, English language learners will know how to organize and develop their project without the need for lengthy descriptions and explanations.
- **DI** Students with bodily-kinesthetic intelligence will enjoy the hands-on approach to this project. Group these students and students with strong interpersonal skills with students still developing skills in these areas.
- **Enrichment**—Students with a high level of interest could research what Canadian government grants are currently in place to enable people to reduce their carbon footprint. Have students share their findings with the class. A good source of information can be found at www.scienceontario.ca.

Rubric

ACHIEVEMENT CHART CATEGORY	Level 1	Level 2	Level 3	Level 4
Knowledge and Understanding	A list of dependent, independent, and control variables is not provided.	A list of some of the dependent, independent, and control variables is provided.	A list of the dependent, independent, and control variables is provided.	A detailed list of the dependent, independent, and control variables is provided.
	The hypothesis is not testable and is written with little clarity.	The hypothesis is not testable and is written with some clarity.	The hypothesis is testable and is written with considerable clarity.	The hypothesis is testable and is very clearly written.
Thinking and Investigation	A list of equipment and materials is not provided.	A list of some equipment and materials is provided.	A complete list of equipment and materials is provided.	A very complete list of equipment and materials is provided.
	A step-by-step procedure is included that controls few of the variables.	A step-by-step procedure is included that controls few of the variables.	A step-by-step procedure is included that controls some of the variables.	A step-by-step procedure is included that controls as many variables as possible.
	Conducts the experiment, carrying out the procedure safely and recording data accurately with limited effectiveness.	Conducts the experiment, carrying out the procedure safely and recording data accurately with some effectiveness.	Conducts the experiment, carrying out the procedure safely and recording data accurately with considerable effectiveness.	Conducts the experiment, carrying out the procedure safely and recording data accurately.
Communication	Information is organized with limited effectiveness.	Information is organized with some effectiveness.	Information is organized with considerable effectiveness.	Information is organized with a high degree of effectiveness.
	Few results are recorded in a table and graphs may be lacking.	Some results are recorded in a table and summarized using a graph.	Results are recorded in a table and summarized using a graph.	Results are neatly recorded in a table and correctly summarized using a graph.
	Opinion piece is not included and there is little evidence of research.	Opinion piece is included and opinion is not well supported with research and experimental evidence.	Opinion piece well written and opinion is supported with research and experimental evidence.	Opinion piece well written and opinion is well supported with research and experimental evidence.
Application	Makes few connections between results and government grants.	Makes some connections between results and government grants.	Makes connections between results and government grants.	Effectively makes connections between results and government grants.

Please see also **BLM A-51 Unit 3 Inquiry Investigation Rubric**

An Issue to Analyze

Dealing with Climate Change (Student textbook page 265)

Pedagogical Purpose

Assessing how to combat climate change must be done with an awareness of the financial costs of the initiatives. In this project, students analyze the costs and benefits of various initiatives to reduce climate change, choose the best initiative, and write proposal for implementing it.

Planning

Materials	BLM A-52 Unit 3 An Issue to Analyze Rubric (optional) BLM 3-5 Cost-Benefit Matrix (optional)
Time	120-160 min class

Background

A cost-benefit matrix or analysis is a business management technique used to help companies make decisions. This tool is only useful if all the possible benefits and costs are included. A simpler form of this tool is a pros and cons chart, which is a simply two-column chart comparing positive and negative features of something. Cost-benefit analyses are often used with projects related to environmental issues. However, money is usually the only definition of cost in these cases. An alternative viewpoint would be to include the global environmental consequences as a cost—pricing the “priceless”.

Skills Focus

- find relevant sources of information
- draw conclusions based on data
- communicate using appropriate language, in a variety of formats

Activity Notes and Troubleshooting

- Before students begin, review the Assessment Criteria with them to ensure they are aware of how they will be evaluated for this activity. You may wish to provide them with **BLM A-53 Unit 3 An Issue to Analyze Rubric**.
- As a class, read through the activity and answer any questions students may have. Ensure students understand the instructions.
- Have students work in pairs or small groups for this activity.
- You may wish to make Initiate and Plan question 1 a class brainstorming session. Record the ideas on the chalkboard or chart paper and leave the list posted for students' reference throughout the project. Consider assigning five to ten initiatives for students to research to keep the project manageable.

Additional Support

- **DI** Students with logical-mathematical intelligence will enjoy the financial aspect of this project. Pair these students with students who struggle in this area.
- **ELL** Have English language learners use **BLM 3-5 Cost-Benefit Matrix** for this activity.

Rubric

ACHIEVEMENT CHART CATEGORY	Level 1	Level 2	Level 3	Level 4
Knowledge and Understanding	A list of actions and initiatives related to climate change not provided.	A list of actions and initiatives related to climate change provided but incomplete.	A list of actions and initiatives related to climate change provided.	A detailed list of actions and initiatives related to climate change provided.
Thinking and Investigation	Used few resources to investigate cost and strategies related to climate change.	Used some resources to investigate cost and strategies related to climate change.	Used a variety of resources to investigate cost and strategies related to climate change.	Used many resources to investigate cost and strategies related to climate change.
Communication	A persuasive letter written with little effectiveness in communicating information to the intended audience.	A persuasive letter written with some effectiveness in communicating information to the intended audience.	A persuasive letter effectively and accurately communicates its purpose to the intended audience.	A persuasive letter well written and effectively and accurately communicates information to the intended audience.
Application	Student does not make a recommendation based on supporting evidence from cost-benefit analysis.	Student makes a recommendation without supporting evidence from cost-benefit analysis.	Student makes a recommendation for action or initiatives based on evidence from cost-benefit analysis.	Student makes a very detailed recommendation for action or initiatives based on evidence from cost-benefit analysis.
	Does not identify ways that student can assist in the implementation of recommended actions.	Identifies less than two ways that student can assist in the implementation of recommended actions.	Identifies two ways that student can assist in the implementation of recommended actions.	Clearly identifies at least two ways that the student can assist in implementation of recommended actions.
	Personal opinions of classmates not surveyed before choosing one action.	Some consideration given to opinions of classmates before choosing one action.	Personal opinions of classmates surveyed before choosing one action.	Personal opinions of classmates well surveyed before choosing one action.
	Little collaboration with classmates to reach a consensus on the most highly recommended action.	Some collaboration with classmates to reach a consensus on the most highly recommended action.	Collaborated with classmates to reach a consensus on the most highly recommended action.	Collaborated well with classmates to reach a consensus on the most highly recommended action.

Please also see **BLM A-52 Unit 3 An Issue to Analyze Rubric**.