Unit 3 Projects

Inquiry Project
Reflecting on Land Use (Student textbook page 390)

Pedagogical Purpose

Students will design investigations to test a variety of materials and determine their albedo. This engages the scientific inquiry process to lead to supported arguments concerning best practices for land use and ground cover as it relates to mitigating climate change. This investigation gives students first hand experience with assessing the albedo of a variety of materials and considering real world applications for their results.

Planning	
Materials	Variety of "ground cover" materials as identified by students
Time	20 min for preparation 60 to 90 min to design and carry out

Background

Each "land use" can be linked to a variety of "ground covers." For example, farming might involve land covered by pasture, cities covered by light or dark roads and roofs, recreational areas covered by sandy playgrounds, etc. Each of these ground covers will have a different effect on the amount of heat absorbed by the land. Mostly, this is linked to the albedo of the substance. However, trees have the added effect of shading the ground below, reducing the amount of solar radiation that is absorbed by Earth's surface.

The urban heat island effect is common in many large urban areas. The materials in the area (e.g., concrete, asphalt, etc.) increase the absorption of heat and the loss of natural vegetative cover reduces cooling via evapotranspiration. Additionally, tall buildings block some of the cooling winds, or redirect them, reducing the cooling effect. Developing parks and other green spaces is one way to reduce the urban heat island effect.

Activity Notes and Troubleshooting

- The image of the house implies that the definition of "ground cover" should include the colour of roofs. Ask students to evaluate the implications of roof colour, given the albedo of each.
- Ground cover materials might include: grass or leaves, dark and light roofing shingles, cement and asphalt, water, dirt, and sand.
- Direct students to Science Skills Toolkit 2 on pages 532 to 535 of the student textbook, especially the sections on Controlling Variables for a Fair Test.
- Equipment should include thermometers and may include containers for sample material.
- You may wish to assign the investigation as homework, with in-class time reserved for getting help with the design and analysis as well as the actual presentations.
- Presentations could be made to the class as a whole or to small groups, or laid out for the whole school to access.
- Secure a large area for all students to lay samples in the sunshine.
- You may wish to have peers provide feedback on experiment design before students submit them for approval.
- You may wish to have a student research and report to the class on the specific challenges of driving on a light-coloured road (for example, Highway 407 north of Toronto). Research studies or reports on the temperature savings or an increase in accidents.

- Encourage students to use quantitative terms expressed in a graph or other visual to answer Analyze and Interpret question 1.
- As a class, decide how presentations will be assessed. You may wish to use the rubric below, or **BLM A-46 Presentation Rubric.**
- To assess students' process, use **BLM A-42 Design an Investigation Rubric.**

Additional Support

- DI Interpersonal learners could work in groups, while you may want to provide the option for intrapersonal learners to work independently.
- Students may find these blackline masters helpful when designing their investigations: **BLM G-10 Variables in Science, BLM G-29 Testing Scientific Ideas, BLM G-30 Developing a Hypothesis, BLM G-31 How Is an Experiment Like Baking Cookies?, BLM G-32 Experiment Checklist, BLM G-33 Experimental Design Worksheet,** and **BLM A-3 Designing an Experiment Checklist.**

Rubric

Achievement Chart Category	Level 1	Level 2	Level 3	Level 4
Knowledge and Understanding	Describes each ground cover material and how it does not interfere with land use in limited detail.	Describes each ground cover material and how it does not interfere with land use in some detail.	Describes each ground cover material and how it does not interfere with land use in considerable detail.	Describes each ground cover material and how it does not interfere with land use in thorough detail.
Thinking and Investigation	Formulates a hypothesis with limited accuracy. Executes a procedure controlling appropriate variables and using equipment and materials safely, accurately, with limited effectiveness. Analyzes and interprets data for each material to determine whether the evidence supports or contradicts initial predictions with limited accuracy. Identifies sources of error and suggests improvements to the original design in limited detail.	Formulates a hypothesis with some accuracy. Executes a procedure controlling appropriate variables and using equipment and materials safely, accurately, with some effectiveness. Analyzes and interprets data for each material to determine whether the evidence supports or contradicts initial predictions with some accuracy. Identifies sources of error and proposes suggestions for improvements in some detail.	Formulates a hypothesis with considerable accuracy. Executes a procedure controlling appropriate variables and using equipment and materials safely, accurately, with considerable effectiveness. Analyzes and interprets data for each material to determine whether the evidence supports or contradicts initial predictions with considerable accuracy. Identifies sources of error and proposes suggestions for improvements in considerable detail.	Formulates a hypothesis with a high degree of accuracy. Executes a procedure controlling appropriate variables and using equipment and materials safely, accurately, with a high degree of effectiveness. Analyzes and interprets data for each material to determine whether the evidence supports or contradicts initial predictions with a high degree of accuracy. Identifies sources of error and proposes suggestions for improvements in thorough detail.
Communication	Organizes and records data using appropriate visual and written components with limited effectiveness.	Organizes and records data using appropriate visual and written components with some effectiveness.	Organizes and records data using appropriate visual and written components with considerable effectiveness.	Organizes and records data using appropriate visual and written components with a high degree of effectiveness.

Please also see **BLM A-53 Unit 3 Inquiry Investigation Rubric.**

An Issue to Analyze
Dealing with Climate Change (Student textbook page 391)

Pedagogical Purpose

Linking change to realistic personal action is important in empowering students to surmount the huge and varied issue of climate change. This activity helps students summarize the initiatives presented in the unit, and move toward personal action. It also encourages civic involvement by having students draft a letter to an elected official.

Planning	
Time	60 to 120 min

Background

This unit covered the following actions and initiatives related to climate change:

- educate yourself (forming an opinion and confronting bias)
- calculate your carbon footprint (e.g., electricity use, plastic bags, and food miles)
- take personal responsibility
- be an advocate
- government initiatives (e.g., IPCC and Kyoto Protocol)
- reduce, re-use, recycle, and upgrade
- economic solutions (e.g., cap-and-trade systems and carbon tax)
- alternative energy sources

Activity Notes and Troubleshooting

- As a class, decide on and communicate the criteria on which products will be assessed. You may wish to use the rubric on the next page, or work together to determine the criteria for assessment.
- As an alternative to consensus building, this activity could culminate in a debate.
- Students may wish to address their letters to a local authority such as a school board member or city official, focusing on actions they could help implement locally.
- Many of the initiatives may be scored differently based on subjective assignments of cost and benefit. Ensure students support their ranking with notes.
- Students may have difficulty coming up with ways that they can help or implement a particular initiative (such as a cap-and-trade system). Open the topic to class discussion about which stakeholders could contribute.
- Students can be challenged to research initiatives and actions that were not addressed in class (e.g., water conservation, land use planning, etc.). They can develop a mini-presentation on the initiative and how it would affect climate change.

Additional Support

- DI ELL This is an excellent activity for peer-tutoring and interpersonal learners.
- DI Interpersonal learners could collect signatures on a petition to share their findings with a larger audience.
- ELL Allow English language learners to select an alternative format for presentation such as video recording or multimedia display.

- Have students with different learning styles work in groups to create an informational pamphlet to distribute to other classes or to their families. Ensure that each student contributes to the final product.
- Have students develop key visuals to match and support their findings. This could become an appendix attached to their letter or an additional deliverable covered in the class-developed rubric.

Rubric

Achievement Chart Category	Level 1	Level 2	Level 3	Level 4
Knowledge and Understanding	Prepares a list of actions and initiatives related to climate change with limited accuracy.	Prepares a list of actions and initiatives related to climate change with some accuracy.	Prepares a list of actions and initiatives related to climate change with considerable accuracy.	Prepares a list of actions and initiatives related to climate change with a high degree of accuracy.
Communication	Includes information from a variety of sources using an accepted form of academic documentation with limited effectiveness. Organizes and communicates information for the intended audience and purpose with limited effectiveness.	Includes information from a variety of sources using an accepted form of academic documentation with some effectiveness. Organizes and communicates information for the intended audience and purpose with some effectiveness.	Includes information from a variety of sources using an accepted form of academic documentation with considerable effectiveness. Organizes and communicates information for the intended audience and purpose with considerable effectiveness.	Includes information from a variety of sources using an accepted form of academic documentation with a high degree of effectiveness. Organizes and communicates information for the intended audience and purpose with a high degree of effectiveness.
Application	Applies evidence from cost-benefit analysis when making recommendations with limited effectiveness. Identifies two personal contributions to support the recommendations with limited accuracy. Surveys personal opinions of classmates prior to selecting an action or initiative with limited effectiveness. Summarizes multiple perspectives on the action related to cost, implementation and enforcement with limited effectiveness.	Applies evidence from cost-benefit analysis when making recommendations with some effectiveness. Identifies two personal contributions to support the recommendations with some accuracy. Surveys personal opinions of classmates prior to selecting an action or initiative with some effectiveness. Summarizes multiple perspectives on the action related to cost, implementation and enforcement with some effectiveness.	Applies evidence from cost-benefit analysis when making recommendations with considerable effectiveness. Identifies two personal contributions to support the recommendations with considerable accuracy. Surveys personal opinions of classmates prior to selecting an action or initiative with considerable effectiveness. Summarizes multiple perspectives on the action related to cost, implementation and enforcement with considerable effectiveness.	Applies evidence from cost-benefit analysis when making recommendations with a high degree of effectiveness. Identifies two personal contributions to support the recommendations with a high degree of accuracy. Surveys personal opinions of classmates prior to selecting an action or initiative with a high degree of effectiveness. Summarizes multiple perspectives on the action related to cost, implementation and enforcement with a high degree of effectiveness.

Please also see **BLM A-54 Unit 3 Issue to Analyze Rubric.**