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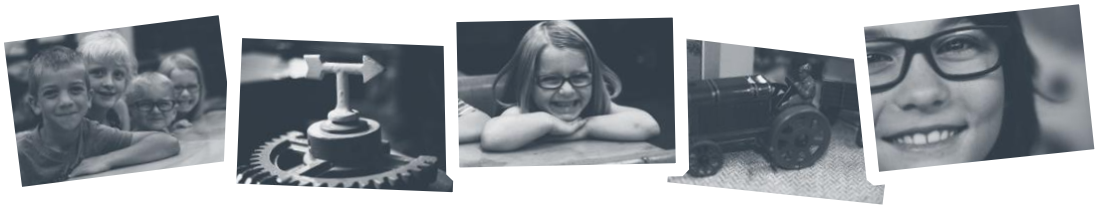

SMARTER SCIENCE BETTER BUILDINGS PROGRAM EDUCATOR MANUAL

Brief Description

In 2010, the WDM Saskatoon agreed to display a net zero home as an exhibit for one year. A net zero home produces as much energy and electricity as it uses each year. It does this by being highly energy efficient and by producing energy with solar panels placed on the south side of the home. While the home was on display, the WDM, Saskatchewan Environmental Society (SES), Vereco Homes and educators from Saskatoon Public Schools worked together to design a school program about energy efficient buildings that included a tour of the home.

When the net zero home left the Museum in 2011, the WDM and SES began work to redesign the program so they could continue to educate students about energy efficient buildings. In 2013, the program was piloted at the WDM Saskatoon and, in 2014, the program was offered at all four WDM locations. In 2014, Smarter Science Better Buildings was recognized by the Regional Centre for Expertise on Education for Sustainable Development - Saskatchewan for promoting sustainable education.

The program is made up of two components. In the first component, students explore six workstations designed around various themes related to sustainability and energy efficiency. These hands-on workstations encourage students to think and talk about energy efficiency and sustainable living.

The second component consists of a museum gallery visit with guiding questions. Students, and their chaperones, are provided guiding questions and a map that takes them to various exhibits in the Museum galleries and to look at the Museum building. The questions ask students to take a close look at historical examples of energy efficiency, or inefficiency, compare what they see to modern buildings, and consider what can be learned from examples from the past.

The program is updated every five years to keep it up-to-date and to include new technologies.

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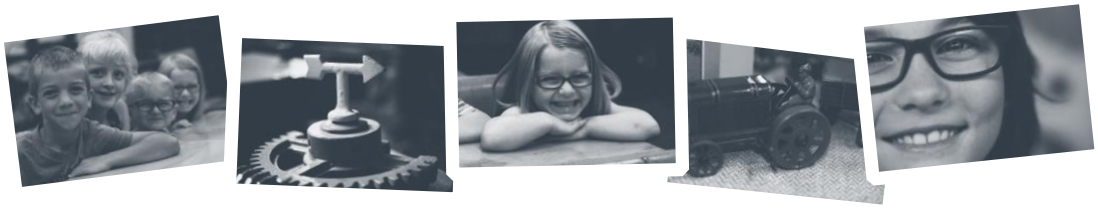

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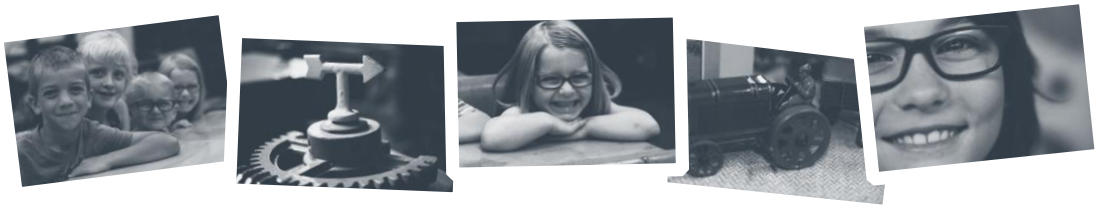


Curriculum Connections and Program Goals

Grade 7

Science

Curriculum Connection HT7.1: Assess the impact of past and current heating and cooling technologies related to food, clothing, and shelter on self, society and the environment.
Program Goal: By exploring the hands-on workstations and touring museum exhibits, students will see and experience examples. Through answering questions and reflection, they will learn how heating and cooling choices have impacts for the present and future.

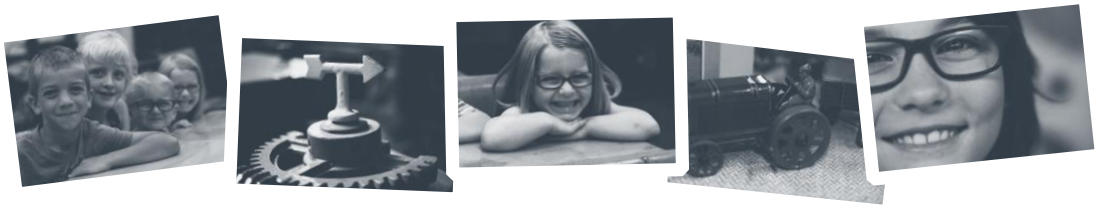
Curriculum Connection HT7.3: Investigate principles and applications of heat transfer via the processes of conduction, convection and radiation.
Program Goal: Through examples on the hands-on workstations and the pre-visit video, students will learn about these processes. Guiding questions and exploration of workstations will assist students in this learning.

Curriculum Connection IE7.4: Analyze how ecosystems change in response to natural and human influences and propose actions to reduce the impact of human behaviour on a specific ecosystem.
Program Goal: Through the guiding questions and information provided on the workstations, students will learn about ways to reduce human impact on the environment and what influence they can have.

Social Studies

Curriculum Connection IN7.2: Examine the effects of globalization on the lives of people in Canada and in circumpolar and Pacific Rim countries.
Program Goal: Through the pre-visit video and hands-on workstations, students consider where building materials come from and how this impacts the environment.

Curriculum Connection IN7.3: Analyze the relationship of technology to globalization.
Program Goal: In the pre-visit video students learn about sustainable development. This includes recognizing how the ability to live sustainably is influenced by the economic and/or political conditions in which people live and that they may not have access to the latest technology.



English Language Arts

Curriculum Connection CC7.1: Create various visual, oral, written and multimedia texts that explore identity, social responsibility and efficacy.
Program Goal: The guiding questions for the hands-on workstations and museum exhibits provides students and opportunity to discuss and record their observations about sustainability and energy efficiency.

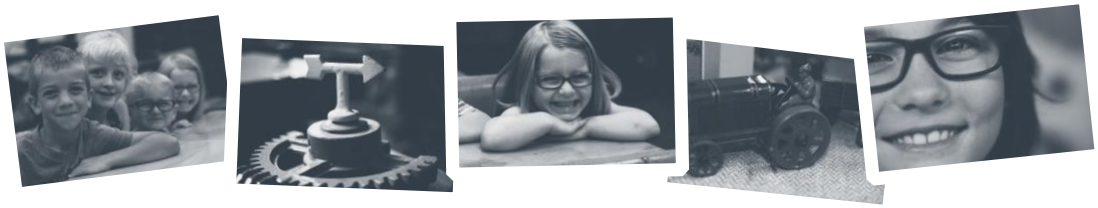
Arts Education

Curriculum Connection CP7.12: Use image-making skills, tools, techniques, and problem-solving abilities in a variety of visual art media.
Program Goal: Students will interact with hands-on components of the workstations and will record and illustrate their findings in their student package.

Math

Curriculum Connection P7.1: Demonstrate an understanding of the relationships between oral and written patterns, graphs and linear relations.
Program Goal: As students explore the hands-on workstations, they will see examples of patterns and linear relations with the goal of learning new information while reviewing them.

Curriculum Connection SP7.2: Demonstrate an understanding of circle graphs.
Program Goal: A number of circle graphs are in the hands-on workstations which provides students an opportunity to review and discuss the information provided.



Pre-Visit Resources and Preparation

Smarter Science Better Buildings offers your students an educational and entertaining way to learn about energy efficient buildings. To make your visit more enjoyable and productive, we have included a list of instructions and suggestions. Before attending the program, please familiarize yourself and your chaperones with the program instructions.

Resources

The Smarter Science Better Buildings program is made up of six workstations and a tour of Museum exhibit buildings and related artifacts.

The WDM website, https://wdm.ca/for_teachers/smarter-science-better-buildings/ contains a 12-minute Smarter Science Better Buildings video. It provides an introduction to the program and an overview of the concepts of heat and temperature. Please watch the video with your students before your visit to prepare them for the concepts discussed in the program.

Review the vocabulary list of key terms that will be used in the program. The vocabulary list can be found in this manual in Appendix A.

A copy of the program introduction can be found in Appendix B.

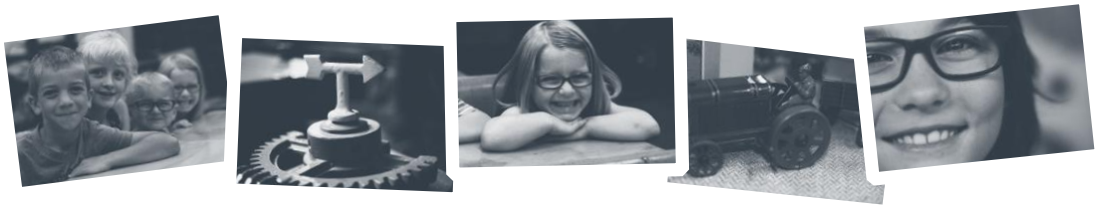
A list of additional resources can be found in Appendix C of this manual.

Preparing for your visit

Before your visit, divide your class into **six groups**. Please make these groups as equal in size as possible. Each group should, ideally, have no more than six or seven students. If you have a larger class (more than 40 students), please consult with Education staff to determine how to best divide your students into groups.

It is highly recommended that you bring adult chaperones to assist with student supervision. Chaperones are admitted free of charge at a ratio of 1 adult per 5 students. Chaperones for children with significant needs are allowed at a 1:1 ratio at no charge.

Print copies of the student package which includes the program guiding questions. You will need six packages or one per group if the students are working together. You may also choose to print one package per student if you prefer each student to record their answers. Copies can be found at: https://wdm.ca/for_teachers/smarter-science-better-buildings/, then scroll down and click on the Student Package for the location that you will be visiting. Be sure to get the package for your location, as they contain location-specific information. Bring a clipboard and pencil for each group.



Program Visit

Groups will be greeted by WDM staff when they arrive.

The program involves two components of approximately 50 minutes each. Component one involves students investigating themed workstations. The second component consists of a visit to the Museum galleries with guiding questions to look at exhibits relating to energy efficiency and sustainable living. Please note that with larger groups, half of your students will start on the workstations while the other half starts in the Museum galleries. After 50 minutes, these groups will switch places.

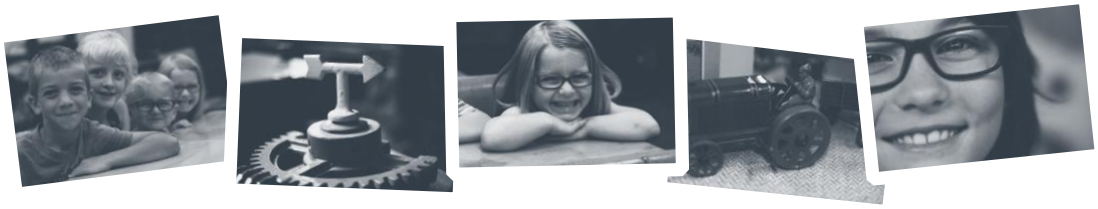
Component One – Hands-On Workstations with Guiding Questions

The workstations are designed to discuss six themes. Students will explore each workstation by answering questions about the themes.

Workstation Themes

- Heating and cooling
- Model of a net zero home
- Lighting and appliances
- Water conservation
- Solar
- Home retrofits

Net Zero Home workstation



Each workstation is designed to highlight these three areas:

- General information (centre panel)
- Innovative technology and design (left panel)
- Making changes in our homes (right panel)

Guiding questions (like the example on the right) can be found at each display and in student packages to help focus student investigations. A list of display topics appears below. The guiding questions do not cover all topics and you may want to ask students to focus on specific areas to help them generate inquiry questions for further research. Students will have about eight minutes at each station.

Workstation Details

Below are some of the topics and questions featured in the workstations:

Heating and Cooling

General information

- How heat moves – definitions of conduction, convection, radiation
- How radiant floor heating works

Innovative technology and design

- Lifecycle of cellulose insulation
- Heat pumps – how they move heat energy
- Furnace efficiency – comparing modern heating to the past
- okáwímá askiy míkwahp - Mother Earth Dwelling project

Making changes in our homes

- Reducing energy use by lowering the thermostat

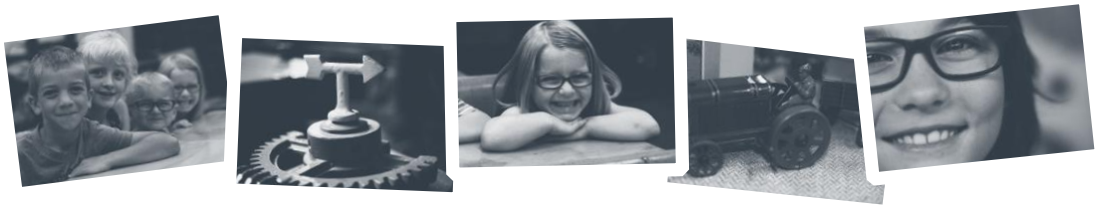
Net Zero Model Home

General information

- What is net zero? Definitions of reduce, reuse, replace
- What has history taught us about good design?

Innovative technology and design

- Building Envelope
- Canada's National Energy Code



- Double wall construction. Model of a wall with separate pieces of insulation to install

Making changes in our homes
- The connection between energy efficient homes and climate change
- Moving closer to net zero
- Q = A x ΔT/R: Adjusting home size, temperature and insulation values to change energy use
- Renewed use of cisterns

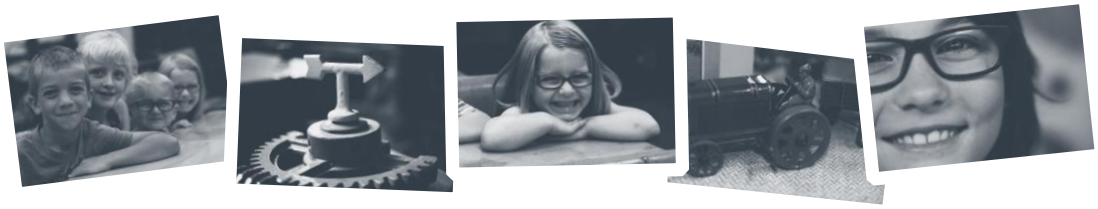
Lighting and Appliances
General information
- Electricity use of an average Saskatchewan home compared to a net zero home
- Where Saskatchewan's electricity comes from
- How electricity is used in Saskatchewan homes
- Net zero use of electricity - reduce, reuse, replace
- How lighting works - display of different lamps and their energy use

Innovative technology and design
- Daylighting - mirror ducts, light shelves and light pipes
- Gym lighting retrofit shows reduced power use
- Smart Power Bars - reduce phantom load

Making changes in our homes
- Reading an EnerGuide label
- What is Energy Star®?
- Audits Turn out the lights
- Drying clothes outside

Water
General information
- Daily water use per person comparison between Saskatchewan and the United Kingdom
- How water is used in Saskatchewan homes
- Logan Green Water Management System in Yorkton
- Water saving showerheads and aerators
- Water use in toilets - old tank compared to new 2 button flush tank

Innovative technology and design
- Water treatment process



- Rainwater system
- Drain water heat recovery with example pipe

Making changes in our homes
- Rain barrels, reducing lawn watering and shower water use

Solar

General information
- Solar Energy - light and heat
- Solar photovoltaic panels
- Solar panels on typical Saskatchewan home compared to a net zero home
- Average annual hours of sunshine

Innovative technology and design
- Passive solar design
- Solar panels
- Buildings that generate power

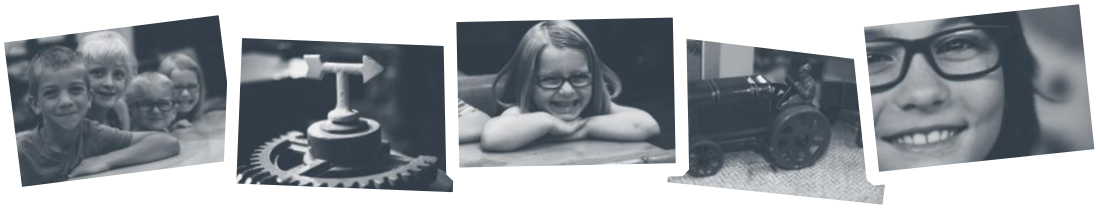
Making changes in our homes
- Solar evacuated tubes
- Pesâkâstêw Solar Project
- How we use solar panels

Retrofits

General information
- Timeline of homes and energy ratings/energy use
- Innovative window design

Innovative technology and design
- A real retrofit – energy retrofit of insulation, heating system and windows
- A deep retrofit – add solar panels, seal air leaks, upgrade to heat pump
- EnerGuide Rating System

Making changes in our homes
- Window shades to keep heat and cold out
- Saskatchewan heritage schools energy upgrades



Component Two - Museum Gallery Visit with Guiding Questions

The Museum gallery visit allows students to look at historical examples of building efficiency and inefficiency. Students are asked to answer questions about these exhibits and to think about how buildings were designed in the past and how we can learn from them. The Museum building itself may also be included in the questions.

Students will visit the following at each WDM location.

WDM Moose Jaw
Explore the Railway Station and other exhibit buildings as well as the *100 Years of Saskatchewan History* exhibit.

WDM North Battleford
Explore selected buildings in the Heritage Village as well as the *100 Years of Saskatchewan History* exhibit.

WDM Saskatoon
Explore the Sod House, First Nations Log House, Eaton's Catalogue House and other displays within the *A Saskatchewan Story* exhibit. If time allows, you can also visit the Fueled by Innovation exhibit.

WDM Yorkton
Explore the Settlers Cabin, Showcase Room exhibits as well as the *100 Years of Saskatchewan History* exhibit.

Each group of students should have at least **one** copy of the guiding questions. The guiding questions are part of the student package available on the WDM website at: https://wdm.ca/for_teachers/smarter-science-better-buildings/

A map is included in the student package to guide groups through the exhibits.

Teachers and/or chaperones are responsible for the supervision of students during the visit. This may mean that the six smaller groups will be joined into one larger group.

Students will work their way through the Museum exhibits, answering questions provided and discussing what they see. Energy ratings are displayed near each exhibit building. Is the energy rating what you would expect for those buildings? Have students identify where air would leak into homes and where heat would be lost. As students visit the exhibits, have them compare the exhibit buildings to each other. What factors make some of the buildings more energy efficient than others? What factors make modern buildings more or less energy efficient than these buildings?

Post-visit, in-classroom discussion

If you have time once back in your classroom, discuss with your students their guiding question sheets. Ask students to consider the following questions:

- Name some things that were new to you. What technologies were interesting?
- Would you like living or working in any of the buildings or spaces you saw in the Museum?
- Which buildings would be more energy efficient and why?
- What are inexpensive things you can do to make buildings more energy efficient?

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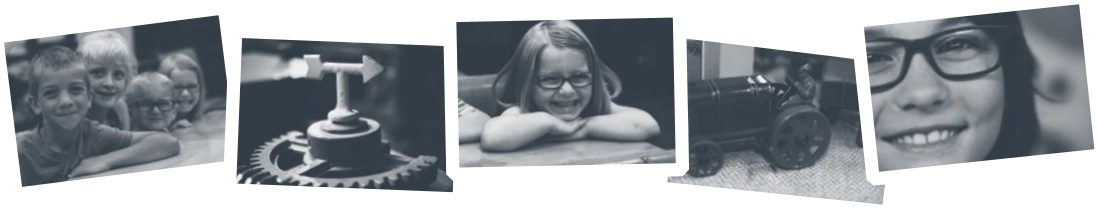
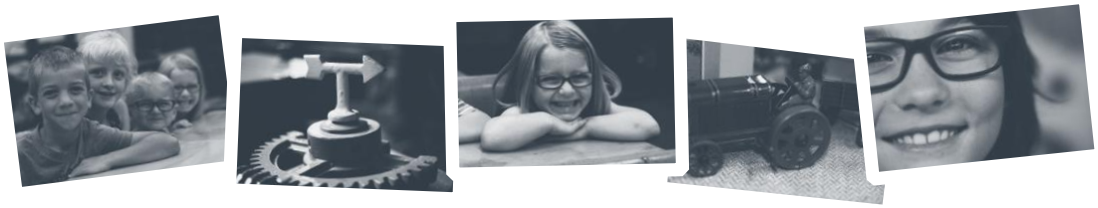


Teacher Feedback Survey

We are always working to improve our education programs. Your valued feedback helps us decide which features to build and what improvements we can make. To help us make this program the best it can be, we need your input. Please take a few minutes and complete the survey below.

SURVEY LINK: https://forms.office.com/r/17PFtdnjca



Appendix A – Vocabulary

Building Envelope – The walls, roof, windows, doors and the foundation of a building. It separates the inside environment from the outside environment.

Climate Change – The long-term shifts in temperatures and weather patterns that can be caused by human activities such as burning fossil fuels and by natural occurrences such as volcanic eruptions or the changes in the sun's activity.

Cistern – A large concrete, stone or plastic container that stores collected rainwater from the eavestroughs of a house for later use.

Conduction – Heat that moves through materials that are touching. For example, metal such as copper is good at conducting heat.

Convection – The transfer of heat energy that happens when heated gas or liquid particles move from one location to another. Convection is driven by temperature changes.

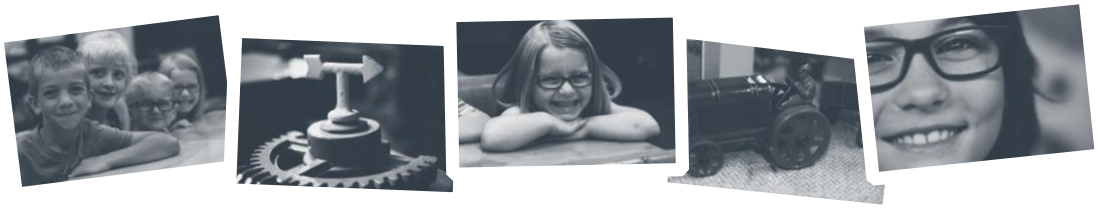
Drain Water Heat Recovery – Warm wastewater from, for example, a shower flows down the drain and clean cool water flows through copper pipes that wrap around the drain. The drain water's heat is conducted through the copper pipes which pre-heats the clean water on its way to the shower. Drain Water Heat Recovery (DWHR) can capture 40-75% of drain water heat.

Eaton's Catalogue House – A mail-order house that was purchased through the T. Eaton Company catalogue. In the early 20th century, house plans and materials were ordered and shipped to the purchaser so they could build a house themselves. This was advantageous for early settlers who did not live near stores or lumber yards.

EnerGuide Rating System (ERS) – Rates the energy efficiency and performance of a home. This system has been developed by and is regulated by the Government of Canada.

ENERGY STAR® - An international symbol of energy efficiency. Products with this label meet or exceed high standards of energy efficiency.

Greenhouse Gas Emissions – Certain gases like carbon dioxide or methane that are released into the atmosphere when burning fossil fuels. These gases trap heat and act like a blanket wrapped around the earth causing temperatures to rise.



Heat Pump – A heating/cooling system that uses the process of thermal energy transfer to warm or cool a building by using the refrigeration cycle. A heat pump can move heat from a cooler space to a warmer space.

Insulators – A substance or device that resists heat transfer.

National Energy Code for Buildings (NECB 2020) – A set of rules that regulate how we build for safety and energy efficiency.

Net Zero Home – A home that produces as much energy and electricity as it uses over the course of a year.

Passive Solar Design – The use of the sun's energy to heat and cool living spaces by exposure to the sun.

R Value – The measurement for how well something insulates against heat loss or gain or resists the movement of heat.

Radiant Floor Heating – A heating or cooling system that can be installed in the floor, wall or ceiling. It is dependent on radiant heat transfer or the delivery of heat directly between a heated surface and the people and objects in the room via radiation. It is more efficient than baseboard or forced air heating.

Radiation – Heat energy that moves through space in waves.

Rainwater System – A method of collecting and storing rainwater for use in your home.

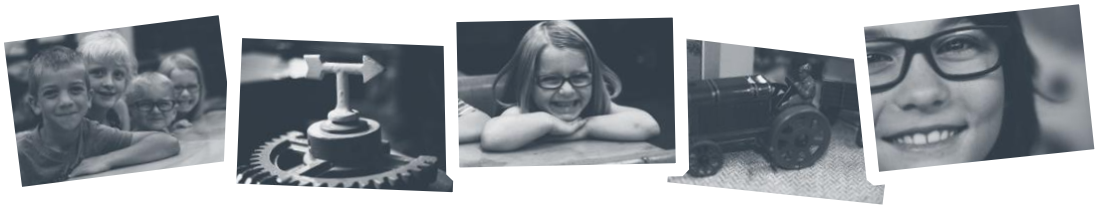
Solar Evacuated Tubes - Converts the energy of sunlight into heat that can be used for water or home heating.

Solar Panels – A panel designed to absorb and convert the sun’s rays into a source of energy.

Sustainably Made – The energy needed to produce or create an item is lower than typical methods; and the item can be made from renewable or recycled sources; and it can be recyclable or recoverable at the end of its life.

Thermal Bridging – An area where there is more heat transfer than the areas near it. This is normally caused by a gap in insulation, or by a lower R-value material with higher R-value materials around it.

Thermal Mass or Heat Capacity – The ability of a material to store heat. High thermal mass material takes a long time to heat up and to cool down, regulating the temperature in a building.



Appendix B – Program Introduction Script

Do you know what a net zero home is? A net zero home is one that produces as much energy and electricity as it uses each year. It does this by being highly energy efficient and by producing energy with solar panels placed on the south side of the home. Is your home like this? Do you think there are things you can do in your home to make it more energy efficient?

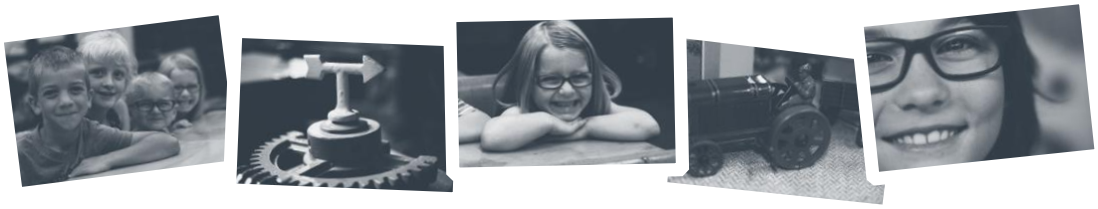
Today, you will be exploring six workstations that focus on how a net zero home uses energy efficiently and generates the energy it needs. The displays also show innovative technologies to help us build better, smarter buildings. While you are at each workstation, use the guiding questions to help you focus your investigations. Take some time to read the information and examine the technologies. You can touch these displays, but treat them respectfully. You will have eight minutes at each workstation. We will use a timer and when it beeps, your group will move to the next station.

You will also be visiting some of the exhibit buildings at the Museum, as well as some of the other exhibits that center around generating electricity or using energy efficiently. While you are touring the Museum's exhibit buildings, use the guiding questions to guide your groups' discussion. Buildings in the Museum are full of artifacts that should not be touched. Stay with your group on the tour and return to the room when you are done (about 50 minutes).

There is a connection between the workstations and the exhibit buildings in the Museum. Throughout history, people in Saskatchewan have been using local, natural materials to build their homes, and to try to keep themselves comfortable through long, cold winters and hot summers. These people learned a lot about how to be energy efficient with what they had. Now we know many things about how both natural and synthetic materials can be used to save energy in our buildings. A tool we use to measure a building's energy efficiency is the Energy Rating System. (Show photo on the right of the Energy Rating System.) One way to determine this is to have a blower door test done.

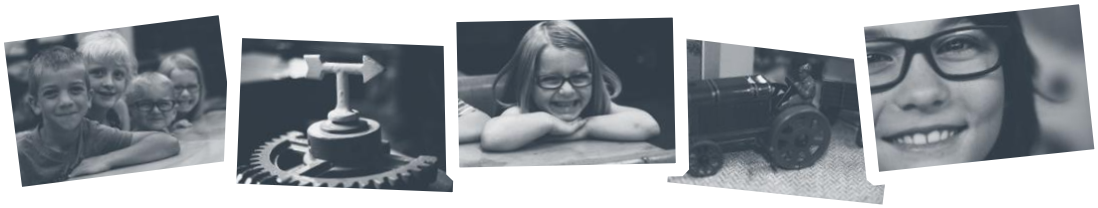
Have any of you had a blower door tests done in your own home?

A blower door test helps to show where heat is escaping your home and where cold air is getting in. It shows you where you can make changes to improve the energy efficiency of your home.



The WDM had Sun Ridge Residential rate the energy efficiency of many of its historical buildings. When you tour these buildings, you can compare their efficiency to the modern buildings that are included in the workstations. Try to figure out why they are efficient or inefficient. There are other exhibits at the Museum that connect to energy efficiency – your guiding questions will lead you to them.

Remember, the workstations are made to be explored and touched respectfully. The Museum exhibits are not to be touched.



Appendix C – Additional Resources

Western Development Museum - program application, introductory video and additional resources - wdm.ca/for_teachers/smarter-science-better-buildings/

Information about WDM exhibits:
WDM North Battleford's Farm House & Village - wdm.ca/exhibits/heritage-village/
WDM Saskatoon's Sod House - wdm.ca/exhibits_articles/sod-house/
WDM Yorkton's Settler's Cabin - wdm.ca/exhibits_articles/log-home/
WDM Yorkton's Showcase Rooms - wdm.ca/exhibits/showcase-rooms/

Saskatchewan Environmental Society - Free lesson plans, audits and campaigns, program information and additional resources - https://environmentalsociety.ca/resources/teachers/

SaskEnergy - https://www.saskenergy.com/ways-save

SaskPower - saskpower.com/Power-Savings-and-Programs

Government of Canada - natural-resources.canada.ca/energy-efficiency/homes/what-energy-efficient-home/20548

Government of Canada - natural-resources.canada.ca/energy-efficiency/homes/make-your-home-more-energy-efficient/20550

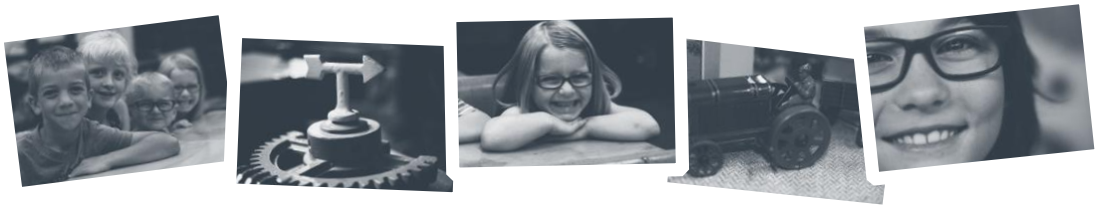
National Energy Code of Canada for Buildings 2020 - publications.gc.ca/site/archivee-archived.html?url=https://publications.gc.ca/collections/collection_2022/cnrc-nrc/NR24-24-2020-eng.pdf

The Vereco Homes – Their website shows the various projects and types of homes they are now producing. Vereco.ca

The Vereco Home - okáwímá askiy míkwahp (Mother Earth Dwelling project):
https://www.vereco.ca/communityprojects

Saskatoon Water Treatment Plant - saskatoon.ca/services-residents/power-water-sewer/wastewater/wastewater-treatment-plant

Yorkton - Logan Green Water Management System - yorkton.ca/en/your-city/resources/Documents/LOGAN-GREEN-WATER-MANAGEMENT-SYSTEM.pdf



Annual Hours of Sunshine - currentresults.com/Weather/Canada/Saskatchewan/average-saskatchewan-weather.php

Pesâkâstêw Solar Project - pesakastewsolarproject.ca/

Solar Wall by Conserval Engineering - solarwall.com

EnerGuide® Home Evaluation - nrcan.gc.ca/energy-efficiency/energuide-canada/energuide-energy-efficiency-home/after-your-energuide-home-evaluation/20572

Forest Stewardship Council Canada (FSC lumber) – fsc.org/

Recycle Saskatchewan website - recyclesaskatchewan.ca

Saskatchewan Waste Reduction Council website - saskwastereduction.ca

Last updated: October 2024