Smarter Science Better Buildings
Western Development Museum - North Battleford

Explore Jakob Marjan's Shoe Repair Shop, the McLaren Family Farmhouse, and the Schoolhouse as well as the *100 Years of Saskatchewan History* exhibit.

Students will work their way through the Museum exhibits, answering the questions provided and discussing what they see. Students will explore three Museum exhibit buildings. Have students identify where air would leak into the homes and where heat would be lost. As students tour 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 either more or less energy efficient than these buildings?

MOVE TO JAKOB MARJAN'S SHOE REPAIR SHOP

This brick building was the business of Jakob Marjan. Jakob was a shoemaker who immigrated to Saskatchewan from Europe. In 1931, he asked for this little building to be built in North Battleford so he could run a shoe repair shop. His business was open on Railway Avenue for 37 years. Both Jakob and his wife, Leokadia, were very active in the community. Jakob's family still lives in North Battleford today.

In 1991, the WDM saved Jakob's brick shoe repair shop from demolition and made it part of the Heritage Farm and Village.

Saskatchewan has a long history with brick as a building material. The Claybank Brick Plant manufactured bricks made from clay found onsite from 1914-1989. These bricks were used in the construction of several well-known buildings, including the Bessborough Hotel in Saskatoon and on NASA's rocket launch pads at Cape Canaveral.

DO NOT enter this building. Examine the building from the outside as you read the questions below.

The answers to the questions below are given to students so that they can compare with the next building they will visit.

1. Estimated thickness of the walls: **8 inches of brick and 1 inch of stucco**

2. Places where heat would escape from this building:
   1. **Under and around the front door**
   2. **Around windows**
   3. **Through the roof (there is no insulation)**
   4. **Through the walls (there is no insulation)**

3. How many windows does the brick shop have? **The shop has 3 windows.**

4. Think about the thickness of brick when compared with the thickness of wood. Do you think a building made of brick keeps the building warm better or worse than a building made of wood? Why or why not? **Although these bricks are thicker than a typical wood frame wall, brick does not insulate well. That means that the heat can move through the walls easily and escape the building.**

5. Look through the windows. Can you see the pipe hanging from the ceiling and the brick outline on the wall? They are the leftover parts of the machine that would have been used to heat the shop. What type of machine do you think it would have been? Can you guess what would have been the fuel source for this type of machine? **The shop was heated by a stove. Wood would have been used as the fuel source.**

6. As a business, the door of Jakob's shop would have been frequently opening and closing. How would this impact energy efficiency when compared with a home? **Energy is lost each time the door opens. The door opens and closes more frequently in a shop than a home. More wood would have needed to be chopped to keep the building warm in winter. In summer, the breeze coming through the door would have helped to cool the building.**

7. Compared to many businesses today, Jakob's shop is very small. If we are trying to conserve energy, what are some helpful things about a smaller building? **Not as much energy is lost or wasted heating the building in winter, it is easier to get air and heat to cycle through the building.**

MOVE TO THE MCLAREN FAMILY FARMHOUSE

The farm home of the McLaren family of Rockhaven was built in 1914 and donated to the WDM in 1987. The house was not wired for electricity.

Prior to 1949, about one percent of Saskatchewan's farms had electricity. A few communities, like North Battleford, had electricity but it was considered a luxury enjoyed by city dwellers. In the 1950s and 1960s, electricity came to many rural areas.

1. Estimate the thickness of the walls: **10-15.5 cm (4-6 inches)**

2. Find two of the places where heat would escape from this building:

   1. **Under & around doors**
   2. **Around windows, around chimney**
   3. **Through the attic space as there is no insulation.**
   4. **Through the walls**

3. How was this home heated? **A wood or coal stove**_____

4. What could have provided light for this house? **daylight through windows,**

   kerosene or coal oil lamp

5. How many panes of glass are in the windows? **1 (single pane)**

6. List three things in this building that did not use electricity in the 1920s, but today might require electricity.
   1. **Stove/oven, ice box/fridge**
   2. **Lighting**
   3. **Clocks, phone, sewing machine, washrooms**

COMPARE THE FARMHOUSE AND JAKOB MARJAN'S SHOE REPAIR SHOP

Let's compare Jakob Marjan's Shoe Repair Shop and the McLaren Family Farmhouse now that we have looked at both buildings in the Heritage Farm and Village.

Which building is more energy efficient? Think about the size of the buildings, thickness of the walls, number and size of windows, type of heat, etc. Explain your choice.

Students can provide their own answer based on what they've seen in each of the houses.

1. List the materials that were used to build this building. Where would local builders get these materials? **Wood siding, shingles and walls. Stone foundation. The foundation materials may have been found locally. Wood may have been found locally from sawmills in northern Saskatchewan. If local wood wasn't available, it may have been shipped by rail from larger cities. Windows were likely purchased from a local hardware store or shipped from a larger city.**

2. Estimate the thickness of the walls: **10-15.5 cm (4-6 inches)**

3. Find two of the places where heat would escape from this building:

   1. **Around the door or when the door opens (bathroom breaks!)**
   2. **Around windows**
   3. **Through the roof and through the walls**

4. How was this building heated? **wood burning stove**

5. What provided light for this building? **daylight through windows, kerosene lamp**

6. How many windows are in the Schoolhouse? **8**

   How many panes of glass are in each? **1**

7. List three things in this Schoolhouse that did not use electricity in the 1920s, but in your classroom today might require electricity:
   1. **Pencil sharpener**
   2. **Blackboard (if classroom has an interactive white board/ Smart Board)**
   3. **School Bell, heat/cooling system, lights, washroom…**

COMPARE THE SCHOOLHOUSE WITH YOUR SCHOOL

The Museum's schoolhouse was built in the 1920s. Let's compare it with your school building today.

Which building is more energy efficient? Think about the size of the schools, thickness of the walls, number and size of windows, type of heat, etc. Explain your choice.

_____

Students can provide their own answer based on what they've seen in the schoolhouse

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MOVE TO the *100 YEARS OF SASKATCHEWAN HISTORY* EXHIBIT

Traditionally, nomadic Indigenous groups used easily transportable tipis or tents. Tipis were constructed, owned and set up by women. Women erected the tipis by constructing a framework of 15-17 wooden poles upon which a covering of 12-20 hides,

usually buffalo, was overlaid and held in place using pegs. Smoke flaps near the top allowed for smoke to escape from the fire that was built within for cooking and heat. The tipi was waterproof, windproof, warm in winter and cool in summer, and portable - all important attributes to support a nomadic lifestyle in a changing climate.

Imagine you are standing in a real tipi.

1. Why do you think tipis were warm in the winter? **As tipis were not very big they were easier to heat. A small fire could be built inside to keep it warm. Tipis were made of animal hide, often buffalo, that was overlapped. By overlapping the animal hide it would prevent gaps where heat could be lost.**

2. Which home do you think would be more comfortable in the winter – a tipi covered in buffalo hides or a wooden farmhouse? Explain your choice.

   _____

   Student answer.

   _____

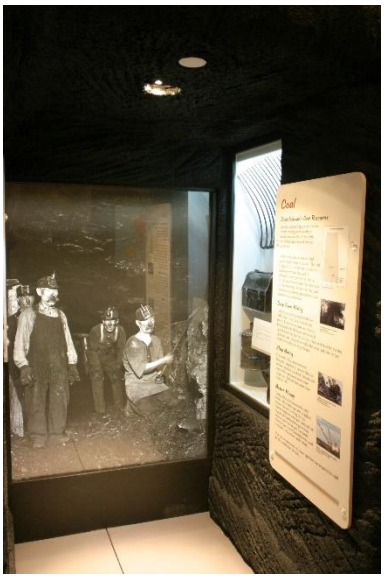
   _____

   _____

Natural Resources

Near the tipi is an exhibit about natural resources in Saskatchewan.

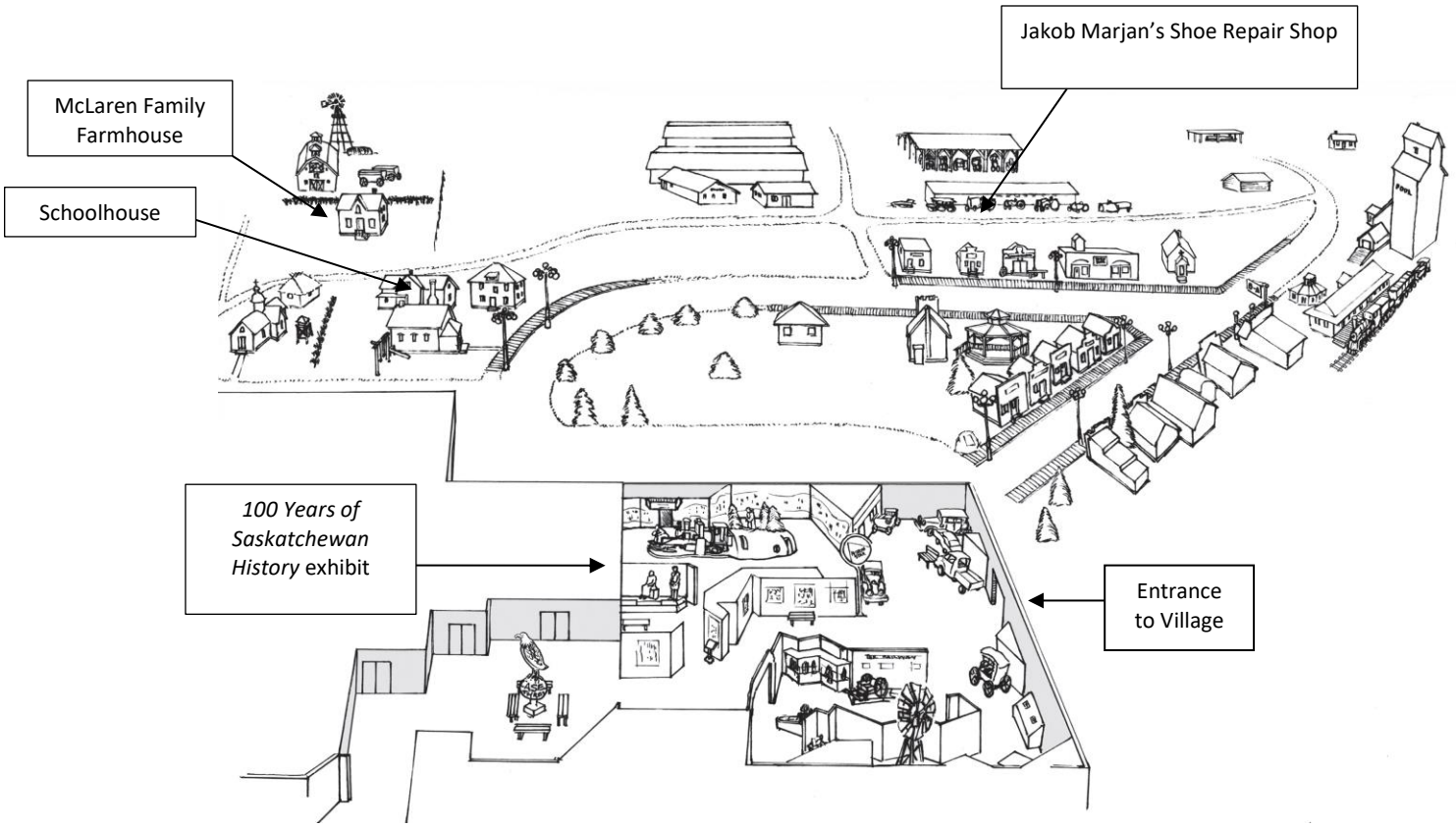
Few places have been blessed with the richness of natural resources that Saskatchewan enjoys. Beneath our feet are natural resources such as coal, oil and natural gas. For many years we have used these natural resources to heat our homes. These natural resources are called non-renewable resources meaning that we cannot replenish them once they are gone. Solar and wind power are called renewable resources. In Saskatchewan we are starting to see the use of more renewable resources. For example, the visitor centre at Fort Battleford has solar panels on the roof and a wind turbine to provide power to the building.



Enter the mine door when the light above the door is green. Make your way to the Coal display.

1. What is most of Saskatchewan's coal used for? _**To create power.**_____

2. What are modern mine operators required to do after they have removed all the coal from the ground? **They are required to back fill or replace the earth that was removed so that the land can be used again.**


Jakob Marjan's Shoe Repair Shop
McLaren Family Farmhouse
Schoolhouse
100 Years of Saskatchewan History exhibit
Entrance to Village

Workstation Guiding Questions – Answer Key

BUILDING MATERIALS

Spend some time looking over the materials at the display. Use these questions to help focus your investigations.

1. Why is it important to consider the whole **life cycle of building materials**? Describe how this information could affect how we choose products?

   The energy and resources that go into making materials contribute to how sustainable they are. Knowing about how a product is made from raw materials through manufacturing, transportation and what happens to a product at the end of life, helps us decide whether this is a product we want to use, or one that we should avoid. Example: concrete is made locally, but uses a lot of energy in production. Materials that are recycled or are recyclable when they are at the end of life, are better for the environment. No product is perfect, we need to make informed choices.

2. How do materials that have a high **R value** increase the energy efficiency of a building?

   R value refers to the ability to resist heat loss. High R value means that less heat will be lost from the building.

3. Name one **social, environmental or economic benefit** of building an energy efficient home.

   Student choice. Social benefits include that the home is comfortable, affordable, low voc products improve air quality, construction jobs are good jobs, etc. environmental benefits include that the house has a small footprint, uses resources responsibly, reduces waste and harm to surroundings, supports new energy efficient technologies. Economic benefits include that the cost of products is paid back over time by energy savings, supports new energy efficient technologies and companies, local, well paid construction jobs.

4. Check (✓) **sustainable building materials**, and for one item, explain why you chose it.

Vinyl flooring	Polyurethane insulation ✓	Concrete board siding ✓
Reclaimed or FSC wood ✓	Granite countertops	Triple pane windows ✓
Metal roofing ✓	Straw bale insulation ✓	Other:

Item:_____

Why I would choose it: students might name durability, recyclable at end of life, renewable source of materials or local vs. material coming from a great distance

5. In **Saved from the Landfill**, 67,436 tonnes of material kept out of the landfill equalled 95% of the weight. What was the weight of the material that went to landfill (5%)?

   $\frac{67{,}436 \text{ tonnes}}{95} = \frac{x}{5} = 3549 \text{ tonnes}$

RETROFITS

Spend some time looking over the materials at the display. Use these questions to help focus your investigations.

1. Compare the **EnerGuide® ratings** of the historical and modern houses. What factors helped the older homes use less energy? What factors help the modern homes use less energy?

   Students compare ratings in display. Smaller houses use less energy. Small windows lose less energy. Better insulation and windows, fewer air leaks help the new ones use less.

2. Test the **window display**. Which types of glass allow more heat to escape? Which kinds keep more heat in and how does their construction contribute to this?

   Window with HP coating loses less heat than clear 3 pane window. Display shows a number of factors that reduce heat loss- durable materials, multiple panes, coatings, inert gas, warm edge spacers, air tight.

3. Do you have a **programmable thermostat** in your home? Program this one to the suggested setting and then consider doing the same thing in your home. How would it help you save energy?

   Yes or no, or I don't know. It helps to save energy by remembering to turn down the heat for you. The programmed thermostat will reduce or increase heat on the schedule you program.

4. Try out the home retrofit samples like **weather stripping, pipe and wall place insulation**. Which retrofits would be useful in your home and where would you use them?

   Student choices.

5. Insulating the basement/foundation of the **1970s Split-Level** home will reduce the home's energy use by 25 GJ/year. Calculate the reduction in greenhouse gas emissions from making this retrofit to the home. Use this calculation:

   25GJ/year x 50kgCO2/GJ = ___1250____ kgCO2/year reduction

SOLAR

Spend some time looking over the materials at the display. Use these questions to help focus your investigations.

1. Explain **convection, conduction**, and **radiation**. Hint: They are part of the radiant floor heating and solar evacuated tube panels.

   From Grade 7 Science text book:
   Conduction is: "The transfer of heat energy between substances that are in contact."
   Radiation is: "The transfer of heat energy in the form of radiant energy waves."
   Convection is: "The transfer of heat energy that happens when heated gas or liquid particles move from one location to another."

2. Check (✓) ways you could use **solar power** in your home or school. Student choice.

Use natural light from windows	Close curtains to keep summer heat out	Use solar panels for yard lighting
Use solar photovoltaic panels to make electricity at the cabin	Use solar thermal panels to heat pool water	Other:

3. Try the solar panel display. What difference do the clouds make to how much the meter moves? Why?

   The clouds reduce the amount of power that the solar panel makes.

4. If your home uses 7500 kWh/yr and the average panel produces 300 kWh/yr, how many panels will you need to produce enough electricity for your home?

   $\frac{7500}{300}$ = 25 panels

5. List buildings in your neighbourhood whose roofs are large or face south, aren't shaded by trees or buildings, and could be used to hold solar panels.

   Student choices of buildings in their neighbourhood.

WATER

Spend some time looking over the materials at the display. Use these questions to help focus your investigations.

1. How does the **drain water heat recovery Powerpipe** use **conduction** to save energy? Look at the large copper pipe on the left side of the display.
   Warm waste water flows inside copper pipe, cool fresh water is pumped up and passes warm water. Warmth is transferred to cool water by conduction.

2. Explain how a **grey water system** described here works to make use of rainwater.
   Rainwater is captured in a tank, filtered, chlorinated and pressurized for use in toilets or for watering outside, instead of fresh treated water being used for those purposes.

3. Look at ***Try This!*** Using a water efficient low flow showerhead, calculate the amount of water used for a 5 minute shower, compared to a 20 minute shower.

   6L/min x 5min = ___30_____ L 6L/min x 20min = ___120_____ L

   How much water do you save by shortening your shower this much? 120-30 = 90 L saved

4. Check (✓) ways you could **save water** in your home and at school. Student choice.

Turn off the tap while brushing your teeth	Replace your old washing machine with an ENERGY STAR® washing machine	Replace your old dishwasher with an ENERGY STAR® dishwasher
Fix a leaking toilet	Turn off the tap after washing your hands	Take a shorter shower
Collect rainwater	Grow drought tolerant plants	Other:

5. People in the UK (United Kingdom – England, Scotland, Wales & Northern Ireland) use half the water that we do in Canada. What do you think they are doing differently?
   Student ideas: take shorter showers? Water lawns less? Water saving technology in more homes? Wash clothes less often?

NET ZERO HOME

Spend some time looking over the materials at the display. Use these questions to help focus your investigations.

1. **LEED buildings** reach a high standard of energy efficiency. Why do you think **awareness and education** are included in the checklist?
   Letting people know about innovative ideas helps to spread those technologies and ideas around.

2. List the things that make up the **building envelope**. Why is it important for the envelope to be airtight and have good insulation?
   The wall, roof, windows and doors make up the building envelope. An airtight home doesn't let air leak in and out, wasting energy. Good insulation reduces heat loss through walls, roof and foundation.

3. What is **thermal bridging** and how does the double wall construction reduce it?
   Thermal bridging is when heat is lost by conduction through wood or joints in construction. Double wall construction surrounds wood and joins with insulation, stopping more of the heat loss.

4. $Q = \frac{A \times \Delta T}{R}$

   When you "turned down" the thermostat (ΔT), what happened to the power (Q), consumption of the house? Why?

   The power consumption went down. When the thermostat is lower, not as much energy is needed to keep the house at that temperature, compared to a higher temperature.

5. **"Warming of the climate system is unequivocal** [and] **Human influence on the climate system is clear."** – Intergovernmental Panel on Climate Change, Climate Change 2013. The Physical Science Basis, Summary for Policymakers

   a. What does "unequivocal" mean?

   b. What does "human influence on the

climate system is clear" mean?

Unequivocal means there is no doubt
Human influence on the climate system is clear means that things that humans are doing (like driving cars and heating our homes) are affecting the climate system.

LIGHTING & APPLIANCES

Spend some time looking over the materials at the display. Use these questions to help focus your investigations.

1. The **average Saskatchewan home** uses a lot more electricity than the Vereco NET ZERO home. Name three ways the NET ZERO home uses less.
   Energy star lighting and appliances, smaller house, fewer lights, phantom power controls that can shut off electronics and lighting.

2. Look at the circle graph of **household electricity use**. Check (✓) ways you think you and your family could make changes to save electricity. Student choice.

Use LED lights	Turn out lights that aren't needed	Dry clothes on the line
Use timers for lights and block heaters	Use a power bar	Unplug electronics
Buy ENERGY STAR® appliances	Reduce Air Conditioner use by setting the thermostat to 24ºC	Other:

3. Look at the **light display**. Excluding the exit lamp, which light uses the least amount of power?
   The Bright LED uses 9W. the soft LED uses 9.5W.

4. Look at ***Try This!*** We use much more electricity than our parents and grandparents did. Name two modern appliances you could do without in order to use less electricity.
   Student ideas – special appliances, security systems, air purifiers, second or third computers or TV's, etc.

5. **Energy = Power x Time.** Explain what this equation means in terms of the kind of lights we use and how long they are on.

   Power is the amount of Watts a light uses. If we leave a light on for one hour, it will use less energy than if we leave it on for 6 hours. Good technology is a light bulb that doesn't use much power, good behavior is turning out the light when we don't need it.