SENIOR YEARS FIELD RESEARCH
WEATHER AND CLIMATE CHANGE LAB
PRE- AND POST-VISIT KIT

GOAL
To investigate meteorological techniques and to determine human causes, impacts and solutions to climate change.

OBJECTIVES
2. Learn field techniques in meteorology and climate change ecology.
3. Record weather using manual and computerized techniques.
4. Determine causes of climate change.
5. Evaluate human impact on climate change, including the students' own contributions, and potential solutions to the climate change issue.

VOCABULARY
Microclimate – the minor differences in weather found in variations in habitats, e.g. hilltop versus wetland
Climate – long-term averages in weather conditions that provide expected weather for a region
Weather - what is happening in the atmosphere at the present moment, includes clouds, wind, precipitation, barometric pressure and temperature
Greenhouse gas – a gas in the atmosphere that keeps heat that has radiated from the earth in the atmosphere, includes carbon dioxide, methane, nitrous oxide,
Carbon sequestration
Renewable energy – energy sources that are not depleted and can be replenished as they are used, e.g. solar and wind
Non-renewable energy – energy sources that are depleted and not replenished as they are used, e.g. fossil fuels

INTRODUCTION
Weather is a variable that affects every part of our lives and the lives of the animals and plants surrounding us. Animals and plants have adapted to the weather

We have the ability to modify our environment so that is suits us, sometimes this leads to problems such as pollution, habitat loss and climate change. Animals and plants do not have the ability to change at this rate.
North American's are the largest greenhouse gas produces on a per capita basis.

Students have several activities to complete over the course of the day. Individually, students record the current weather conditions at both the manual and computerized weather stations. In groups, students then measure some weather variables and biotic and abiotic parameters in several habitats (e.g. dense forest, open forest, wetland, and meadow) to determine impact of habitat type on microclimates. Individually, students investigate the many climate change and conservation exhibits in the Interpretive Centre and Siobhan Richardson Field Station to learn about causes of, impacts of and solutions to climate change. Students complete a Carbon Footprint to determine their individual contribution to greenhouse gas emissions in a single day. In groups, students measure the quantity of timber in the Fort Whyte Centre forests and its potential for carbon sequestration. The methods for this portion of the lab are similar, but scaled-down, to the Forest Use Study described earlier.

CONCLUDING QUESTIONS

There are several follow-up questions in the lab handout that the students receive the day of the program. Most of these questions they will not have enough time to complete at Fort Whyte Centre, so take the time to cover them when you return.

ACTIVITIES

1. Weather and Climate Change Videos

There are several amazing videos available about severe weather events and how meteorologists track them. Some can be borrowed from Fort Whyte Centre those include: NOVA What's Up With The Weather? and National Geographic Nature's Fury.
We also have many videos available regarding climate change issues including: Turning Down the Heat, After the Warming Part I and II, and Lila Alongotok: Inuit Observations on Climate Change.

2. Weather on a Local Scale

Discuss how location can affect weather on a small scale. Brainstorm on how vegetation or lack of vegetation would affect the weather. Check out Environment Canada Website. Look at current conditions of many cities compared to small towns and remote locations. Pavement and buildings in cities tend to warm the air and cause greater wind currents. This will affect moisture, temperature and wind speeds. Small-scale microclimate investigations at the Fort Whyte Centre field trip will look further into the impact of plant cover, proximity to water, pavement and buildings.

3. Calculate Your Field Trip Carbon Balance

There are many reasons to plant a tree – beautifying your school yard, cooling your house, honouring a birthday, providing wildlife habitat. Now there's another reason! And it will affect people all over the planet. This year, plant a tree for climate change! Climate change is a serious environmental issue caused by our dependence on fossil fuels. We burn fossil fuels to heat our homes, power factories and run our cars and busses. The result of burning fossil fuels is the release of carbon dioxide into the atmosphere, causing our planet to heat up. Trees remove and store carbon dioxide from the atmosphere.

Carbon Sources: Finding the Culprits

The addition of greenhouse gases to the atmosphere traps more heat on Earth. Human activities – driving cars and heating homes - are increasing greenhouse gases at unprecedented rates. Carbon dioxide (CO_2) is an important greenhouse gas, one of the "heat-rebounders" in the atmosphere. CO_2 is also the product of fossil fuel combustion – it is spewing out the tailpipes of automobiles by the tone – one of the many CARBON SOURCES. Since the Industrial Revolution, we have increased CO_2 in the atmosphere by 30% - this may not sound like a lot but it has already caused an increase in the average global temperature. Scientists are no longer saying "if" but "how warm?" and they agree that the consequences will be dramatic and costly.

The results for Manitoba are not just warmer temperatures - they include more extreme weather events, droughts, forest fires, dieback of the boreal forest, pest outbreaks (including mosquitoes); all of which will disable our economy. The impact of climate change is starting to be felt…right now.

Carbon Sinks: Trees to the Rescue!

During the process of photosynthesis, trees 'breathe' in CO_2 and convert it into leaves, branches and bark. Because of this, we call them CARBON SINKS! **Tree Canada** states that one Canadian tree can remove more than 9 kg of CO_2 from the atmosphere each year or more than 700 kg in its lifetime. Think of the amount of CO_2 that the world's forests can suck out of the air each year.

How Many Trees?

How many trees do you need to plant to create a **FWC Field Trip Carbon Balance**?

How will you travel to Fort Whyte Centre? Choose a. or b.

a. **Travel by Car** _____ cars x _____ km = _____

Total km. _____Total km x 0.25 ÷ 9 = _____ trees!

Our School will plant _____ trees to create a Field Trip Carbon Balance. These trees will absorb all the carbon dioxide produced by our **cars**, travelling from school to Fort Whyte and back.

b. **Travel by Bus** _____ km x 0.54 ÷ 9 = _____ trees!

Our School will plant _____ trees to create a Field Trip Carbon Balance. These trees will absorb all the carbon dioxide produced by our **bus**, travelling from school to Fort Whyte and back.

4. Plant a tree!

This activity works well in conjunction with the "Calculate Your Field Trip Carbon Balance" from the Pre-Visit Kit. Review with your students the idea of Carbon Balance. Using the white spruce saplings you've received from Fort Whyte, plant the trees in your schoolyard (check with the school first). This activity can be enhanced by obtaining saplings for all the students to plant. If the

schoolyard location is not possible, encourage your students to plant the saplings in their backyards. What would happen if no one planted trees? What benefits do the trees you've planted provide for the environment? What other actions can you take to reduce the emission of CO_2?

5. Ecological Footprint Calculations
One activity we suggest for all field research programs is the ecological footprint calculation. This gives yours students an idea of what their impact is on the earth. Since most of our research projects have an environmental aspect, this is a great way to tie in the impact of our lifestyles on the environment your students just studied.

6. Transportation and Climate Change
This activity will help the students realize the full cost of vehicles: costs of ownership, of maintenance and of climate change contributions.
Resources: and Student Worksheet: "Calculating the Cost of Vehicle Ownership" (at end of this document) and Fact Sheet: "The Facts on Cars, Carbon and Climate Change" (available by fax from Fort Whyte Centre Education Staff, 989-8358).
Introduction: Total up the number of fossil fuel powered vehicles owned by students' families (include cars, motorbikes, snowmobiles, jetskis, etc.). How many vehicles per people does this represent? In China, there is on average one vehicle to 200 people. Brainstorm on affects that cars have on the environment (e.g. pollution from vehicle, pollution from production of materials for vehicle, disposal of components such as batteries and air conditioners).
Methods: In smaller groups, students will compare three different vehicles on the basis of ownership costs and CO_2 emissions. Students can complete the Cost of Ownership Student Worksheet by their own research (sales representatives at dealerships, vehicle buyer's guides, government and environmental websites) or from the information that you provide for them. Once they've completed the data sheet, they will have CO2 emission rating for production and running of each vehicle. The resulting data can be presented in a number of ways: have each group rank their three vehicles, rank the entire class data, rank the class data based on vehicle categories (e.g. minivan, car, luxury vehicle, SUV).
Conclusions: Rank the vehicles surveyed based on the preference for the students. (Do you students want a minivan or a sports car?). Compare those results to the results of the emission study. Is it realistic to expect young people to place their priority on fuel economy when purchasing new vehicles? Why or why not? What are barriers to wide acceptance of electric vehicles or other 'zero-emission' vehicles? How would government incentives for buying low- or zero-emission vehicles help?

7. Use the results of the research from Calculating the Cost of Vehicle Ownership on the vehicle efficiency and costs to create a display for the school, a regional education conference or the local mall.

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STUDENT WORKSHEET

CALCULATING THE COSTS OF VEHICLE OWNERSHIP

Vehicle Data

	Make	input			
	Model	input			
	Engine Size (L)	input			
	Fuel Type	input			
	Retail Price	input			

Operating Costs

A	Fuel Efficiency (L/100 km)	input			
B	Annual Mileage (km)	assume 24 000	24 000	24 000	24 000
C	Fuel Price ($/L)	input			
D	Annual Fuel Consumption (L)	B x A ÷ 100			
E	Annual Fuel Costs	C x D			
F	Annual Maintenance Costs	input			
G	Annual Insurance Premium	input			
H	Vehicle Registration Fee	input			
I	Other Annual Fees	input			
J	Total Annual Operating Costs	E+F+G+H+I			
K	Operating Costs for 4 Years	4 x J			
L	Daily Operating Costs	J ÷ 365			

Ownership Costs

M	Down Payment	input			
N	Monthly Payments	input			
O	Term (number of payments)	assume 48	48	48	48
P	Financed Cost Over 4 Years	M + (N x O)			
Q	Daily Costs of Ownership	P ÷ (365 x 4)			

CO_2 Emissions

R	Tailpipe CO_2 Emission Factor	select from below			
S	Ann. Exhaust CO_2 Emission (kg)	D x R			
T	Upst. CO_2 Emission Factor	select from below			
U	Annual Upstream Emissions (kg)	D x T			
V	Total Annual Emissions (kg)	S + U			
W	Emissions Over 4 Years (kg)	V x 4			

Summary

X	Total Cost Over 4 Years	K + P			
Y	Avg. Daily Cost Over 4 Years	X ÷ (365 x 4)			
Z	Avg. Daily CO_2 Over 4 Years	V ÷ 365			

CO_2 Emission Factors

CO_2 Source	Gasoline	Diesel
Tailpipe CO_2 Emissions from Fuel Consumption (kg/L)	2.36	2.77
Upstream CO_2 Emissions from Fuel Consumption (kg/L)	0.65	0.54

The CO_2 Emission Factors are estimates of how much CO_2 is released during the production and combustion of the fuels used by vehicles.