Impacts of Climate Change presentation notes

Slide #	Slide Text	Slide Notes
1	The Impacts of Climate Change	
2	Ontario EcoSchools Partners	
3	The Impacts of Climate Change	
4	Natural and Human Systems	• Natural and human social systems are interconnected and interdependent.
5	Natural systems	• Natural environment made up of many interrelated systems , processes and parts: ecosystems, climate system, water cycle, carbon cycle, energy flow, etc. • All plants and animals on earth are part of these natural systems.

6	Human systems	• Common misconception that natural systems separate from human systems • Human systems include transportation, industry, communications, energy, human populations, cities (these are interconnected)
7	Natural - Human interconnected	• Human systems are also interconnected and interdependent with the natural systems of our planet. • Human systems rely on natural systems for survival: air we breath, the water we drink and the soil that produces our food. • Humans take raw material from the Earth's natural systems to produce goods and materials. • Industries make consumer products using trees logged from the forests and metals and other rocks mined from the earth. • We use water in all our systems, from our own domestic uses, to industries, factories, agriculture and to generate electricity • The global climate system also influences human systems: the way we build and heat or cool our houses, get water, move from place to place, etc.

8	Human systems energy	• The energy human systems use is derived from natural systems. • Energy use, specifically the use of fossil fuels, is directly linked to climate change. • In 1999 North Americans consumed 4.5 times more energy than the average for the rest of the world. • Industrialized nations are the greatest contributors to climate change http://www2.nrcan.gc.ca/es/es/energypicture/chap1_e.cfm
9	Human systems fossil fuels	• Fossil fuels - oil, natural gas and coal mined from the earth provide fuel for almost all of the energy we use today on the planet. • Fossil fuels are formed over millions of years from buried plant and animal materials that escaped the normal process of decomposition. • Oil is also the raw material used to make plastics, Styrofoam and numerous different kinds of chemicals used to clean our houses, fertilize our crops and spray for pests. • We burn fossil fuels mined from the earth – this pollutes the air, and contributes to climate change.

10	Climate change	• More recently, scientists have discovered that human activities are now influencing the earth's climate - by changing the concentration of CO2 and other greenhouse gases in the atmosphere. • Fossil fuels are rich in carbon, and when burned in engines or used to generate electricity, they produce CO2, and other greenhouse gases linked to climate change.
11	Climate change the greenhouse effect	• The greenhouse effect is a natural process that influences the climate system. • The greenhouse effect allows the earth to be warm enough to support a diversity of life forms. • Gases of the atmosphere trap the sun's heat near the earth's surface – the greenhouse effect • Without the greenhouse effect, the earth on average would be 34°C colder. • Main greenhouse gases in the atmosphere: carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), and ozone (O3), • Also tiny particles in the earth's atmosphere (aerosols) and water or ice particles also trap radiation from the sun.
12	Causes of climate change	• Natural and human causes

13	Climate change the natural way	• Scientists have been able to determine that the earth's climate has changed in the past- caused by natural processes. • Rocks underlying much of southern Ontario provide clues to the existence of warm shallow seas which once covered the land – millions of years ago • The last ice age ended about 10,000 years ago. At this time Ontario was covered in ice 1 -2 km thick. • The glaciers melted, leaving the foundation of the physical features we have today. • Scientists believe that natural changes in climate were triggered by slight *variations in the earth's orbit, variations in solar radiation, increases in greenhouse gas concentrations from volcanic eruptions*.

14	Climate change human influence	• Earth's *atmosphere* has been relatively *stable for past 400,000 years* • Around 1750 the Industrial Revolution started – *fossil fuels were burned as a major source of energy* • Since then industrialized countries have released huge amounts of CO2 into the earth's atmosphere – concentrations have increased from *280 ppm (1750) to 379 ppm (2004)* due to human activities. • Scientists track changes in atmospheric CO2 by measuring the CO2 content in air bubbles trapped in glacier ice hundreds of years old, or trapped in ancient coral reefs. • Tree rings of ancient tree stumps provide clues to temperature changes • Global temperatures have risen .6oC since the mid 1850's. • Other greenhouse gas emissions are also on the rise. • How has this happened? • Useful to look at how lifestyles and use of energy have changed since the Industrial Revolution. _____ Click on the "graph icon" to view the changes in CO2 and temperature over the last 250 years.

	Link to graph notes	• Generally earth's atmosphere has been stable for the last 1000 years • 1750: CO2 concentration around 280 ppm – earth's atmosphere relatively stable at that level for millennia • present CO2 levels are at around 360 ppm • Climate generally on a slow cooling trend during past 2000 years, then a sharp increase in 20th century • Direct relationship between increasing CO2 levels and temperature levels since the industrial revolution • Increase in CO2 definitely from human activities (anthropogenic) – changing isotopic composition of atmospheric CO2 shows fossil fuel origin

15	Pre-industrial era 280 ppm CO2	How has Ontario changed over time? pre 1800's, before industrialization: • Homes made out of natural materials such as wood, some brick, animal skins etc. • Transportation on foot, by canoe, by horse or carriage • For cooking, warmth, and light: wood, sun, candles • Farming & industry: people, horse and ox power, small mills run on hydro power • Extensive forest cover still, with some clearing occurring. Deforestation in Europe was widespread, and starting in North America. • Many people around the world lived off the land- farming, logging • CO2 levels have been relatively steady at 280 parts per million (ppm) Parts per million is a way of measure concentrations. For example: If you took two drops of red food colour and mixed into a bath tub of water you would have created a mixture of approximately 2 part per million food colour to water. _____ All number and statistics are for the Province of Ontario CO2 concentrations are the measured world average during this time period.

16	Early 1900s	1900:
		• Settlement pattern shifting – more people living in villages, towns and new cities, working in factories, mines and farms.
		• Forests shrinking – wood used for construction of factories and houses
		• Industries powered by coal and hydro
		• Transportation: first cars and street cars appear, trains, steamships, foot, horse, carriage, first bicycles
		• Warmth and light: coal, oil lanterns
		• By the 1900s, the industrial revolution was well underway, and fossil fuels provided the energy to make it possible
		  ○ Ships, trains and the new automobile all powered by fossil fuels
		  ○ Population of North America greatly increased with influx of immigrants from Europe and other continents
		  ○ Forests cleared to make way for farms and human settlements
		
		• CO2 levels up to 300ppm.
		• 1910 – 4000 passenger cars registered in Ontario
		_____
		All number and statistics are for the Province of Ontario
		CO2 concentrations are the measured world average during this time period.

17	Today	• Present Day: life in Canada and much of the western world is based on speed, consumerism and convenience: • Much bigger world population – also true for Canada and Ontario • More people live in cities • People live farther away from their food sources, their work place • Goods and people constantly transported all over the planet by cars, buses, trucks, trains, planes, ships - *all run on fossil fuels* • Chemicals used in agriculture, industry, our homes pollute the water, soil and air • Ecosystems all over the planet under threat from deforestation, development, pollution, and now… climate change. • Most human systems rely on *fossil fuels* in one way or another: transportation, electricity, food production and transportation systems, production of consumer goods and packaging, transportation and disposal of waste, communication systems. • CO2 concentration in atmosphere 379 ppm. • Other greenhouse gases also on the rise due to human activities. _____ All number and statistics are for the Province of Ontario CO2 concentrations are the measured world average during this time period.

18	Carbon sources	• Earth's atmosphere is changing. • Human sources of greenhouse gases: deforestation / burning, burning of fossil fuels, cattle production, cement production etc. • Predominantly a hunger for energy (fossil fuels burning) is releasing large amounts of CO2 into the atmosphere. • Carbon in the form of greenhouse gases is being released into the atmosphere from the following human social systems. • Burning fossil fuels for energy • Transportation – Car culture • Intensive agriculture • Cement production
19	Carbon sinks	• Earth has natural mechanisms for removing CO2 from the atmosphere (sinks).Sinks buffer the effects of excess CO2.Natural sinks include *forests, wetlands and oceans*.

20	Sinks lost	• Human activities since industrial revolution have increased CO2 being released but also destroyed sinks. • Forests are cleared for agriculture and wood products. • Wetland converted to agricultural land, parking lots, housing developments • Oceans still absorbing CO2, but as the planet warms, the oceans warm, and warm water holds less CO2 Canadian forests are becoming *net sources of CO2* rather than sinks – through fires, insect infestation, and harvesting (David Suzuki Foundation, 2003)
21	The enhanced greenhouse effect	• An increase in the concentration of greenhouse gases (CO2 and others) traps/absorbs larger amounts of infrared radiation (heat). (In the past would this radiation would have escaped into space.) • The additional trapped radiation absorbed by the atmosphere creates an energy imbalance. • Increased energy in the global climate system has resulted in climate change.
22	Impacts of Climate Change	How will climate change affect people, economies, ecosystems?

23	Intergovernmental Panel on Climate Change (IPCC), 2001 report	• 2001 – the Intergovernmental Panel on Climate Change released their third report to the world • Report convinced scientists and most politicians around the world that climate change is already happening • Scientific models incorporate human and natural influences on climate • Scientists continue to refine the models that they use to predict climate change impacts • Most models agree on a number of the impacts that climate change will have on the natural and human systems of the planet If connected to the internet click on the “link” to go to a Climate Change Hotspots map of North America

24	Severe weather	• As the atmosphere warms, climate becomes hotter but also more unstable • *Frequency, duration, intensity* of weather events, such as winter storms, ice storms and tornadoes, have increased steadily over the 20th century • *1 in 5 Canadians was directly affected by a weather disaster between 1996 and 2000.* • Steady loss of wetlands over the years has reduced capacity of land to absorb floodwaters • Scientists have not yet established a direct correlation between the frequency of severe weather events (e.g. hurricanes) and the increasing CO2 levels during the past two centuries • Canada: more severe and more frequent winter storms, ice storms and tornadoes expected. • Scientists agree that more intense precipitations events are likely over many areas of the globe. _____ Click on the “graph” to go to a graph of Canadian weather related disasters (1900 – 1999).

25	Floods	• Intense precipitation events also lead to increased flood, landslide and avalanche damage • Agricultural potential of flood-vulnerable lands will be reduced • Ontario: frequency of heavy rainstorms expected to increase. • Continued *development in wetland* areas reduces capacity for wetlands and floodplains to absorb and filter floodwaters • Increased erosion and pollution of runoff with pesticides and other toxins may occur. • Extreme interventions are required: • Example: Thames Barrier in England was build in 1982 to protect UK from floods – expected to be used once every 3-5 years, but used 24 times in 2000-2001. If the barrier were to break, flooding would cost about $56.7 billion of damage, 2% of GDP, leading to destabilization of the country and economy.

26	Drought	• Ontario already experiencing drier summers • Great Lakes and other lake levels continue to drop due to increasing evaporation • Resulting lower river levels are already reducing hydro power potential. • Globally, scientists predict increased summer drying over most mid-latitude continental interiors, and associated risk of drought • Drought will affect agricultural activities (reducing crop yields), reduce ground water levels and decrease water quality, and lead to an increased risk of forest fires.

27	Arctic meltdown	• Climate change in polar regions is expected to be the most severe – impacts are already documented by northern communities* • In the arctic, higher average temperatures expected to result in a continued decrease in extent and thickness of sea ice • Permafrost is thawing, resulting in mudslides and erosion • Increased heat stress for people and wildlife • These changes are affecting the infrastructure of northern human communities (buildings collapsing) • Polar regions contain “drivers” of climate change which, once triggered, may continue to impact the earth’s climate for centuries, long after greenhouse gases are stabilized, affecting global ocean circulation and sea-level rise. * Click on the “movie icon” to see a video clip on “Inuit observations of climate change in the arctic”

28	Sea level rise	• Glaciers are retreating worldwide • Higher temperatures are both *melting polar icecaps* and *warming the oceans*, increasing their *mass and volume*. • Scientists have measured an increase of 10-20 cm during the last century and higher sea levels are expected. • Eight to ten million people live within one metre of high tide in each of the unprotected river deltas of Bangladesh, Egypt and Vietnam. Half a million people live in archipelagos and coral atoll nations that lie almost entirely within three metres of sea level, such as the Maldives, the Marshall Islands, Tuvalu, Kiribati and Tokelau. _____ Click on the “movie icon” to see a video clip on sea level changes in the Maldives.

29	Coastal erosion	• Coastal erosion has an impact on human settlements on coastlines worldwide. • Rising sea levels increase coastal erosion, cause billions of dollars worth of damages to buildings and infrastructure, damages coastal ecosystems and forces communities to adapt and relocate. • The costs of building sea walls and dikes to protect infrastructure is enormous • Coastal wetlands and other ecosystems will also be affected.

30	Giant ocean conveyor belt	• Thermohaline circulation is known as the great ocean conveyor belt – it is a series of connected currents which move water and nutrients from pole to pole, and is one of the major global drivers of climate. • The density of sea water is controlled by its temperature (thermo) and salinity (haline). The circulation of ocean currents by differences in water density is therefore called thermohaline circulation. • Some climate models suggest that if the climate warms, thermohaline circulation could stop altogether. • One section, known as the Gulf Stream, moves warm water up to Europe, tempering the climate. • Long term effects of this is unknown although if Gulf Stream stops flowing, Europe will most likely cool. • Changes to thermohaline circulation will likely have impact on marine and coastal ecosystems and wildlife.

31	Global warming A good thing	• *Nine of the ten hottest years on record were in the 1990s* • Temperatures have already risen by 0.6^{o}C globally, 1^{o}C in the arctic. • Globally 1998 was the hottest year on record. • Higher maximum temperatures predicted globally. • On the plus side, in Canada, lower winter extremes may reduce cold stress for people, wildlife and livestock. • Frost free growing season will extend. • Heating energy demand may decrease. • However it is predicted that the negative impacts will outweigh the benefits of a warmer climate. _____ Click on the “movie icon” to see a video clip modeling global temperature change from the present to 2100.
32	Ecosystem in Danger	• Scientists have already documented effects of a warming climate on wildlife and ecosystems

33	Wetland ecosystems	• Wetlands are already in decline due to filling and destruction for agriculture, urban sprawl, industry, etc. • Many wetland species will find it difficult to migrate and shift their range in response to climate changes because of habitat fragmentation and loss. • Climate change could add to these existing problems ◦ Example: hotter, drier summers will likely shrink wetland ecosystems which are already under pressure from development - wetland species will decline as a result.
34	Marine ecosystems	• Marine ecosystems are vulnerable to change • Climate trends are already recognized to affect fish abundance and population dynamics, with a direct impact on fish-dependent human populations, e.g. during El Nino events. • Sea level rise and higher ocean temperatures will have an impact on diverse and productive coastal ecosystems such as coral reefs, mangrove forests and reef islands. • Coral reefs found in warmer ocean regions throughout the world are extremely productive ecosystems. • Warmer ocean temperatures have already been observed to produce stress on coral reefs Stress causes widespread bleaching and death; results in loss of habitat for fish and other marine life.

35	Wildlife in danger	• Wildlife is affected by regional changes in climate, either directly due to temperature changes and severe weather, or indirectly through changes in vegetation, disease and habitat • Many species will find it difficult to migrate and shift their range in response to climate changes because of habitat fragmentation and loss. • Some species can relocate more easily than others • Scientists estimate that 18-35% of species are destined to extinction under the currently predicted climate change scenarios. • Climate change could be responsible for the extinction of 1 million species by 2050. (*Nature,* 2003) • Example: shorter ice seasons mean less feeding time for polar bears, who need to access their prey on ice floes near the shore. • Polar bear populations will likely decline as a result. (see video) • In Ontario, cold water species such as lake trout and whitefish are expected to decline while warm water species expand their range northwards.
36	Human Systems at Risk	

37	Human communities	• Climate change is generally expected to have negative side effects on human systems • Northern communities already in flux – water supply, food supply, infrastructure being affected by changes in precipitation, temperatures and wildlife. • Sea level rise will disrupt or destroy communities in small island states or in coastal areas • Flooding destroys infrastructure and claims lives.
38	Human health	• Health– *heat stress will increase* – more premature deaths in Canada expected • More people, worldwide can be expected to suffer injuries as a direct result of climate related severe weather events such as floods, severe storms etc – including Canadians. • Increased *cooling demands will mean more air conditioners = more energy, more emissions, more smog*

39	Human health respiratory illness	• In addition to producing greenhouse gases, burning fossil fuels generates other pollutants that cause smog, e.g. SO_2, CO NO_x and particulate matter • Higher temperatures predicted by climate change scenarios and more electricity generation for air conditioners increase the formation of ground-level smog, making asthma and other respiratory diseases more frequent and or severe. • Air pollution estimated to cause about 2000 premature deaths in Ontario and over $1 billion in health care costs in the Toronto-Niagara area. (Pollution Probe: Climate Change and Health in the Toronto-Niagara Region, 2002). • For every death there are numerous other implications for the health system: hospital admissions, emergency room visits, visits to the doctor, medications, and impaired lung function. (note the statistics in the pyramid)

40	Human health disease transmission	• Mosquitoes and ticks are examples of disease vectors. • They enable the transmission of many diseases such as Malaria and Dengue Fever. • Disease vectors are sensitive to changes in climate. • Increased exposure to diseases such as West Nile virus and Lyme Disease is projected due in part to climate change. • Decreased quality and quantity of groundwater from droughts is expected to result in an increase in waterborne infectious diseases.
41	Economic impact fisheries	• Rising ocean temperatures affecting fisheries • West coast salmon industry has already been affected (David Suzuki Foundation, 2003)
42	Economic impact forestry	• Forests in Canada can expect increased outbreaks of insect pests • Warmer, shorter winters allow pests such as spruce pine beetle to thrive. (see inset picture) • In BC in 2001 the spruce pine-beetle infested an estimated 500,000 hectares of timber worth $4.2 billion (BC ministry of Forests) • Warmer, drier summers increase risk of forest fire

43	Economic impact agriculture	• Droughts and new pests expanding their range northwards will affect the economic viability of the agriculture sector • 2001 drought in the Canadian prairies estimated to have cost the Canadian economy $5 billion in agricultural losses • increased heat stress for livestock
44	Economic impact insurance	• Potential economic costs of climate change are staggering • Health costs mentioned above • Repairing damage from severe weather events • Insurance costs are predicted to rise • Insurance companies become more reluctant to insure risks perceived to be associated with climate change or vulnerable to the impacts of climate change. • Repairing damage from severe weather events, dealing with increased crop failure from disease and drought, health related costs rising insurance rates to cover potential losses related to severe weather etc. • Before 1988, global insurance industry claims never exceeded $1billion for any one incident, but between 1988 and 1996 there were 15 events, resulting in several companies going out of business.

46	The Climate Change Challenge	• This is the future that scientists are predicting, and most believe that we are already experiencing the beginnings of this change. • Need to start taking action at every level to reduce greenhouse gas emissions, and at the same time increase carbon sinks • Also communities and individuals need to think about ways to adapt to climate change • IPCC report concludes that poorer countries are more vulnerable to the impacts of climate change, and will be less able to adapt quickly to the changing climate and environment
47	Opportunity for change	• Although the predictions are grim, need to look at opportunities • Find new ways of living in harmony with the planet - many actions needed to address climate change will also benefit human and natural communities in other ways, resulting in cleaner air, water, soil, and more habitat for wildlife • New economic opportunities will also arise, as we develop new sustainable technologies which enable us to continue to • Enjoy a reasonable standard of living without compromising the rest of the planet.

48	International agreements	• International agreements have an important role to play and can work. • Serve to bring scientists and politicians from many countries together to share findings • Discuss and agree on strategies to solve global problems which transcend political boundaries. • Kyoto Protocol is one such agreement

49	Kyoto protocol	• Many governments of the world are committed to work together to slow climate change. • In 1997, representatives of over 160 countries gathered in Kyoto, Japan to draw up the Kyoto Protocol, an international agreement that seeks to reduce greenhouse gas emissions to below 1990 levels by 2008-2012. • Canada ratified, or committed to the accord in 2002 • To become legally binding the protocol required ratification by countries representing 55% of the global CO2 emissions – by September 2004, enough countries had ratified the protocol for it to come into effect. • In Canada, implementing Kyoto means reducing our greenhouse gas emissions by 20% below today's (2003) levels, or 5% below 1990 levels. • Kyoto is just the beginning. Many scientists say that much more drastic reductions in GHG are needed – more like 50% to be really effective in combating climate change • Before Kyoto has even become official, many people, organizations, governments and corporate leaders are taking the initiative to implement strategies to reduce their greenhouse gas emissions, often exceeding the Kyoto targets.

50	Public transit	• Municipalities across Canada are promoting their public transit systems as a means of reducing traffic and controlling smog. • *Fewer cars on the road mean fewer greenhouse gas emissions.*

51	Energy revolution wind	• Several studies show that implementing Kyoto in Canada will create employment and stimulate the high tech and construction industries, as well as benefit our health and our ecosystems. (David Suzuki Foundation) • Wind energy proving to be extremely promising worldwide as a new energy technology • Total number of utility scale wind turbines in Ontario (December 2003) = 9 • Toronto's first wind turbine built in 2002 by WindShare • Toronto's turbine unique – first in North America in a downtown urban setting • Ontario Power Generation (OPG) and other energy distributors offer green energy options for businesses which include energy generated from renewable sources like micro hydro stations, and wind. • Across Canada, turbines operate in 5 provinces generating a total of 205,000kw • Wind power more popular in Europe, growing at 40% per year. • Denmark generates 17% of energy through wind, and is aiming form 50% by the year 2030. Many people are employed in the production of wind turbines. • Ontario has the potential to produce 3,000MW of wind power (5% of the province's power) (Canadian Wind Energy Association [CanWEA])

52	Energy revolution solar	• Development of non-polluting energy sources key to combating climate change • Reduce global dependence on fossil fuels as source of energy • Solar energy becoming popular in tropical areas where electricity from the grid not always available • Remote Canadian communities also experimenting with solar power applications • Batteries to store the power are the limiting technology at present • Hydrogen fuel cells are being developed to provide better power systems
53	The Earth is in Your Hands	
54	Ecological Footprint measuring our impact	• Each person contributes to the problem of unsustainable use of the earth's resources and climate change. • Individual's impact on the planet can be calculated by measuring the Ecological Footprint.

55	How much space do you need?	• Ecological Footprint: amount of space (land & air) that is required to support a person's lifestyle and activities. • Not just the area of the house or apartment we live in • We need space to produce food to feed us, plants and other raw materials to clothe us, provide us with energy, entertain us, transport us around, and absorb the waste that is generated from everything that we consume. • Energy makes up 55 % of the average Canadian footprint (Federation of Canadian Municipalities, 2003) • The average Canadian needs 8.8 hectares of space on planet earth to support his or her lifestyle (1999) • World average: 2.3 hectares • Indonesia: 1.1 hectares

56	Carbon activism	• Guy Dauncey, a well known Canadian climate change writer and activist, author of Stormy Weather: 101 solutions to global climate change, challenges everyone reduce our own carbon emissions by 20% by becoming carbon activists! • You can calculate your carbon emissions using a simple calculator on his website: http://www.earthfuture.com/climate/carbonactivism.asp • Have students identify how each image might represent an action that would reduce carbon dioxide emissions.
57	We have choices	• Climate change is a daunting issue – it seems beyond the control of individuals • Many things individuals can do • Environmental citizenship – we are responsible for our own actions, how they impact the earth and other people • Need to be mindful of the impacts of our actions • Need to be informed of options / alternatives • Individuals, corporations, various levels of government – all have a role to play