Key Topic #1: Climate Change Projections

Evidence Of Climate Change:

•Changing temperature and precipitation patterns

•Increases in ocean temperatures, sea level, and acidity.

•Melting of glaciers and sea ice.

•Changes in the frequency, intensity, and duration of extreme weather events.

•Shifts in ecosystem characteristics, like the length of the growing season, timing of flower blooms, and migration of birds.

Key Greenhouse Gases:

Carbon Dioxide, Methane, Nitrous Oxide, F-Gases (CFC's and HFCS which are found in coolants, foaming agents, fire extinguishers, solvents, pesticides, and aerosol propellants.

•Different Greenhouse Gasses have different warming potentials and remain in the atmosphere for different amount of time. Some gases are more effective at warming the planet than others. This is called the Global Warming Potential (GWP)

Climate Change Indicator: Climate change can dramatically alter the Earth's snow- and ice-covered areas because snow and ice can easily change between solid and liquid states in response to relatively minor changes in temperature.

•Scientific studies indicate that extreme weather events such as heat waves and large storms are likely to become more frequent or more intense with human-induced climate change

•Average temperatures have risen across the contiguous 48 states since 1901, with an increased rate of warming over the past 30 years. Nine of the top 10 warmest years on record have occurred since 1998.

•Weather is the state of the atmosphere at any given time and place. Climate is the long term average of the weather In a given place.

•The elderly are commonly identified as being among the most vulnerable to climate change, especially with respect to health-related impacts.

•On average, Canada has warmed by more than 1.3°C since 1948 (Figure 7), a rate of warming that is about twice the global average

Changes in the frequency of extreme temperature and precipitation events have been observed in Canada from 1950 to 2003, including:
• fewer extreme cold nights, • fewer extreme cold days, • fewer frost days,
• more extreme warm nights, • more extreme warm days, • more days with precipitation,
• decrease in mean amount of daily precipitation,
• decrease in maximum number of consecutive dry days,
• decrease in annual total snowfall (southern Canada),
•increase in annual total snowfall (northern and northeastern Canada).

Scenarios and Climate Models

Based on best practices in the global science community, the Government of Canada usually presents 3 RCPs

- RCP8.5: high global emission scenario. This scenario indicates global average warming levels of 3.2 to 5.4°C by 2090.
- RCP4.5: medium global emission scenario, includes measures to limit (mitigate) climate change. This scenario indicates global average warming levels of 1.7 to 3.2°C by 2090.
- RCP2.6: low emission global scenario, requires strong mitigation actions. This scenario indicates global average warming levels of 0.9 to 2.3°C by 2090.

Managing uncertainty in climate projections

We can't say for certain how the climate will change in the future. This is because:

• we can't predict the exact amount of greenhouse gasses future human activity will produce
• we can't perfectly model the Earth's climate system

Use of different scenarios or RCPs help deal with the first issue. For the second issue, multiple climate models, each constructed somewhat differently, are used. There is no one best climate model. Plus, some models are better at capturing different aspects of the climate than others.

•Since the Industrial Revolution, emissions of greenhouse gases due to human activities have increased from a negligible level to more than 40 billion tons a year.

•the richest countries represent only 16 percent of the world population but almost 40 percent of CO2emissions. The two categories of the poorest countries in the World Bank classification account for nearly 60 percent of the world's population, but for less than 15 percent of emissions

• Climate change is directly contributing to humanitarian emergencies from heatwaves, wildfires, floods, tropical storms and hurricanes and they are increasing in scale, frequency and intensity.

• Research shows that 3.6 billion people already live in areas highly susceptible to climate change. Between 2030 and 2050, climate change is expected to cause approximately 250 000 additional deaths per year, from undernutrition, malaria, diarrhea and heat stress alone.

• The direct damage costs to health (excluding costs in health-determining sectors such as agriculture and water and sanitation) is estimated to be between US$ 2–4 billion per year by 2030.
• Areas with weak health infrastructure – mostly in developing countries – will be the least able to cope without assistance to prepare and respond.

• Reducing emissions of greenhouse gases through better transport, food and energy use choices can result in very large gains for health, particularly through reduced air pollution.

Key Topic #2: Forest Health in a Changing Climate

Globalization: Spread of Insects and Disease:

- Increase speed of international travel and transport of goods and materials
    - Foreign diseases and insects imported either intentionally or by accident
    - Native species did not evolve with these and are very susceptible to damage

- **Native species** – Indigenous species that evolve over many generations and co-evolve in the presence of other native species including pests. Damage can still occur from other native diseases and pests, but it is usually in a balance or ebb and flow that develops over thousands of years.
- **Alien Species** – Species that is imported from far away, that evolved in a completely isolated ecosystem. Alien species in some cases can co-exist with native species and do not necessarily become invasive.
- **Invasive Species** – An Alien Species that causes significant damage to native species either by rapidly taking over land area displacing native species or by causing widespread and significant disease damage to the native species.

*** Know some examples from the PowerPoint and/or Study Materials.

Wildfires

- Wildfires are a natural phenomenon, and an important part of forest health, causing a disturbance and resetting the forest succession process.
- Climate change increases temperatures and drought, increasing susceptibility to larger and more severe fires.
- Fire suppression and humans limiting natural wildfire can also increase 'fuel' or burnable material, leading to more intense fires when they do ignite.
- Climate Moisture Index (CMI) developed by Canadian Forest Service to monitor drought and help predict where forest fires are more likely to develop.

Other Climate Change Effects

- Warmer temperatures can alter the range for both native and invasive plants, insects, and fungi/pathogens.
- Warmer winters allow pests to survive winters in traditionally colder climates.
- Longer growing seasons can shift animal migration.
- Increased water temperatures can affect fish spawning and survival.

Key Topic #3: Inherent Rights of Indigenous Peoples to Land Stewardship

United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP).

•UNDRIP is a declaration containing an agreement among governments on how indigenous peoples should be treated.
•Drafted in 1985 and was first adopted by the United Nations general assembly in September 2007
•At the time of the vote in 2007 Australia, Canada, New Zealand and the United States of America voted against the Declaration and 11 countries abstained (decided not to vote).
•Since then, Australia, Canada, New Zealand and the United States have decided to support the Declaration. It is due to indigenous peoples' advocacy for their rights in their countries that this change has come about.

UNDRIP consists of **46 articles** that describe specific rights and actions that governments must take to protect these rights. All the articles are very important, linked to each other and form a frame for governments to make sure that the rights of indigenous peoples are protected. Main Themes of the articles:

The Right To Self-Determination**:** Control of their own lives by implementing what they believe is best for them.
The Right to be Recognized As Distinct Peoples: distinct language, culture, worldview, beliefs, and values.
The Right to Free, Prior and Informed Consent: All decisions regarding indigenous people's land right should be discussed and approved by them prior to any action from external actors.
The Right to be Free of Discrimination: Rights to jobs, education, social services, etc.

Indigenous Science compared with Western Science:

•Traditional ecological knowledge is knowledge shared by Indigenous knowledge keepers. It is sacred. Information acquired from our deep relationship with the places we are from. Intergenerational awareness, passed through lineages about plants, animals, places, and how we care for them. Knowledges acquired in ways beyond that of the physical. Knowledges continuing to be practiced and gained, building upon our ancestral understanding. Knowledges generated and their use guided by community values and needs.

•Traditional Ecological Knowledge carries a deep emotional connection to what is being studied, developed, or consumed – land, animal, or water. This interconnected relationship produces a great sense of responsibility within Indigenous Peoples, obligating them to choose technologies and practices that are beneficial to the well-being of all their relations.

•Indigenous knowledge carries ancient and intergenerational wisdom that is flexible, fluid, and adaptive as it evolves through relationships with the land and other beings. This knowledge evolves from and is responsive to the natural world, which makes it ideal for developing and advancing meaningful climate solutions

•The Native American Paradigm is comprised of and includes ideas of constant motion and flux, existence consisting of energy waves, interrelationships, all things being animate, space/place, renewal, and all things being imbued with spirit…Everything is interrelated. If everything is interrelated, then all creation is related.

•What Native Americans refer to as "spirit" and energy waves are the same thing. All of creation is a spirit.

•Western Views of science are largely about measurement using Western mathematics.

•Blackfoot Knowledge Keeper and scholar Leroy Little Bear says that we must move beyond the either/or mentality of western thought: "We're not talking about either Western science or native science. What we're talking about is a marriage of the two, because that'll bring about enrichment. That's what we refer to as a holistic approach."

Overall Worldview:

Indigenous science:

•Emphasis on animate beings that are interconnected. Everything in the cosmos from a rock to a human is imbued with spirit.

•spirit + energy + matter

Western science:

•Emphasis on objects that are comprised of parts and wholes characterized by systems and emergences through evolution.

•energy + matter

Overall Knowledge Objectives:

Indigenous Knowledge:

•collective, living knowledge to enable nourishment of one's journey within expanding sense of "place, emergence and participation" for collective consciousness and interconnectedness.

•towards resonance of understanding within environment

•towards long-term sustainability for the people and natural environment (tested and found to work by the vigorous challenges of survival over millennia).

Western Knowledge:

•dynamic, testable, published knowledge independent of personal experience that can enable prediction and control (and "progress")

•towards construction of understanding of environment.

•towards eventual understanding of how the cosmos works (tested and found to work by the rigorous challenges of experimental design).

Key Topic #4: Vulnerability Assessment and Adaptation Strategies

Forest vulnerability: the degree to which systems are susceptible to, and unable to cope with, the adverse effects of climate change. Comprised of 3 components:

- Exposure – the degree in which climate change effects a system
- Sensitivity – how responsive a system is to climate change exposure
- Adaptive capacity – the ability of a system to cope with climate change. Persist in Place or Shift in Space

Climate Change Vulnerability Assessments (CCVAs) – can range in scale, incorporate local knowledge along with scientists, historical trends & future changes, evaluation of effects of climate change on particular areas

Positive effects of climate change on forests: longer warm periods lead to longer growing seasons, species can expand their range to previously cooler areas, some bird species benefit from younger forests or use dead trees for shelter and food

Negative effects of climate change on forests: winter thaw can cause trunk cracking, early onset of warm weather decreases breeding success, disease pressure from warmer and wetter weather, drought stunts tree growth, lowered carbon sequestration, altered phenology

Assisted migration is the human assisted movement of plants and animals. More feasible for commercially available trees, can include population, range or species migration

Key Topic #5: Legislation and Regulation

Sustainable Forest Management (SFM):

- Canadian Government requires Forest Management Plans to be developed and maintained for timber harvest areas.
- Input from various stakeholders: Indigenous people, Recreation, Wildlife, Environment
- SFM requirements based on the latest best management practices and regulations are regularly updated.
- Plans typically are developed for a 5-10 year period.
- Three pillars of SFM: Economic, Environmental, Social/Cultural
- Forest managers try to emulate natural disturbances
    - Prescribed, low-intensity fire
    - Clear cut areas to simulate/stimulate forest succession
    - Replanting with beneficial, native species
    - Retaining older 'veteran trees' for nesting birds and other wildlife
    - Providing buffers around nest trees and streams
- Forest Certification – 3 accepted standards:
    - Canadian Standards Association (CSA)
    - Sustainable Forest Initiative (SFI)

2015 Paris Agreement

- International Agreement with goal of limiting global average temperature increase to well below 2 degrees Celsius
- Forestry plays a large role in Canadian climate change goals
    - Forest management and lumber production can help to store/sequester more Carbon than simply not harvested forests
    - Young trees grow faster and absorb Carbon at a faster rate
    - Older trees grow more slowly, and ultimately die and decay, releasing CO_2
- **Carbon balance is yet another key component that must be considered when developing forest management strategies**

2022 Kunming-Montreal Protocol

- International agreement to protect and restore biodiversity
- Forestry practices include: land conservation, ecosystem restoration, reduction of invasive species, reduction of environmental threats (nutrients, pesticides, chemicals)

Key Topic #6: The Boreal Forest aka Taiga Biome

Band circling the North Pole characterized by long cold winters and cool dry summers. Wetlands lessen effects of floods and drought. Vegetation controls erosion, cycles nutrients, promotes formation of soil, huge carbon sequesterer, provide jobs and products in multiple industries

Boreal forest/wetlands and climate change:

- Longer growing seasons increase C sequestration, but wildfires, drought and windstorms release huge amounts of carbon. Eutrophication, acidification, brownification
- Stressed trees more susceptible to pests, dead trees increase risk/severity of wildfires
- Average temp in Artic increased twice as fast as rest of planet
- Changes in biological diversity, deterioration of moisture and quality of wood, change in range and migration of animals, decrease in water purification, higher methane production from increased microbial activity

Mitigating climate change – remove non-native species, restore wetlands, plant fire-resistant mosses