MPB

Mountain Pine Beetle

Junior High School Resource

Mountain Pine Beetle

Inside education

Alberta Government

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Curriculum Connections:

This resource was designed to bring the biology and issues surrounding mountain pine beetle into the spotlight for junior high science students in Alberta and British Columbia.

The major curriculum connections are as follows:

Alberta Grade 6 Science Topic E: Trees and Forests
Alberta Grade 7 Science Unit A: Interactions & Ecosystems
Alberta Grade 7 Science Unit B: Plants for Food & Fiber
Alberta Grade 9 Science Unit A: Biological Diversity

Other connections in the Alberta junior high curriculum include the Junior High Environmental & Outdoor Education and Career and Technology Studies (Forestry, Wildlife strands) programs

British Columbia students may benefit from the resource as well. Applicable science curriculum connections include:

British Columbia Grade 6 Life Science: Diversity
British Columbia Grade 7 Life Science Unit: Ecosystems
British Columbia Grade 10 – Sustainability of Ecosystems

Key Messages:

Mountain pine beetle is a naturally occurring insect.

An abundance of mature pine forests across the province, resulting from wildfire suppression and mild winters, have allowed the mountain pine beetle to move outside of its historic range.

Many different groups are concerned about managing mountain pine beetle. All of these groups have the goal of healthy forests, but may differ on methods to manage the beetle.

Provincial governments, the federal government and the forest industry are working cooperatively to monitor and deal with mountain pine beetle to protect forest health, recreational opportunities, enhance wildlife habitat and reduce wildfire risk.

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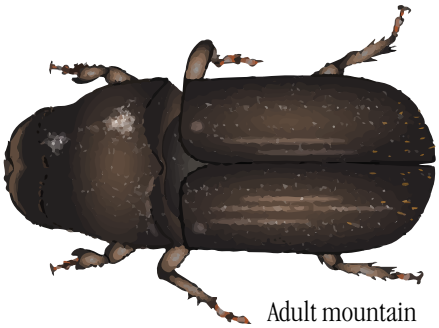
What is the Mountain Pine Beetle?

A Primer for Teachers & Students

You may have heard of a small (usually less than 1 cm long), yet very significant insect: the mountain pine beetle (*Dendroctonus ponderosae* Hopkins). It may be small, but it is the most important insect affecting forests in western Canada and the United States.

The mountain pine beetle (MPB) is a forest insect naturally found in the southern Rocky Mountains; however, until 2006 it had not occurred in the northeastern slopes of the Rocky Mountains or west-central Alberta.

actual size



Adult mountain pine beetle

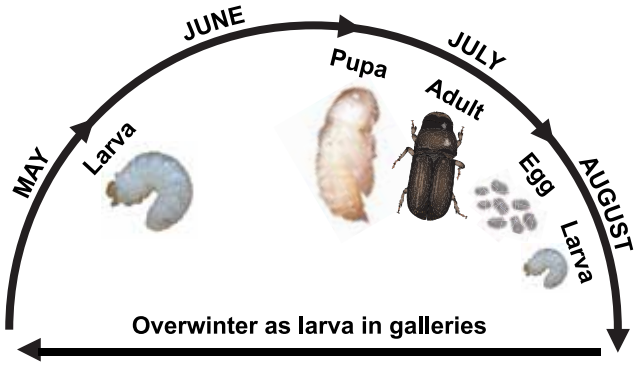
Because it is a bark beetle, the majority of its life cycle is spent under the outer bark of mature pine trees (generally 80 – 120 years old). Adult female beetles bore into **inner bark** called **phloem**. They create j-shaped vertical **galleries** into which eggs are laid. Each female lays about 60 eggs. The eggs mature and develop into **larvae**, and then larvae tunnel away from egg galleries.

Usually, larvae over-winter in the tree, develop into **pupae** in the spring, and in summer emerge as adult beetles. They then exit the tree to find another pine tree **host**, and the cycle continues.

Mountain pine beetle larval galleries

This cycle is usually one year, but may take two years to complete if conditions are not favourable (e.g. rainy summers, cool summers, high altitudes).

Generally, the life cycle of the mountain pine beetle is as follows:



There are four species of pine naturally found in Alberta - lodgepole pine (*Pinus contorta*), jack pine (*Pinus banksiana*) , whitebark pine (*Pinus albicaulis*) and limber pine (*Pinus flexilis*). Each of these pine species can be attacked and killed by MPB.

Lodgepole pine is Alberta's provincial tree. Jack pine spreads from Alberta all the way across Canada. Whitebark and limber pine have been listed as species at risk within Alberta. Whitebark pine is listed as a species at risk federally.

What Role Does it Play in the Forest?

MPB prefers large, mature pine trees and can kill them within a few months of attack. Under normal, low population levels, the beetle plays a role in helping to renew the forest by attacking aging, stressed, large pine trees - a process called **succession**. Succession is the term used to describe the process by which a forest originates, grows and changes over time. Initially, the dead trees provide food and shelter for other species. Eventually, nutrients of these trees are broken down and returned to the soil. By removing larger trees, more light and space are available for young trees to grow. During this **endemic population** stage, it is sometimes difficult to find a beetle in the forest.

MPB is also a food source for some bird, mammal and other insect species. In particular, woodpeckers have adapted to find and eat bark beetles under the bark.

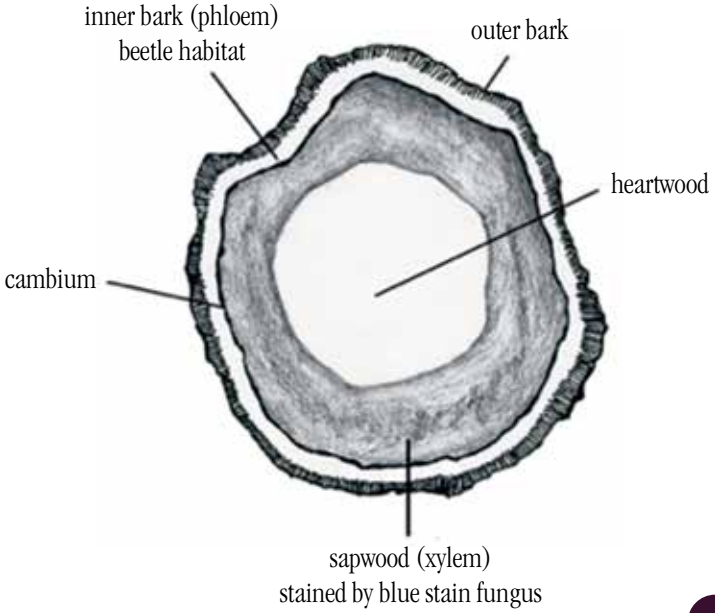
When mountain pine beetle populations are high many trees can be killed which can lead to ecological issues such as;

- The water table in affected areas can change.
- Natural growth or regeneration of new trees can take many years.
- An abundance of dead and very dry trees can increase the risk of large wildfires.

How does mountain pine beetle kill a tree?

Once a female beetle attacks a new host tree, she releases **pheromones** that attract other female and male beetles to the tree – meaning a successful MPB attack always involves many beetles. Sharp mouthparts of adult mountain pine beetles are ideally suited for boring through bark to make long, vertical galleries where eggs are laid. It is also those mouthparts that carry **blue stain fungus** (their body carries it too). Blue stain fungal spores clog up the tree's water-conducting vessels, or **xylem**.

In addition, larvae cause even more direct feeding damage than adults do. They tunnel horizontal galleries around the tree. These galleries remove layers of inner bark, known as **girdling**, disrupting the phloem layer. Phloem is important because it transports nutrients throughout the tree. By disrupting both xylem and phloem of pine trees, MPB larvae and their accompanying blue stain fungus make a deadly combination. Girdling the tree and cutting off nutrient flow in the phloem layer is what causes the tree to die so quickly – within a few months of attack, in most cases.



Signs and Symptoms

A mountain pine beetle attack has the following signs and symptoms:

Outside the Tree

- Yellowish-green to reddish-brown needles throughout the crown of the attacked pine. Depending on the time of year, needles will turn from green to red within a year of attack. Once the needles turn red, the tree is dead and the majority of the beetles have moved to another tree.
- Cream coloured resin (pitch) that looks like crystallized honey oozing out of beetle entry holes(**pitch tubes**) on the tree trunk. The tree's natural defense against the MPB is to try to "pitch" the beetle out of the tree by a flow of sap or pitch. Sometimes the tree can successfully get rid of the beetles before the **gallery** is completed and before any major damage has occurred. These trees will usually survive.
- Round exit holes where adult beetles have left the tree the following year will be evident.
- Boring sawdust found in bark crevices and around the base of the tree.
- An abundance of woodpecker evidence such as flaked off bark can also indicate an attacked tree.

Under the Outer Bark

- Egg galleries (j-shaped and up to 41 cm long) under the bark, beginning above the entrance holes and running along the grain of the wood.
- Larval galleries girdling around the tree.
- Presence of eggs, larvae, pupae and/or beetles.
- Greyish blue sapwood caused by blue stain fungi carried by beetles.

How Did The Beetles Get Here?

The Rocky Mountains were once thought to be a barrier that beetles could not cross over. Beetle populations in British Columbia were so high that they were killing all the pine trees. In 2006, millions and millions of newly developed adult beetles emerged, were caught up in wind currents and blew over the mountains. They landed throughout the north-western and north-central part of Alberta. The same **inflight** of beetles occured again in 2009.

So What Has Changed to Allow Beetle To Live in Alberta?

Normally, MPB populations are kept in check by natural factors such as predators, **parasites**, wet summers, and early, cold snaps or late, cold springs. Mountain pine beetle larvae survive cold winters by producing antifreeze called glycerol. Harsh weather conditions are the most effective means of controlling populations; however, winters in Alberta are no longer cold enought to kill beetles. As a result, they are able to survive in areas where they could not have in the the past.

Limiting or prevention of forest fires on our landscape has resulted in large continuous areas of mature pine trees older than 80 years – MPB's favourite **habitat**. Warmer winter temperatures and a large amount of mature pine on the landscape have combined to allow MPB to expand beyond its historical range.

Suitable pine trees for MPB are found in British Columbia, Alberta and throughout the boreal forest right to the east coast of Canada. As such, this insect can be a very serious threat to the **biodiversity** of forests throughout Canada.

What Can be Done?

There are no easy answers to this question!

Dealing with the spread of the MPB is not a simple task. Currently in Alberta, more than 1.27 million **hectares** of forest have sustained some level of MPB damage. This figure represents about 20 percent of the more than six million hectares of forest at risk of MPB **infestation**. In addition to the large size of the area affected, many different land objectives and land managers are involved. This requires careful and timely consideration.

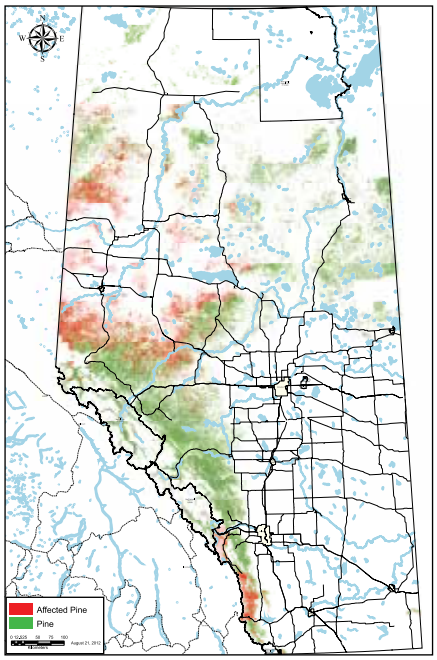
The beetle is difficult to control. It is protected under the bark for most of its life except for when the newly developed adult beetles fly to find new host pine trees. Because they are out of the tree for such a short time, **pesticides** that would kill beetles are not very effective. In addition, these chemicals could harm beneficial insects.

In Alberta, there are two main approaches to mountain pine beetle control: a short-term strategy that focuses on beetle-infested trees and a long-term strategy focusing on beetle-susceptible pine stands.

Short term strategy

The short-term beetle strategy focuses on limiting the spread of the infestation before it reaches **outbreak** levels, and containing the population if/when it becomes an outbreak. This strategy requires prevention, monitoring for early detection, and quick control of infestations when populations are small. To reduce the risk of mountain pine beetle attacked trees moving from an infested area to a new area, Alberta restricts transportation of pine logs with bark attached — especially during the summer beetle flight. This includes firewood!

Ground and **aerial surveys** are used to monitor MPB populations. Detection is difficult because the main identifying characteristic of a MPB-infested tree — red needles — is good evidence to find out where the mountain pine beetles were, not where they are, and even more important, where they are going.



Total area affected in Alberta as of August 21, 2012

Control involves removing attacked trees by cutting them down soon after detection, and before adults leave to find new trees. Cut trees are then destroyed by burning, peeling off the bark or processing them. Pheromone baits can be used to attract and contain beetles in a given area designated for future tree removal.

Long term strategy

The long-term strategy involves reducing the future threat of mountain pine beetle outbreaks by carefully planning to replace highly susceptible and **contiguous** mature pine stands with less susceptible stands of mixed species and age classes. These stands will then be more resilient to insect outbreaks, less susceptible to large wildfires and have improved wildlife habitat. The approaches to create a more diverse forest include: **prescribed burning**, reduction of MPB-susceptible host trees and harvesting of stands (earlier than normal) to reduce available host trees for beetles. Replanting with species other than pine, where possible, could also be implemented.

Summary

From a human perspective, we rely on the forest more than ever to meet a variety of economic and social needs. The widespread MPB outbreak in British Columbia has had significant economic and social impacts on the forest products industry, communities and tourism. Loss of income, resources and jobs are a result of the MPB outbreak. Alberta faces the same potential impacts currently being felt in British Columbia.

It is important to keep in mind that the mountain pine beetle is native to British Columbia and some parts of Alberta, and does have a role to play in a healthy forest; however, things have changed. A general climate warming trend and years of **fire suppression** have created large areas of good beetle habitat, which has been favourable for its expansion. This is a grave concern as society increases its reliance and places higher values on the forest to meet a variety of social, economic and environmental needs.

To help address this large and complex issue, federal, provincial and municipal governments, the forest industry, and researchers are working together to best manage mountain pine beetle in Alberta to limit the impact on forest values.

What is the Mountain Pine Beetle?

Student Worksheet

Answer the following questions based on the information given in the Primer or your own research.

1. Describe the four stages in the development of the mountain pine beetle.

   I.

   II.

   III.

   IV.

2. How long is the average life cycle of mountain pine beetle?

3. What conditions can affect the length of the life cycle of mountain pine beetle?

4. Write a 1-2 paragraph newspaper article on the process of mountain pine beetle attacking and killing a pine tree using the headline: *Tag Team Pair Wreaking Havoc*

5. Why do you think that mountain pine beetle is more attracted to older pine trees? (hint: think about where in the tree they spend most of their time)

Journal Activity

Learning Log

Purpose

- to summarize learning about mountain pine beetle through a creative journal project

Materials

- sheet of 8.5 x 11 white paper

Time Needed

- varies depending on project

Class Arrangement

- individual

Procedure

- Before starting the following activities, each student receives a blank sheet of white paper for use as both a title page and journal for the length of the program.
- students sketch or write a brief description of what they've learned about mountain pine beetle.
- Use the finished title page/journal as an assessment of student learning

Mountain Pine Beetle Title Page/Journal Evaluation Rubric

Category	4	3	2	1
Information	All information presented on the title page is clear, accurate and thorough.	Most information presented on the title page is clear, accurate and thorough.	Most information presented on the title page is clear and accurate, but was not usually thorough.	Information has several inaccuracies OR is not clear.
Use of Facts and Statistics	Major points are well supported with several relevant facts, statistics and/or pictures.	Every major point is adequately supported with relevant facts, statistics and/or pictures.	Every major point is supported with facts, statistics and/or pictures, but the relevance of some was questionable.	Every point is not supported.
Understanding of Topic	The student clearly understood the topic in-depth and presented information effectively.	The student mostly understands the topic in-depth and presents information adequately.	The student understands the major points about the topic and presents information somewhat effectively.	The student does not show understanding of the topic well.
Completion and Organization	Title page space is well-filled with relevant information and organized logically.	Title page space is filled with relevant information and shows mostly logical organization.	Title page space is almost filled with relevant information and shows somewhat logical organization.	Title page space is not well-filled and information does not show logical organization.

What Do You Know About The Mountain Pine Beetle

Pre and Post Survey

Purpose

- to assess student knowledge of the topic before the start of the activities
- to assess what learning occurred over the course of the program

Materials

- What Do You Know About the Mountain Pine Beetle? worksheet (one copy per student)
- What is the Mountain Pine Beetle? – A Primer for Teachers and Students (one copy per student)

Time Needed

- 30 - 60 minutes

Class Arrangement

- individual and small groups (4-6 students)

Procedure

- Students work through the mix of knowledge and attitude questions individually.
- After completing the survey individually, students get into small groups to discuss their answers.

Questions are worded to provide for good discussion.

- After discussion, students re-circle answers to see if the discussion influenced and/or changed their answers.
- Extension: Have students read "What is the Mountain Pine Beetle?– A Primer for Teachers & Students" and either discuss or write down answers to the five questions at the end of the Primer. Questions 9 – 13 are attitude based. Discuss with students if their answers would be any different if they lived in different parts of the province.

What Do You Know About The Mountain Pine Beetle

Student Worksheet

Name: _____

You are going to be learning about the mountain pine beetle and the effect it could have on Alberta's forests.

Circle the appropriate number that corresponds to your opinion or knowledge about each statement.

Then, with your group, go through each statement and discuss what you know about the topic. Re-circle a number for each statement (with another colored pen/pencil) showing how your opinions changed (if at all) after discussion with your group.

1. Mountain pine beetle is currently found all across Alberta.

   True False Don't Know

2. Putting out forest fires can help to increase the spread of mountain pine beetle.

   True False Don't Know

3. A single mountain pine beetle can kill a tree.

   True False Don't Know

4. The mountain pine beetle was introduced into Canada from Europe.

   True False Don't Know

5. You can rarely tell if mountain pine beetle has attacked a tree.

   True False Don't Know

6. The mountain pine beetle is an important food source for some bird species.

   True False Don't Know

7. Pesticides are the most effective way to kill mountain pine beetle.

   True False Don't Know

8. Mountain pine beetle mainly attack young, healthy pine trees.

   True False Don't Know

9. Mountain pine beetle has had a huge effect on Alberta's forests.

   1 2 3 4 5 Strongly Agree Neutral Strongly Disagree

10. The mountain pine beetle could have a big effect on you or your family.

    1 2 3 4 5 Strongly Agree Neutral Strongly Disagree

11. A healthy forest is a forest with no tree-killing insects or diseases.

    1 2 3 4 5 Strongly Agree Neutral Strongly Disagree

12. Mountain pine beetle needs to 'run its course' in the forest.

    1 2 3 4 5 Strongly Agree Neutral Strongly Disagree

13. The mountain pine beetle helps contribute to the biological diversity of a forest ecosystem.

    1 2 3 4 5 Strongly Agree Neutral Strongly Disagree

The Rise & Fall of the Mountain Pine Beetle

Class Demonstration and Graphing Activity

Purpose

- to understand the differences and connection between endemic, incipient, epidemic, and declining phases of a mountain pine beetle outbreak
- to understand that when natural controls are in place, mountain pine beetle populations stay in balance

Materials

- The Rise & Fall of the Mountain Pine Beetle Class Demonstration Script (one copy for teacher)
- The Rise & Fall of the Mountain Pine Beetle worksheet (one per student)
- graph paper, ruler, and pencils (one set per student)

Time Needed

- 60 Minutes

Class Arrangement

- individual and class

Vocabulary

endemic
incipient
epidemic
declining
limiting factors
outbreak
natural controls

Procedure

- Following the directions on the next page, lead the students through the class demonstration using The Rise and Fall of the Mountain Pine Beetle Class Demonstration Script.
- Using the remaining materials listed above (graph paper, ruler, pencils), students examine the rise and fall of mountain pine beetle populations while doing the graphing activity on The Rise and Fall of the Mountain Pine Beetle worksheet.
- Students graph how the population (y-axis) of mountain pine beetle changes over time (x-axis)with no human controls. They will then label each section of the line on the graph with where each of the phases is represented.
- **Extension:** have students think about what happens to the graph when a major fire in an area wipes out most of the 80-120 year old pine and what happens after several years of early fall or late spring –40 ºC or lower temperatures that kill off many of the larvae.

Teacher Note: Sample graphs have been provided for you, but student graphs will vary depending on when they have the scenarios occur. These differences are a good discussion tool – each student's graph will be different just like in a forest ecosystem where some areas will experience a fire or climate differences at different times.

The Rise & Fall of the Mountain Pine Beetle - cont'd

Class Demonstration Script

Introduction

We will use the following demonstration to model the normal (historical) pattern of outbreaks of MPB.

Teacher Note: Outbreaks of MPB in Alberta followed a different population pattern than what this activity depicts. Alberta experienced inflights of MPB from British Columbia, resulting in a sudden increase of beetle attacked trees. Beetles arrived in west-central Alberta for the first time ever in June 2006. Strong winds occurred at the same time beetles emerged from their pine hosts, and carried them 400 kilometers from central British Columbia into the region. In 2009, another long-distance disbursal carried beetles from British Columbia into Alberta. Beetles disbursed into relatively the same area, however, they were detected farther east and in higher numbers.

The following are **limiting factors** for the mountain pine beetle

1) woodpeckers
2) cold winters, wet summers
3) forest fire (hot!)
4) nematodes (small worms)
5) parasitic fungi
6) other insects
7) a lack of suitable pine trees
8) 'pitching out' – a natural defense by the tree

Procedure
(for a class of 25 – 30 students)

1. **Endemic phase**: Have five students in the class stand up. They represent the trees within the forest (the class) that are attacked by MPB. During the endemic phase, MPB levels are low and they attack older, weaker trees randomly. This is considered a 'normal' beetle population. Under normal circumstances, climatic conditions and predation keep the beetle levels in check. MPB performs an important role in the ecosystem; they remove mature trees from the canopy, allowing younger trees to grow up in their place. This stage will last until one of the limiting factors is removed. Have three of the students sit down because the 'beetles' have been killed by cold, fire, or predation.
2. **Incipient phase**: During the 'incipient' phase, beetle numbers increase because at least one of the limiting factors is missing (i.e. no forest fire in the area, warm winters, and abundance of host pine trees). Have ten more students stand up with the other two. The beetle attack is still random, but the number of trees affected increases.
3. **Epidemic phase** ('Outbreak'): When the number of beetles within a forest ecosystem reaches a certain number, they have the ability to attack almost all of the mature trees, and even some of the younger ones. At this stage, none of the limiting factors, and even human controls can restore the balance. Have the students who are 'attacked' with MPB tag another student nearby and have them stand up too. Any students within arm's reach of an 'attacked' student, must stand up. This is the 'epidemic' phase.
4. **Declining phase**: In this final stage of the epidemic cycle, the number of beetles declines because of a lack of suitable hosts, or because of fire and/or cold conditions, bringing the population back down to normal 'endemic' levels. Have all but one of the students in the class sit down (choose one student at random to remain ''attacked'). Look around the class at all of the 'dead' trees. What will happen now? (Student answers will vary, but possible answers could be: young seedlings can grow up in the shadow of the dead trees from seeds dropped from cones, remaining beetle population will have to migrate to another older pine forest for food/habitat, forest companies could possibly use some of the timber.)

Teacher Note: In order for mountain pine beetle populations to stay in check, 97.5% of all offspring must die. If only 95.5% die in a year, it can prompt an outbreak.

Graphing Activity

Name: _____

Using the following definitions and your graph paper, sketch the pattern mountain pine beetle follows in becoming an epidemic in the forest. Your graph should have the population level of the MPB on the y-axis and time on the x-axis. Draw a line to represent the change in population level as the MPB passes through each phase and label each section of the line on the graph where each of the phases is represented:

1. **Endemic phase** – very low populations of beetles randomly attack weak and old trees throughout the forest.

   Timeline: this stage can last for decades. (For this example, use 10-20 years.)

2. **Incipient phase** – increased migration of beetles from infested areas, decreased larval mortality from favourable weather conditions (warm winters), and decreased effectiveness of natural controls (e.g. bird predators) cause increased numbers of infested trees.

   Timeline: this stage can last for 2-3 years.

3. **Epidemic phase** – usually only in areas with many mature host trees. Large population outbreaks of beetles cause wide-scale tree **mortality**.

   Timeline: this stage can last several years if there are enough hosts available.

4. **Declining phase** – a lack of host trees or unfavourable climate conditions (e.g. cold winters) cause increased beetle mortality.

   Timeline: this stage can last a few (2-3) years and leads back to the endemic phase.

Choose one of the following to complete this activity:

Extension 1
Draw the same x- and y-axis labels on a new graph. Mark a vertical line along the x-axis representing a major fire in an area that wipes out most of the 80+ year old pine during the incipient phase of a beetle epidemic cycle. Now re-draw the stages of the MPB, showing how the beetle population will change because of the fire. How is this graph different than your first one?

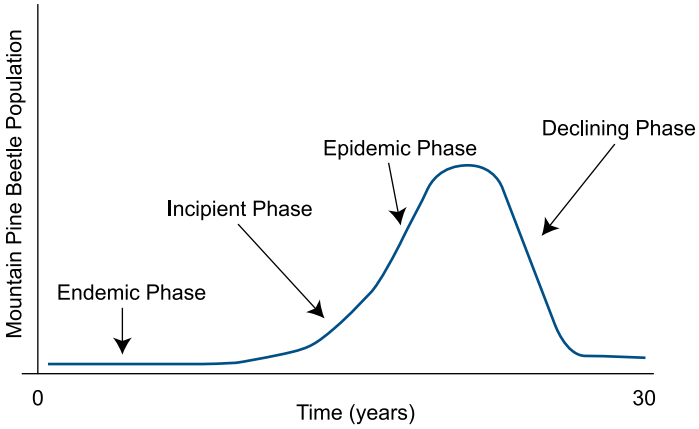
Extension 2
Draw the same x- and y-axis labels on a new graph. Mark a few vertical lines along the x-axis representing several years of early fall or late spring –40 ºC or lower temperatures that kill off many of the larvae during the epidemic phase of a beetle epidemic cycle. Now re-draw the stages of MPB, showing how the population will change because of these years of weather effects. How is this graph different than your first one?

Extension 3
In your own words, tell the story of a MPB infestation in a pine forest. Be sure to use the following terms: endemic phase, incipient phase, epidemic phase, declining phase.

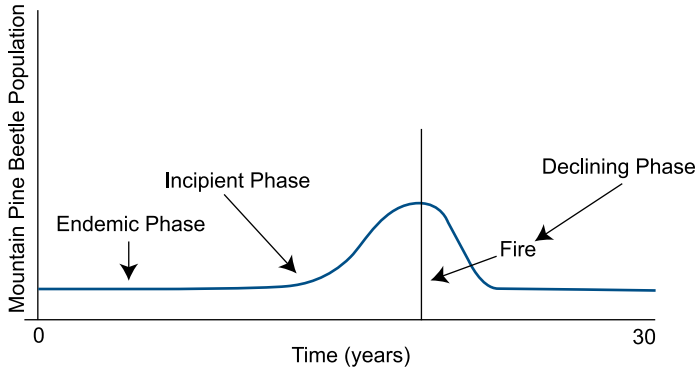
The Rise & Fall of the Mountain Pine Beetle - cont'd

Sample Student Answers

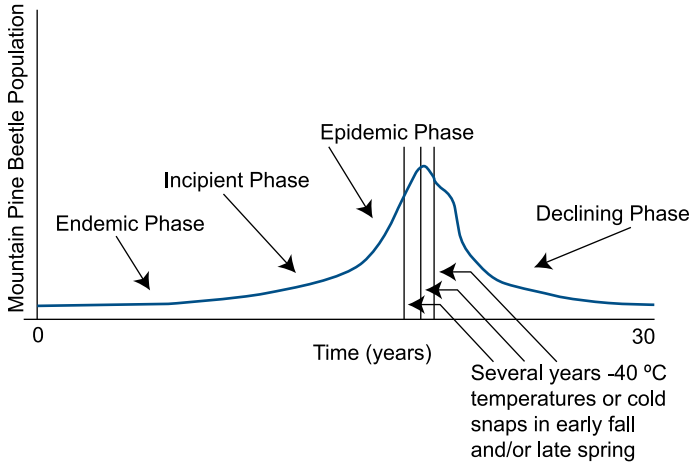
Mountain Pine Beetle Typical Population Growth



Extension 1
A Fire Removes Most of the 80+ Year Old Pine



Extension 2
Several Years of -40 ºC or Cold Snaps in Early Fall or Late Spring



Examining Epidemics

Data Interpretation

Purpose

- to use maps and data to analyze how MPB epidemics have occurred in the past and may occur in the future

Materials

- computer lab time to access www.mpb.alberta.ca and/or do key word search on highlighted words in vocabulary
- Examining Epidemics student worksheet (one set of questions/ graphs per student or pair)

Time Needed

- 45-60 minutes

Class Arrangement

- individual or pairs

Vocabulary

Historical outbreaks
Mean monthly temperature
Climate change
Mountain Pine Beetle
Epidemic
Endemic
Temperature

Procedure

- Have students set themselves up in the computer lab and bookmark the website noted previously.
- Have students work through the questions listed on the Examining Epidemics worksheet while in the computer lab.

Examining Epidemics

Student Worksheet

Name: _____

Mountain pine beetle outbreaks have occurred in the past, but not with the severity of the current outbreaks in British Columbia and Alberta. Governments, industry, and other land managers have been keeping track of outbreaks in order to learn more about how and when these events occur.

Using the Alberta Government's mountain pine beetle website, and the charts that have been provided, answer the following questions:

1) Examine the historical maps of MPB outbreaks at http://www.mpb.alberta.ca/BeetleFacts/HistoryOfInfestations.aspx
Where in Alberta have outbreaks occurred historically? Why might outbreaks have happened in these areas?

_____

_____

_____

2) Look at the *Mean Monthly Temperature in Banff During the Month of November* graph below. Explain why you think the MPB outbreak of 1985 did not continue to 1986.

_____

_____

_____

3) Why is the temperature in November particularly important to MPB? How could an overall increase in temperature due to climate change affect the population of MPB?

_____

_____

_____

4) Using the *'Mean Monthly Temperature in Banff During the Month of November'* graph, in what year would you predict there to low numbers of MPB? Why?

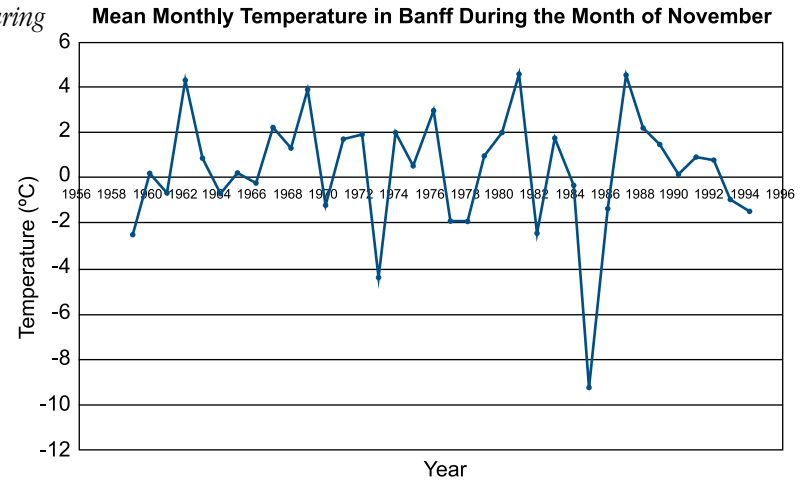
_____

_____

_____

_____

_____



Environment Canada: Climate Change Data

5) In Alberta, there are unique areas in the forest where pure lodgepole pine and pure jack pine have bred together to create lodgepole/jack pine hybrid trees. MPB are able to attack, kill and reproduce in hybrid and pure jack pine. Jack pine is a significant component of the boreal forest. Examine the map at http://cfs.nrcan.gc.ca/pages/251. List at least 3 provinces in Canada that could be directly affected by MPB if it were to spread through the boreal forest.

_____

_____

_____

6) Using the maps located at:
www.mpb.alberta.ca/Resources/documents/MPB-PineAffectedByMPB-Aug2012.pdf
www.mpb.alberta.ca/Resources/documents/MPB-InfestationOverTime-2012.gif

   a. The per cent of Alberta covered with pine trees.

   b. The per cent of those trees that have been affected by the MPB.

What's the Problem

Mind Mapping Activity

Purpose

- to understand that climate change and fire suppression have had and probably will have the biggest effect on mountain pine beetle populations
- to think about the effect mountain pine beetle populations have on humans and introduce the role humans have in healthy forest management

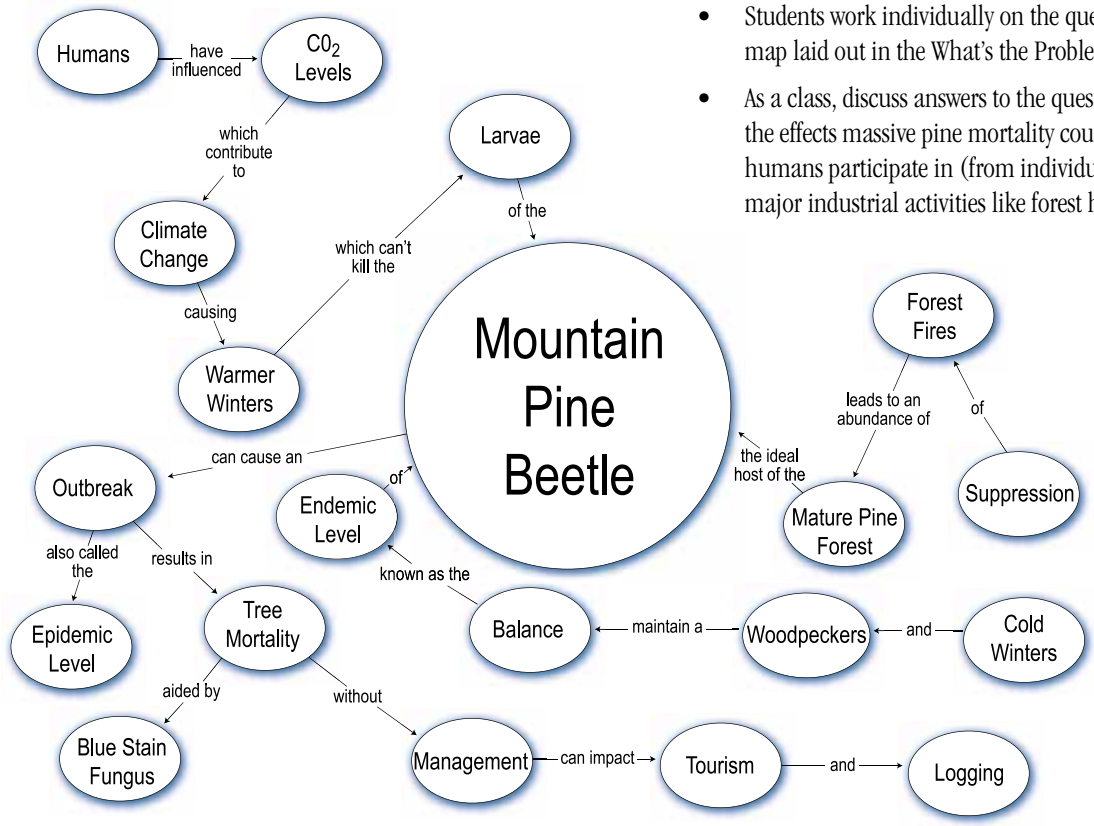
Materials

- What's the Problem? worksheet (one per student or group)
- large sheet of chart paper
- markers

Time Needed

- 45 minutes

Sample Mind Map



Class Arrangement

- pairs or small groups for mind map, individually for remaining questions

Vocabulary

Climate change
Mortality
Severe weather event
Growing season

Procedure

- Discuss the idea of a 'mind map' for students who have not done one before – key concepts are linked together to form cause and effect statements all leading back to the main focus: mountain pine beetle.
- A sample mind map has been included for your use – you may want to start with one common example for all groups if students are new to this style of activity.
- Students work individually on the questions following the mind map laid out in the What's the Problem? worksheet.
- As a class, discuss answers to the questions, making a list of all the effects massive pine mortality could have on the activities humans participate in (from individual activities like hiking to major industrial activities like forest harvesting).

Teacher Note: Use mind map technology like 'Inspiration' software.

What's the Problem

Student Worksheet

Name: _____

The mountain pine beetle is at the center of a big challenge. In this activity, you will look at how MPB populations affect the forest and how climate change and human activities can influence MPB.

1. The Six Degrees of Mountain Pine Beetle

   Create a 'mind map' linking the mountain pine beetle to the factors that affect it or that it affects. Using a large sheet of paper, a marker, and the key concepts relating to mountain pine beetle below, your job is to take the key concepts and arrange them into a logical train of thought (cause and effect) using lines and arrows. You need to connect the concepts using logical statements. Feel free to add in any additional concepts to help with your map.

   Key concepts for the mountain pine beetle:

climate change	forest fire	outbreak	warmer winters	fire suppression
larvae	woodpeckers	tree mortality	humans	endemic levels
balance	CO_2 levels	stressed pine	mature pine forests	logging

2. Brainstorm outdoor activities you participate in during the year (e.g. camping, fishing, ATV-ing, skiing, hunting).

   _____

   _____

   _____

3. Outline the positive and negative effects that massive pine forest mortality due to increased mountain pine beetle will have on those activities.

   _____

   _____

   _____

4. Pick one major industry active in Alberta's forests and outline the positive and negative effects increased pine mortality from mountain pine beetle may have on that industry.

   _____

   _____

   _____

Stopping the Spread

Management Activity

Purpose

- to give students an awareness of the variety of choices that can be made regarding management of mountain pine beetle

Procedure

- Students work through Part 1 & Part 2 individually using the *Stopping the Spread* worksheet.
- The main techniques used for controlling the spread of MPB in Alberta (cut and burn, cut and peel, sanitation harvesting, reduction of beetle habitat through prescribed burn, encouraging tree species diversity and a wide age range of trees) are explained in Part 1's matching activity.
- Part 2 has students think about what management options could be used when populations are low or endemic, in the incipient phase, at small-scale epidemic levels, or at larger-scale epidemic levels.
- For Part 3, divide students into small groups (2-3 students per group) and assign them one of the listed perspective groups.
- Outline the 'Town Hall' debate that all students will be participating in and what the situation is around the town with respect to the MPB situation. Each group needs to examine the chart on their worksheet and come up with at least two to three ideas supporting their groups perspective and at least two to three ideas on how that would affect the other groups and possible compromises they could make to address those effects.
- Hand out the evaluation rubric before beginning the debate so students know how they will be evaluated.
- Give students approximately 30 minutes to prepare their presentation and be prepared to be the facilitator of the debate. Once each group has presented on their perspective, facilitate discussion where groups attempt to come up with a plan for the area around the town.
- Once a plan has been reached, summarize the activity by discussing how in the 'real world', decisions are never easy and compromise is necessary in order to balance the needs of all the users of the forest as well as the needs of the ecosystem.

Materials

- *Stopping the Spread* student worksheet (one per student)

Time Needed

- 60 minutes (Part 1, 2, and introduction to 3)
- 60 minutes (Part 3 small group discussion & town hall meeting)

Class Arrangement

- individual (Part 1 & 2)
- small groups (Part 3)

Vocabulary

species diversity
age distribution
prescribed burn
cut and burn
cut and peel
sanitation harvesting
host
forest stand
fire hazard
infestation

Stopping the Spread Part 1

Student Worksheet

Name: _____

You should now have some understanding of the mountain pine beetle and many of its effects on the forest. In Alberta, we have different options for managing MPB and controlling its spread. In this activity, you will work through several small exercises to determine which of these options is most useful in which situations.

Match the possible management option in the left column with its description in the right column.

Short-term options

_____ cut and burn

_____ sanitation harvesting

_____ cut and peel

A) Removing vulnerable stands in the path of the outbreak to promote the growth of various tree species (e.g. spruce, pine, aspen) that reduce the number of hosts for mountain pine beetle.

B) Fire that is intentionally set and controlled to encourage a wide age distribution of trees and reduce habitat available for the beetle.

C) An infested tree is cut before the beetles emerge, cut up into smaller pieces, and burned until at a minimum, the bark is completely charred.

Long-term options

_____ prescribed burn

_____ harvesting at-risk stands

D) An infested tree is cut before the beetle emerges and the bark is peeled off both the felled tree and the stump.

E) The infested trees are harvested (magnitude depends on the size of the outbreak) and beetles are killed in the process of making the tree into a product.

Stopping the Spread Part 2

Student Worksheet

1. Pick one of the forest treatments in Part 1 and brainstorm what you think might be one advantage and one disadvantage to using that technique.

   Advantage _____

   Disadvantage _____

2. For the different situations below, consider the forest treatments listed in Part 1 you would choose if you were the land manager for the area. Be sure to write why you chose a particular option.

   a. There is an outbreak in an area that has had a very dry spring and where the fire hazard is quite high.

   _____

   _____

   _____

   b. There is a small infestation in an area that is not easily accessible by machinery.

   _____

   _____

   _____

   c. There is an outbreak that covers a large area with many trees affected.

   _____

   _____

   _____

   d. There is an infestation in an area that is very sensitive ecologically.

   _____

   _____

   _____

Stopping the Spread Part 3

Student Worksheet

As a class, you are going to debate which of the above strategies should be used in your area. The situation is as follows:

You live in a large town on the eastern side of the Rockies. The mountain pine beetle has crossed from British Columbia into Alberta through the mountains over the past few years and has now killed hundreds of trees around your town. You are invited to a 'town hall' style debate in which you will try to sway the local politician (your teacher) to act on the beetle problem in a way that benefits you. You will be grouped and given a perspective to debate from.

Your group may be one of the following:

- homeowner in town
- oil and gas company
- tour operator (i.e. whitewater rafting company or trail ride outfitter)
- national park staff
- the local Chamber of Commerce
- a "leave no trace" camping group
- provincial government forestry staff
- private landowner
- forester with a forest company
- local First Nations

How do you want the problem dealt with? How will you make sure that the politician will keep your interests in mind?

_____

_____

_____

_____

_____

Once you are in your groups, use the following chart and all of the information you have learned to guide your preparation for the town hall meeting:

If I was the following person, the _____, and was dealing with with MPB in the forest surrounding my community…	…what would I do…	…and what would be the effects on other groups in my community?

Mountain Pine Beetle Management Town Hall Meeting

Evaluation Rubric

Category	4	3	2	1
Respect for Other Teams	All statements, body language, and responses were respectful and were in appropriate language.	Statements and responses were respectful and used appropriate language, but once or twice body language was not.	Most statements and responses were respectful and in appropriate language, but there was one sarcastic remark.	Statements, responses and/or body language were consistently not respectful.
Information	All information presented in the debate was clear, accurate and thorough.	Most information presented in the debate was clear, accurate and thorough.	Most information presented in the debate was clear and accurate, but was not usually thorough.	Information had several inaccuracies OR was usually not clear.
Rebuttal	All counterarguments were accurate, relevant and strong.	Most counterarguments were accurate, relevant, and strong.	Most counterarguments were accurate and relevant, but several were weak.	Counter-arguments were not accurate and/or relevant.
Use of Facts and Statistics	Every major point was well supported with several relevant facts, statistics and/or examples.	Every major point was adequately supported with relevant facts, statistics and/or examples.	Every major point was supported with facts, statistics and/or examples, but the relevance of some was questionable.	Every point was not supported.
Presentation Style	Team consistently used gestures, eye contact, tone of voice and a level of enthusiasm in a way that kept the attention of the audience.	Team usually used gestures, eye contact, tone of voice and a level of enthusiasm in a way that kept the attention of the audience.	Team sometimes used gestures, eye contact, tone of voice and a level of enthusiasm in a way that kept the attention of the audience.	One or more members of the team had a presentation style that did not keep the attention of the audience.
Organization	All arguments were clearly tied to an idea (premise) and organized in a tight, logical fashion.	Most arguments were clearly tied to an idea (premise) and organized in a tight, logical fashion.	All arguments were clearly tied to an idea (premise) but the organization was sometimes not clear or logical.	Arguments were not clearly tied to an idea (premise).
Understanding of Topic	The team clearly understood the topic in-depth and presented their information forcefully and convincingly.	The team clearly understood the topic in-depth and presented their information with ease.	Th e team seemed to understand the main points of the topic and presented those with ease.	The team did not show an adequate understanding of the topic.

Pine Beetle Squares

Wrap-up Activity

Purpose

- to quickly assess student knowledge learned throughout this guide.

Materials

- one set of nine sheets of paper with a large 'X' on one side and a large 'O' on the other
- list of questions (below) to ask student volunteers

Time Needed

- 20 Minutes

Class Arrangement

- class activity

Procedure

- Follow the same rules as the TV game show 'Hollywood Squares'.
- Nine student volunteers come up to the front to be the game board (top row needs to stand on chairs or counter, middle row stands on the ground, front row sits on chairs). Each of the nine game board members hold a card beside them until they answer a question.
- The rest of the class is divided in half (an 'X' team and an 'O' team). One team is chosen to go first.

  They ask one member of the game board to answer a multiple-choice or true/false question posed by the teacher. The team then needs to decide whether they 'agree' or 'disagree' with the game board player's answer. If they agree or disagree correctly, their letter goes up on the game board, if not the other team's letter goes up instead (unless it's for the win—team needs to answer their own question to win).
- If no team can finish a line, the team with the most letters on the board wins.
- This activity can also be used as an introductory activity to mountain pine beetle.

Pine Beetle Squares

Questions

1) The mountain pine beetle is a native insect to which of these provinces of Canada:

   a) New Brunswick

   b) Ontario

   c) British Columbia

2) What do we call the tree that forest insects damage?

   a) Host

   b) Unlucky

   c) Carrier

3) The main Alberta host of the mountain pine beetle is

   a) White spruce

   b) A nice person in Canmore who actually likes the beetle

   c) Lodgepole pine

4) Mountain pine beetle larvae feed on the _____ of the tree.

   a) Phloem (inner bark)

   b) Leaves

   c) Fruit

5) Once female mountain pine beetles have successfully attacked a tree, how long does it *usually* take to kill* that tree?

   a) Three days.

   b) Two years.

   c) One season to one year

   *MPB will not always kill the tree; the tree can sometimes 'pitch' them out.

6) Flying above a forest, how can you tell that an area has a mountain pine beetle outbreak?

   a) The trees are black looking like a burn after a forest fire.

   b) The trees are red from the needles changing colour as the tree dies.

   c) There are no branches left on the tree.

7) Mountain pine beetles always have a one year life cycle.

   TRUE or FALSE

8) The major natural control for a mountain pine beetle outbreak is:

   a) Cold temperatures in early fall or late spring (-40 ºC or lower) when beetles are in their larval stage.

   b) A very warm winter, as beetle larvae need cold weather to develop properly.

   c) A big forest fire that kills the host pine trees.

9) The mountain pine beetle has what kind of a relationship with blue stain fungi*?

   a) Parasitic (the beetle benefits, but has a negative effect on the blue stain fungus)

   b) Symbiotic (the beetle and the blue stain fungus benefit from their relationship)

   c) Commensalistic (the beetle benefits, and has no effect on the blue stain fungus)

   * Blue stain fungus is carried to new trees by the mountain pine beetle and in turn 'helps out' the beetle by blocking the resin ducts in the tree, thus preventing the tree from fighting off a beetle invasion.

10) What symptom on the outside of the tree indicates that it may be attacked by mountain pine beetle?

    a) Beetles swarming on the outside of the tree.

    b) Pitch tubes (sap dripping) and sawdust at the bottom of the tree.

    c) Blue trees from the blue stain fungus that travels on the beetle.

11) Mountain pine beetles have historically had a tough time moving into Alberta because:

    a) Cold Alberta winters usually killed them and the Rocky Mountains were a natural barrier to their movements.

    b) They can't decide where to go.

    c) There are more woodpeckers in Alberta to eat them.

12) Climate change could result in:

a) It raining cats and dogs

b) An increased number of severe weather events

c) An expansion of the boreal forest into the prairies

13) Historically, where in Alberta has there been an epidemic mountain pine beetle population?

a) Jasper National Park

b) Crowsnest Pass*

c) There has never been an epidemic in Alberta.

* This epidemic began in the late '70s and carried into the '80s

14) Mountain pine beetle is also found in which of the following U.S. States:

a) Hawaii

b) Alaska

c) Oregon*

* Its range is from the Pacific Coast east to the Black Hills in South Dakota, up to northern BC/western Alberta, and down as far south as northwestern Mexico.

15) What is one human control method used to manage the mountain pine beetle:

a) Cut down attacked trees and burn them

b) Catch-and-release them into the United States

c) Breed extra woodpeckers and release them into mountain pine beetle infected areas

16) The term we use to describe a major mountain pine beetle outbreak is:

a) An unfortunate event

b) An epidemic

c) An endemic attack

17) The main reason we fear the spread of the mountain pine beetle in Alberta is:

a) It will provide woodpeckers with too much food and they will get fat.

b) Our pine forests are old and the beetles could spread quickly, killing large areas within a year

c) It will take over areas that other types of beetles inhabit.

Bonus Question:

The current mountain pine beetle situation is not very important.

a) No. Actually, it is quite important from an environmental, economic, and social perspective.

b) All of the above.

c) Choose a.

Glossary of Terms

Aerial survey
Identifying suspected MPB killed trees from a plane or helicopter. Beetle-killed trees are identified by the discoloration of needles within the first year of attack.

Age distribution
The range of tree ages in a forest stand.

Age-class distribution
The distribution of different age classes within the population being examined. (*Dictionary of Natural Resource Management*)

Baiting
The use of synthetic pheromone baits to detect the presence of MPB in a new area or to monitor changes in the population. It can also be used to attract beetles to a controlled forested area.

Biological diversity (biodiversity)
The variety and variability of living organisms within an ecosystem.

Blue stain fungus
One of several fungi that has a symbiotic relationship with MPB. Spores of the fungus are carried from tree to tree in the beetle's mouth pouches, and stains the wood blue.

Cambium
The living layer of the tree between the sapwood and inner bark that produces new phloem and xylem.

Climate change
Changes in climate (such as temperature, precipitation, wind) that differ significantly from previous average conditions and are seen to endure.

Contiguous
Sharing an edge or boundry. For example, old, mature pine stands that are contiguous with healthy pine forests pose a greater threat of spread than non-contiguous stands.

Cut and burn
A treatment option that includes cutting and burning of either a single tree or small patches of trees that are currently infested. The purpose from a forest health perspective is to destroy beetle populations in the trees.

Cut and peel
A treatment option that includes hand falling and peeling (removing) the bark off either a single tree or small patches of currently infested trees. This method exposes beetles to the elements, and they die from exposure.

Declining population
The last stage in an epidemic cycle where population levels decrease to their normal, or endemic levels. This stage is caused by lack of suitable hosts and/or harsh climatic conditions that increase beetle mortality.

Endemic population
The normal population native to the area that is kept in check by natural factors. It is the first phase of a mountain pine beetle epidemic cycle.

Epidemic population
A population of an organism that is well above the endemic level. It is a temporary, large-scale outbreak. In the case of MPB, the population has the ability to infest almost all mature pine trees in the forest stand. Natural factors are no longer effective in beetle control, when in this phase.

Fire hazard
The level of risk for ignition and/or spread of fire in a forest. A general term to describe the potential fire behaviour, without regard to the state of weather-influenced fuel moisture content, and/or resistance to fireguard construction for a given fuel type.
http://www.srd.alberta.ca/Wildfire/Default.aspx

Fire suppression
All activities concerned with controlling and extinguishing a fire following its detection.
http://www.srd.alberta.ca/Wildfire/Default.aspx

Forest stand
A group of trees in a given area that have similar characteristics (e.g. age or species) and can be uniquely distinguished from adjoining areas.

Gallery
A tunnel carved into the inner bark of the tree by the adult mountain pine beetle to lay eggs or by larvae for food.

Girdling
A term used to describe the damage done to the phloem layer (inner bark) in a circle around a tree. Girdled trees will often die because the flow of nutrients and water is broken between the needles and the other parts of the tree, such as the roots.

Ground survey
A survey that involves walking into a forest and making forest health observations of a given area. If suspected MPB-killed trees are identified from an aerial survey, a scientist will head out to a site to confirm the presence of MPB.

Growing season
The length of time in a year in which trees are actively photosynthesizing. The frost-free part of any one year. (*Dictionary of Natural Resource Management*)

Habitat
The area in which an organism usually lives.

Hazard
The condition of stands (susceptibility) and the prevailing environmental conditions (such as climate)that are conducive to a mountain pine beetle attack. Does not include the probability that this will occur.

Hectare
An area 100m long by 100m wide – just under the size of two football fields.

Host
The plant or animal on which an insect feeds.

Host susceptibility
The lack of ability of a host species to withstand MPB attack. Factors that could affect susceptibility would be tree age, tree diameter, tree species and tree stress.

Incipient
A population of an organism that is on the rise due to a lack of at least one limiting factor.

Infestation
A large-scale temporary increase in numbers in a given location, where the insect and its damage are noticeable.

Inflight
In 2006, millions and millions of newly developed adult beetles emerged from trees in British Columbia, were caught up in wind currents and blew over the mountains. They landed throughout the northwest and north-central part of Alberta. The same inflight of beetles happened again in 2009.

Larva
An immature life stage of an insect, emerging from an egg. In the case of the MPB, this stage causes the most damage to the tree.

Limiting factors
Any factor (biotic or abiotic) that inhibits the growth of a species population.

Mortality
The death rate in a population of organisms.

Mountain pine beetle
A native bark beetle species that feeds on the inner bark of pine trees of western North America.

Natural controls
Methods of controlling organism populations without human intervention.

Natural enemies
The parasites, parasitoids, predators, and pathogens associated in nature with a specific wild population of plants or animals. (*Dictionary of Natural Resource Management*)

Outbreak
A large-scale temporary increase in population causing severe damage over a large geographic area.

Parasite
An organism that benefits from a relationship while negatively affecting its host.

Pesticide
A substance used to kill a pest in an area. Examples include insecticides (for unwanted insects) and herbicides (for unwanted plants).

Pheromones
A chemical hormone released by an organism for communication in the same species; e.g. pheromones released by female beetles attract other female and male beetles to the tree.

Phloem
The food-conducting tissue of the tree forming the main component of the inner bark.

Pitch tubes
Small blobs of pitch secreted by the host tree in an effort to trap and prevent MPB from entering.

Prescribed burn
Fire intentionally set by qualified fire management personnel according to predetermined objectives and burning conditions for a certain purpose. Examples of prescribed burn objectives might include controlling forest insects and exposing rich mineral soil for growing plants. (*Canadian Interagency Forest Fire Centre glossary*)

Pupa
A stage of transition (between larva and adult) in an insect's life. It is inactive during this time.

Risk
The probability of a MPB attack in a stand. Factors that could increase risk include high susceptibility, high hazard, high potential of beetle movement into the stand, and high beetle population levels close to the stand.

Salvage harvesting
The harvesting of beetle-killed trees before the wood quality degrades to a level below merchantability. The purpose of the harvest is maximizing the timber profit of beetle-killed timber.

Sanitation harvesting
A treatment option that involves harvesting infested trees then processing trees at a mill to reduce the beetle population and prevent spread to healthy stands.

Severe weather
Extreme weather events that result in unusually harsh weather, such as colder than normal temperatures, heavy winds, blizzards, and tornadoes.

Sign
Visible evidence showing the presence of a specific insect or pathogen. For example, the presence of larvae and adults and the larval and egg gallery characteristics can be used to identify mountain pine beetle.

Species diversity
The variety of species and their distribution and abundance in a habitat.

Succession
The orderly process of change over time in an ecosystem where an early pioneering community is replaced by another until a stable 'climax' community is reached.

Symbiosis
A relationship between two organisms in which both organisms benefit.

Symptom
The visible reaction of a host tree to an attack by mountain pine beetle. Pitch tubes are a good example of a symptom.

Xylem
The main water- and nutrient-conducting tissues of the tree; the main component of sapwood.

Mountain Pine Beetle Websites

Mountain Pine Beetle Activities

Envirokids Investigate Forest Health
www.srd.alberta.ca/MapsPhotosPublications/documents/SRD-ED-Envirokids-ForestHealthActivityBook.pdf

Mountain Pine Beetle Information Websites

Alberta Environment and Sustainable Resource Development
www.mpb.alberta.ca

British Columbia Ministry of Forests, Lands and Natural Resource Operations
www.for.gov.bc.ca/hfp/mountain_pine_beetle

Manitoba Ministry of Conservation and Water Stewardship
www.gov.mb.ca/conservation/forestry/health/mt-pine-beetle.html

Natural Resources Canada
www.cfs.nrcan.gc.ca/pages/49

Saskatchewan Ministry of Environment
www.environment.gov.sk.ca/adx/aspx/adxGetMedia.aspx?DocID=3630,184,121,104,81,1,Documents&MediaID=4174&Filename=Mountain+pine+beetle.pdf

Private/Industry Information

www.beetlewoodindustries.com/

www.treecanada.ca/en/programs/operation-releaf/alberta-mountain-pine-beetle-releaf/

www.foothillsresearchinstitute.ca/pages/ProgramsMountainPine/default.aspx

Images

www.forestryimages.org

These websites were accurate at time of printing.

Mountain Pine Beetle Answer Key

Answer Key - What is the Mountain Pine Beetle?

Answer the following questions based on the information given in the Primer or your own research.

1. Describe the four stages in the development of the mountain pine beetle.
   1. **Adult – female beetles bore into the inner bark (phloem) where they create j-shaped vertical galleries into which eggs are laid.**
   2. **Egg**
   3. **Larvae – tunnel away from egg galleries to make their own horizontal galleries. Usually over-winter in the tree.**
   4. **Pupae**

2. How long is the average life cycle of mountain pine beetle?
   - **One year – but may take two years to complete if conditions are not favourable (high altitudes, or far north).**

3. What conditions can affect the length of the life cycle of mountain pine beetle?
   - **High altitudes**
   - **Unfavourable habitat conditions (high altitudes, far north)**

4. Write a newspaper article on the process of mountain pine beetle attacking and killing a pine tree as if your headline read:
   Tag Team Pair Wreaking Havoc
   - **It is a combination of the beetles attacking and disrupting phloem through gallery construction and blue stain fungus clogging up the conducting vessels of the tree. Both contribute to tree death.**

5. Why do you think that mountain pine beetle is more attracted to older pine trees?
   (hint: think about where in the tree they spend most of their time)
   - **Older trees are not as vigorous as young healthy trees. They do not have as many resources available to them to defend themselves (i.e.) pitching the beetle out.**

What Do You Know About The Mountain Pine Beetle

Answer Key

Circle the appropriate number that corresponds to your opinion or knowledge about each statement.

Then, with your group, go through each statement and discuss what you know about the topic. Re-circle a number for each statement (with another colored pen/pencil) showing how your opinions changed (if at all) after discussion with your group.

1. Mountain pine beetle is currently found all across Alberta.

   True **False** Don't Know

2. Putting out forest fires can help to increase the spread of mountain pine beetle.

   True False Don't Know

3. A single mountain pine beetle can kill a tree.

   True **False** Don't Know

4. The mountain pine beetle was introduced into Canada from Europe.

   True **False** Don't Know

5. You can rarely tell if mountain pine beetle has attacked a tree.

   True **False** Don't Know

6. The mountain pine beetle is an important food source for some bird species.

   True False Don't Know

7. Pesticides are the most effective way to kill mountain pine beetle.

   True **False** Don't Know

8. Mountain pine beetle mainly attack young, healthy pine trees.

   True **False** Don't Know

9. Mountain pine beetle has had a huge effect on Alberta's forests.

   1 2 3 4 5 Strongly Agree Neutral Strongly Disagree

10. The mountain pine beetle could have a big effect on you or your family.

    1 **2** 3 4 5 Strongly Agree Neutral Strongly Disagree

11. A healthy forest is a forest with no tree-killing insects or diseases.

    1 2 3 4 **5** Strongly Agree Neutral Strongly Disagree

12. Mountain pine beetle needs to 'run its course' in the forest.

    1 2 **3** 4 5 Strongly Agree Neutral Strongly Disagree

13. The mountain pine beetle helps contribute to the biological diversity of forest ecosystems.

    1 2 **3** 4 5 Strongly Agree Neutral Strongly Disagree

Examining Epidemics

Answer Key

Mountain pine beetle outbreaks have occurred in the past, but not with the severity of the current outbreaks in British Columbia and Alberta. Governments, industry, and land managers have been keeping track of outbreaks in order to learn more about how and when these events occur.

Using the Alberta Government's mountain pine beetle website, and the charts that have been provided, answer the following questions:

1) Examine the historical maps of MPB outbreaks at www.mpb.alberta.ca/BeetleFacts/HistoryOfInfestations.aspx

   Where in Alberta have outbreaks occurred historically? Why might outbreaks have happened in these areas specifically?

   Historically, outbreaks have occurred in Southern Alberta. Climatic conditions were good for MPB with an abundance of habitat (older pine stands). In addition to this, there were influences from British Columbia with movement of beetles (inflights) across the boarder.

2) Look at the Mean Monthly Temperature in Banff During the Month of November graph below. Explain why you think the MPB outbreak of 1985 did not continue to 1986.

   Cold November temperatures killed off many MPB larvae.

3) Why is the temperature in November particularly important to MPB? How could an overall increase in temperature due to climate change affect the population of MPB?

   Sudden cold snaps are more lethal in the fall before beetle larvae are able to build up their natural anti-freeze (glycerol) levels. An increase in temperature due to climate change could mean an overall increase in MPB populations. Cold weather is a limiting factor to beetle survival.

4) Using the *'Mean Monthly Temperature in Banff During the Month of November'* graph below, in what year would you predict there to low numbers of MPB? Why?

   1985 – the temperature dipped sharply in the fall before larvae built up natural anti-freeze (glycerol) levels.

5) In Alberta, there are unique areas in the forest where pure lodgepole pine and pure jack pine have bred together to create lodgepole/jack pine hybrid trees. MPB are able to attack, kill and reproduce in hybrid and pure jack pine. Jack pine is a significant component of the boreal forest. Examine the map at http://cfs.nrcan.gc.ca/pages/251. List at least 3 provinces in Canada that could be directly affected by MPB if it were to spread through the boreal forest.

   Alberta, Saskatchewan and Manitoba

5) Using the maps located at:
   www.mpb.alberta.ca/Resources/documents/MPB-PineAffectedByMPB-Aug2012.pdf
   www.mpb.alberta.ca/Resources/documents/MPB-InfestationOverTime-2012.gif

   a. The percent of Alberta covered with pine trees.

      42%

   b. The per cent of those trees that have been affected by the MPB.

      20% in Alberta

Stopping the Spread Part 1

Answer Key

You should now have some understanding of the mountain pine beetle and many of its effects on the forest. In Alberta, we have different options for managing MPB and controlling its spread. In this activity, you will work through several small exercises to determine which of these options is most useful in which situations.

Match the possible management option in the left column with its description in the right column.

Short-term options

__C__ cut and burn

__E__ sanitation harvesting

__D__ cut and peel

A) Removing vulnerable stands in the path of the outbreak to promote the growth of various tree species (e.g. spruce, pine, aspen) that reduce the number of hosts for mountain pine beetle.

B) Fire that is intentionally set and controlled to encourage a wide age distribution of trees and reduce the habitat available for the beetle.

C) An infested tree is cut before the beetles emerge, cut up into smaller pieces, and burned until, at a minimum, bark is completely charred.

Long-term options

__B__ prescribed burn

__A__ harvesting at-risk stands

D) An infested tree is cut before the beetle emerges and the bark is peeled off both the felled tree and the stump.

E) The infested trees are harvested (magnitude depends on the size of the outbreak) and the beetles are killed in the process of making the tree into a product.

Stopping the Spread Part 2

Answer Key

1. Pick one of the forest treatments in Part 1 and brainstorm what you think might be one advantage and one disadvantage to using that technique.

   Answers will vary depending upon each student's background and/or experience. The intention of this question is to provoke independent thought and open up dialogue.

2. For the different situations below, consider the forest treatments listed in Part 1 you would choose if you were the land manager for the area. Be sure to write why you chose a particular option.

   a. There is an outbreak in an area that has had a very dry spring and where the fire hazard is quite high.

      Harvesting at risk stands ~ to control the risk of further spread and avoid the use of fire in an area experiencing very dry conditions.

   b. There is a small infestation in an area that is not easily accessible by machinery.

      Cut and Burn ~ Small infestation area with no access to machinery would require a treatment that only removes infested trees

   c. There is an outbreak that covers a large area with many trees affected.

      Prescribed fire, Sanitation harvesting, Harvesting at-risk stands ~ large infestation area, to suppress the risk of spread into other areas of the province.

   d. There is an infestation in an area that is very sensitive ecologically.

      Cut and Burn ~ sensitive ecological sites need treatments that minimize the impact on the ecosystem.

Pine Beetle Squares

Answer Key

1) The mountain pine beetle is a native insect to which of these provinces of Canada:

a) New Brunswick

b) Ontario

c) British Columbia

2) What do we call the tree that forest insects damage?

a) Host

b) Unlucky

c) Carrier

3) The main Alberta host of the mountain pine beetle is

a) White spruce

b) A nice person in Canmore who actually likes the beetle

c) Lodgepole pine

4) Mountain pine beetle larvae feed on the _____ of the tree.

a) Phloem (inner bark)

b) Leaves

c) Fruit

5) Once female mountain pine beetles have successfully attacked a tree, how long does it *usually* take to kill* that tree?

a) Three days.

b) Two years.

c) One season to one year

*MPB will not always kill the tree; the tree can sometimes 'pitch' them out.

6) Flying above a forest, how can you tell that an area has a mountain pine beetle outbreak?

a) The trees are black looking like a burn after a forest fire.

b) The trees are red from the needles changing colour as the tree dies.

c) There are no branches left on the tree.

7) Mountain pine beetles always have a one year life cycle.

TRUE or **FALSE**

It may take two years for beetles to complete the life cycle farther north and/or in higher elevations

8) The major natural control for a mountain pine beetle outbreak is:

a) Cold temperatures in early fall or late spring (40° C or lower) when beetles are in their larval stage.

b) A very warm winter, as the beetle larvae need cold weather to develop properly.

c) A big forest fire that kills the host pine trees.

9) The mountain pine beetle has what kind of a relationship with blue stain fungi*?

a) Parasitic (the beetle benefits, but has a negative effect on the blue stain fungus)

b) Symbiotic (the beetle and the blue stain fungus benefit from their relationship)

c) Commensalistic (the beetle benefits, and has no effect on the blue stain fungus)

* Blue stain fungus is carried to new trees by the mountain pine beetle and in turn 'helps out' the beetle by blocking the resin ducts in the tree, thus preventing the tree from fighting off a beetle invasion.

10) What symptom on the outside of the tree indicates that it may be attacked by mountain pine beetle?

a) Beetles swarming on the outside of the tree.

b) Pitch tubes (sap dripping) and sawdust at the bottom of the tree.

c) Blue trees from the blue stain fungus that travels on the beetle.

11) Mountain pine beetles have historically had a tough time moving into Alberta because:

a) Historically, the cold Alberta winters usually killed them and the Rocky Mountains were a natural barrier to their movements.

b) They can't decide where to go.

c) There are more woodpeckers in Alberta to eat them.

12) Climate change could result in:

a) It raining cats and dogs

b) An increased number of severe weather events

c) An expansion of the boreal forest into the prairies

13) Historically, where in Alberta has there been an epidemic mountain pine beetle population?

a) Jasper National Park

b) Crowsnest Pass*

c) There has never been an epidemic in Alberta.

* This epidemic began in the late '70s and carried into the '80s

14) Mountain pine beetle is also found in which of the following U.S. States:

a) Hawaii

b) Alaska

c) Oregon*

* Its range is from the Pacific Coast east to the Black Hill in South Dakota, up to northern BC/western Alberta, and down as far south as northwestern Mexico.

15) What is one human control method used to manage the mountain pine beetle:

a) Cut down attacked trees and burn them

b) Catch-and-release them into the United States

c) Breed extra woodpeckers and release them into mountain pine beetle infected areas

16) The term we use to describe a major mountain pine beetle outbreak is:

a) An unfortunate event

b) An epidemic

c) An endemic attack

17) The main reason we fear the spread of the mountain pine beetle in Alberta is:

a) It will provide woodpeckers with too much food and they will get fat.

b) Our pine forests are old and the beetles could spread quickly, killing large areas within a year

c) It will take over areas that other types of beetles inhabit.

Bonus Question:

The current mountain pine beetle situation is not very important.

a) No. Actually, it is quite important from an environmental, economic, and social perspective.

b) All of the above.

c) Choose a.