

**A BUG'S LIFE**  
**EXPLORING THE MOUNTAIN PINE BEETLE**

**Mountain Pine Beetle Initiative Outreach Program**  
**Alberta and British Columbia Grades 2-3**

The Mountain Pine Beetle Initiative is administered by  
Natural Resources Canada and the Canadian Forest Service

# **A BUG’S LIFE – EXPLORING THE MOUNTAIN PINE BEETLE**

## **Mountain Pine Beetle Initiative Outreach Program for Grades 2-3**

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## **Title: A Bug's Life – Exploring the Mountain Pine Beetle**

### **Overview:**

Mountain pine beetle is endemic to the southern Rocky Mountains and areas west of the Continental Divide; however, it has not historically occurred on the northeastern slopes of the Rocky Mountains (Jasper area). Even though insect outbreaks are natural ecological processes that contribute to forest diversity, historically there were few forest stands susceptible to mountain pine beetle due to frequent fires in the montane ecoregion and the foothills. Past fire suppression practices in Alberta and British Columbia, including the national parks, have resulted in an abundance of old, even-age pine stands that are susceptible to mountain pine beetle attack. Fire suppression, coupled with increasing frequency of mild winter temperatures, has resulted in conditions that favour beetle development, outbreak and expansion. The expansion of mountain pine beetle populations is of concern to Parks Canada and its neighbours (provinces of Alberta and British Columbia and the forest industry). In this lesson, students will explore the life of the mountain pine beetle, its body structure and life cycle, and learn how the beetles are related to forest health.

### **Province and Grade Level:**

British Columbia Grade 2

Alberta Grades 2, 3

### **List of the Province/Territory and the Related Curriculum Expectations/Competencies/Outcomes:**

British Columbia Grade 2: Life Science – Animal Growth and Changes

- classify animals according to similarities and differences in appearance, behaviour, and life cycles
- describe some changes that affect animals
- describe ways in which animals are important to other living things in the environment

Alberta Grade 2: Small Crawling and Flying Animals

- describe the general structures and habits of small crawling and flying animals and apply this knowledge to interpret local species that have been observed
- identify each animal's role within the food chain
- describe the relationships of these animals to other living and non-living things in their habitat, and to people

Alberta Grade 3: Animal Life Cycles

- classify a variety of animals based on observational characteristics
- observe and describe the growth and development of at least one living animal as it develops into more advanced stages

### **Learning Expectations/Competencies/Outcomes for the Lesson Plan:**

Through identification, examination, and a game, students are introduced to the characteristics of the mountain pine beetle, its life cycle, and its connection to forest health.

**Duration:** 60 minutes

### **Required Materials:**

#### Meet the Mountain Pine Beetle

- ❑ costume (black T-shirt, headpiece with antennae and compound eyes, and vest with wings and legs)
- ❑ large picture of a mountain pine beetle
- ❑ turkey baster, sponge, pliers, scissors

#### Life Cycle

- ❑ picture of lodgepole pine with needles
- ❑ picture of bark with pitch tubes
- ❑ coke-bottle joke glasses
- ❑ perfume bottle
- ❑ picture of different stages – adult, egg, larva, pupa
- ❑ picture of wood with blue stain
- ❑ blank paper, blue crayons

#### Forest Health Game

- ❑ 2 spray bottles, one containing water and one empty
- ❑ photograph of a beetle killed forest
- ❑ tags with names Aspen, Douglas Fir, old Lodgepole Pine, young Lodgepole Pine, White Spruce

## **Teacher Information:**

Fire is a disturbance that has been around for a long time. It has been part of grassland, brush and forest ecosystems for as long as these ecosystems have existed. Like storms, avalanches and floods, it is a powerful force of change in nature. Fire has shaped landscapes across Alberta, British Columbia, Canada and around the world.

Many ecosystems have evolved with fire and depend on it for renewal. A recent burned area may seem dead but many forms of life survive, giving rise to a new forest. Fire kick starts regeneration by providing ideal growing conditions. In cool temperate areas, decay is slow and logs, leaves and needles pile up on the forest floor. Fire reduces this material to mineral-rich ash, releasing and recycling nutrients. Fire also creates openings in the forest. Sunlight penetrates into these openings or gaps, warming the soil and stimulating new growth from seeds and roots.

Over time, periodic fires create a vegetation mosaic of different ages and types. This provides a rich variety of habitats that support many species of insects, mammals and birds. This is biodiversity – it indicates a thriving ecosystem that is likely to persist in the future. So, fire not only renews and recycles, but also rearranges vegetation in a continual cycle of change.

Many plants and animals are adapted to fires and the conditions they create. After a fire, woodpecker populations may increase fifty times. They come to feast on bark beetles and other insects that colonize the newly burned trees. Aspen, raspberry and rose sprout vigorously from underground roots after a fire passes. Moose and elk feed on the new growth. Both lodgepole pine and jack pine have resin-sealed cones that can stay on the tree for many years. The heat of a fire melts the resin and the cones pop open. Thousands of seeds scatter onto the ground and grow into new stands of pine.

For the last ten thousand years, First Nations peoples have used fire to herd game, create new grazing habitat, and to keep travel routes open. In many areas, they influenced vegetation patterns. When the Europeans arrived, they brought with them very different attitudes toward fire. Fire was dangerous and needed to be controlled. These attitudes resulted in forest fire suppression, leading to a change in the composition of our forests. Even national parks viewed fire as a destroyer. “Only you can prevent forest fires,” cautioned Smokey Bear, who first appeared in the 1950s. Smokey’s message, as well as the development of modern fire fighting equipment and techniques, shut fire out of most of our ecosystems. For example, over the last 65 years, the area burned in the Rocky Mountain national parks has dwindled to less than 10% of historic levels. Most researchers agree that fire suppression is altering many ecosystems. Forests are becoming older and more closed in. The open habitats favoured by many species of wildlife are becoming more rare. Forests are losing the vegetation mosaic and the biodiversity it sustains. These mature forests are also more susceptible to disease and insect outbreaks and create more of a wildfire risk because of the buildup of fuel. The effects of fire suppression are far reaching, for they affect not only parks, but surrounding lands as well.

As trees age and mature, they become more susceptible to insect and disease outbreaks. One such outbreak in the Rocky Mountains is that of the mountain pine beetle. In the summer, the beetles bore through the bark of mature lodgepole pine trees and lay their eggs in the tunnels. The larvae hatch and feed under the bark, which girdles the tree and cuts off the flow of nutrients and water. The larvae pupate in the spring, and emerge as adults from July to September.

Mountain pine beetle does not kill the tree on its own, though. The beetles transmit blue stain fungus. Together, the beetle larvae and the blue stain fungus disrupt the movement of water and nutrients within the trees and prevent the tree from producing resin to defend itself against the beetle, weakening the tree and eventually killing it.

## **Introduction**

**Duration:** 5 minutes

Today we are learning about a really interesting insect in our national parks. National parks are special places. They are places where animals and plants are protected. There are probably many animals that you can think of that live in our national parks and in the mountain forests. Can you name some animals that live in our mountain forests?

Today we are learning about an animal that is very small but can create some very BIG changes in our forests.

It has six legs and three body parts. Any guesses? Yes, an insect. The insect that we're going to talk about today is called the mountain pine beetle. Today we are going to identify the beetle. We are going to learn about its life cycle and how it changes forests.

To start, I'd like to learn three things about you (*write these down on class board*):

- what you know about the mountain pine beetle
- what you wonder about the mountain pine beetle
- at the end of the class, I will ask you what you learned

Would you like to meet a mountain pine beetle?

## Meet the Mountain Pine Beetle

**Duration:** 15 minutes

Let's take a closer look at the adult mountain pine beetle. Why don't we build one? For this I need a volunteer to help me. (*Select volunteer and have them stand facing the class*).

Insects are a lot like us. They can think, see, smell and move. Like humans, they can make very big changes to forests. However, they don't do all of these things the same way as we do. Where is an insect's nose? It doesn't have one, but it can smell. Which part can taste? Which part can digest food? Let's find out the answers to these questions by looking at the body parts one by one.

Let's just put this black T-shirt on to start. *Have student put on T-shirt, representing the exoskeleton*. Did you know that insects don't have any bones in their body? With no bones, how can insects stand up? They have one big structure that covers the outside of their bodies, called an exoskeleton. This exoskeleton is like a large shell: it protects them and gives them shape.

Like all insects, the mountain pine beetle adult has three main body parts.

### **The Head**

The head of an insect has a small brain, eyes and mouth. *Have student put on the headpiece*.

#### **Brain:**

The brain of an insect is very simple. Insects don't think the same way that you do. They cannot imagine or pretend.

#### **Eyes:**

*Refer to the compound eyes on the headpiece*. Instead of two big eyes like we have, the beetle has many small eyes – these are all put together in one large eye. Instead of seeing one picture like we do, the beetle sees hundreds of pictures all at the same time. Have you ever looked through a Kaleidoscope? We don't think the beetle can find a pine tree just by sight ... as a matter of fact, we don't really think it can see well at all. How do you think it finds the right kind of tree, then?

Trees, when stressed, have a particular smell. We can't smell it, but the mountain pine beetle, having lived with pines for thousands of years, is very sensitive to a tree's stress cologne. What do you think it uses for smelling the tree's cologne?

#### **Antennae:**

*Refer to the antennae on the headpiece*. The beetle uses antennae for smelling tree cologne. We think it uses its sight to locate large objects and its antennae to smell and

touch stressed trees. What kind of tree do you think the mountain PINE beetle likes? Right, it likes pine trees. It will try to get through a pine tree's coat of armour, the bark, to get inside to eat and make a home. How do you think it gets through the bark and eats trees? It uses its mouth.

### **Mouth:**

*The headpiece doesn't have a mouth; however, point to where it would be.* Not all insects eat in the same way, just like a baby and an adult don't eat the same way. Not all insects eat the same kind of food, either. Some insects eat food that is crunchy, some that is mushy, and some that is liquid. What do you think the mountain PINE beetle eats? Pine, that's right. What kind of mouth does the mountain pine beetle need to eat bark? *Show a few different objects: turkey baster (mosquito), straw (bees and butterflies), sponge (fly), pliers (grasshoppers), scissors (MPB).*

Unlike our jaw that moves up and down, the beetle's jaws move sideways and meet in the middle. *Hold up the scissors.* Not only that, but it doesn't just have one set of jaws, but two sets! It has a large jaw for grabbing and tearing, and a set of jaws beneath for shredding food.

### **The Thorax**

The Thorax is the middle area of the beetle's body where the legs and wings are attached. *Have the student put on the vest.* It is an important part of the body because it helps all insects walk, jump and fly. This is where most of the muscles are found.

### **Legs:**

Like all insects beetles have six legs. *Point to the legs.* What do you think the legs do for the beetle? Help it to crawl? Jump? Well, they help the beetle do something else, too. Some insects, including the mountain pine beetle, have sensors on their legs that help them hear and taste!!

### **Wings:**

How many wings do you think the mountain pine beetle has? *Have the student turn around with his/her back to the class.* They have two sets. There is a secret set of wings! These wings, called the hind wings, are hidden under some hard wings and are used for flying.

How far do you think the beetle can fly? One metre? Five hundred metres? One kilometre? How about fifty kilometres? The mountain pine beetle can fly up to fifty kilometres. *Find an example of a distance students may have driven to; i.e., from Banff to Lake Louise.* Usually, they will fly about eye-height, but sometimes they will fly above the tops of the trees and fly on the wind currents like birds. However, they won't fly if it is too cool or wet.

The hardened wings are called *elytra*. What do you think the beetle uses these for? They protect the beetle's body and help it crawl through narrow passages. These wings also have microscopic pits in them that are filled with the mountain pine beetle's friends,

fungi. Fungi are living microorganisms like mushrooms and mold but most are too small to be seen with the human eye.

The fungi carried by the mountain pine beetle are a form of blue stain fungus and are much too small for us to see. They might be the mountain pine beetle's best friends, but they are no fun for the tree. Once the beetle gets into the tree, the fungi take off and invade the tree. The fungi can plug up the tree's sap-producing cells, reducing the tree's ability to try to "pitch" or throw the beetle out in its sap. The fungi also weaken the tree by stopping the flow of water and nutrients. It stains the wood a bluish-purple colour  
*Show a picture of pitch tubes and wood with blue stain fungi.*

### **The Abdomen**

The abdomen is the biggest body part. *Point again to the vest, showing that the abdomen would be under the thorax.* The abdomen holds the insect's most important inside organs. You have an abdomen. It holds your stomach and intestines. An insect's abdomen holds its stomach and intestines, too. Insects digest their food in their abdomens, which is the same place you digest your food.

What else do you think might be in the abdomen? What other organs haven't we talked about? What about the heart and lungs?!! Yes, insects have their hearts in their abdomens. You breathe through your mouth and lungs. Insects breathe through their abdomens. How do they do it? Insects have lots of little holes on their abdomens called spiracles. These spiracles allow them to breathe, and that keeps them alive.

*Pointing to the dressed-up volunteer.* Here we have a beautiful example of an adult mountain pine beetle. Hey, student's name looks just like this picture I found of a live mountain pine beetle. *Show image of beetle.* Thank you very much for helping today. *Help the student take off the costume and give the volunteer a round of applause.*

## Life Cycle

**Duration:** 20 minutes

### Life Cycle Art Activity

Now that you've looked at the mountain pine beetle, I have to tell you it doesn't look too different from a lot of other beetles. You really need a microscope and an expert to identify a mountain pine beetle. But if you find the mountain pine beetle in a tree, identifying it would be much easier.

In what kind of tree do you think we would find a mountain PINE beetle? That's right, a pine tree. Around here they usually go for lodgepole pines. *Show a picture of a pine tree.* See the long needles and only a few branches lower down on the tree? We call it the "tweezer tree" because its needles come in pairs and look like a pair of tweezers.

Once we figure out it's a pine tree, we look at what's under the bark. In the field, a scientist would use a small axe to chip away some bark. *Show students a picture of a log sample with a gallery.* This is called a beetle gallery. Each species of beetle makes its own design.

*Hand out pieces of blank white paper. The students will use it to draw out the life cycle, step by step.*

Let's start our story in the summer.

*Put on thick joke glasses and flap arms.* The female mountain pine beetle adult flies through the forest smelling for a home. That's right, I said smelling. She does not have very good eyesight, and we don't really think she can tell a good pine tree from a flagpole with her eyes. She might be able to see a big dark shadow and hit it, but her best sense is her sense of smell. Stressed trees smell different than others. She is looking for a BIG STRESSED-OUT tree.

Why does she want a big tree?

She wants a **big** tree because it has thicker bark. The bark acts like a nice blanket to keep her larvae (kids) from freezing.

She wants a stressed-out tree because it is less able to defend itself against beetles. A healthy tree spurts out sap that can 'pitch' or throw out the beetle. Trees that are thirsty or weak, however, have a harder time defending themselves and can't keep out the beetles. *Show a picture of bark with pitch tubes.*

Once she has chewed her way through the bark, the tree's armour, she builds an egg gallery inside the tree. The gallery runs down the tree and it looks like the letter "J".

*Show the picture of an actual gallery. Ask the students to draw a large J on the sheet of paper. Then ask the students to draw a box alongside the J and draw the adult beetle in the box. Show the students how to draw a simple beetle step by step. First, draw a circle for the head. Attached to that, draw an oval to represent the thorax and abdomen. Draw a line 1/3 down the oval to represent the division between the two parts. Have the students draw one pair of antennae coming from the head, three pair of legs coming from the thorax. Then have the kids draw a line from the box to the J part of the gallery. See figure 1.*

Most of the life cycle of the mountain pine beetle will happen under the bark of a tree.

When the female beetle chews the J-shaped gallery in the tree, she spreads blue stain fungi into the tree. This fungus weakens the tree and makes it harder for the tree to pitch out the beetles. It will stain the wood a bluish-purple. Take your blue crayon and rub a bit of blue on your gallery, near the adult beetle. Don't stay in the lines though, as the fungi will spread out from the gallery.

At this time, the female starts sending out this smell like perfume. *Spray some perfume.* We can't smell it, but it gets a whole lot of other pine beetles to attack the tree. She lays her eggs while spreading more blue stain fungi around, further stopping the tree from defending itself. The blue stain fungi also make it hard for the tree to drink up water and food. *Show blue stain fungus tree cookie picture.*

### **Eggs:**

The eggs (sixty to eighty of them) are laid along the sides of that J gallery. *Ask students to draw a box on the side of the paper, and in the box, draw little oval beetle eggs. Have the students draw a line from the box to the J part of the gallery.* After about two weeks as eggs, they hatch into larvae.

### **Larvae:**

This is the young kid stage, kind of like you guys. When the eggs hatch, they become larvae which feed outward from the egg gallery around the tree stem. *Show a picture. Ask students to draw a box on the side of the paper, and in the box, draw a larva. Show them how to draw a simple larva – a crescent-shaped legless grub/worm – and ask them to draw a line from the box to a gallery that branches out from the J gallery.* They eat the blue stain fungi and get it on their mouths, and spread it as they feed around the tree. The fungi and the larvae slows down the flow of water and nutrients, which eventually kills the tree. *Ask the students to colour a bit more blue coming off of those branching galleries.*

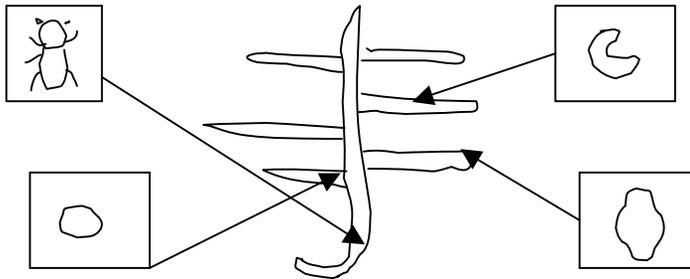
Usually, they are still larvae when winter comes. What's cool is that in cold winter temperatures, the larvae can produce a compound called glycerol, which is like antifreeze, so that they can't freeze unless it is super-cold, like -40°C. The thick tree bark also insulates them.

In the spring (April), they construct chambers where they pupate or change.

**Pupae:**

This is the **teenage stage**. Ask students to draw a box on the side of the paper, and in the box, draw a simple pupa. Draw an oval, but have the centre bulge out. Then get them to draw a line from the box to the end of a branching gallery. Just like teenagers, the pupae's bodies go through a lot of changes. They are white and start to look like the adult as little wings start to grow. They also have blue stain fungi attached to their body parts and in their mouths. By mid-July, they are adult beetles and will fly out to find their own tree and start the cycle of life over again.

Figure 1.



That's the life cycle of the mountain pine beetle. What about death?

The adult beetle dies shortly after the eggs are laid.

What do you think kills mountain pine beetle? They have a lot of predators like woodpeckers and other insects. They become important food for other animals.

Really cold conditions in winter, like  $-40^{\circ}\text{C}$ , will also kill the larvae. Remember that the beetles make glycerol in their bodies as antifreeze. Well, they can make it only once. When the weather gets warmer, they lose their antifreeze. If another cold snap happens, perhaps in the spring, they can't produce this antifreeze again, and they can die if the temperature gets cold enough.

## **Forest Health and Mountain Pine Beetle Demonstration**

**Duration:** 15 minutes

We want our forests to be healthy because forests provide homes for many types of mammals, birds, and insects like the mountain pine beetle. Healthy forests are like lungs: they take in a gas called carbon dioxide, or CO<sub>2</sub>, and pump out oxygen. Does anyone here use oxygen? We breathe in oxygen and breathe out CO<sub>2</sub>, which means our lungs do the opposite of what a tree does. Healthy forests also give us wood and a lot of jobs for families in the forest industry. These are just a few reasons that we are concerned about healthy forests. Mountain pine beetle are very interesting because they tell us a lot about how healthy our forests are.

*Call five volunteers up to the front and ask them to line up to your right. Hand out tree name tags (Trembling Aspen, White Spruce, old Lodgepole Pine, young Lodgepole Pine, Douglas Fir). Call up five more volunteers to be the beetles and line them up on your left hand side. Send beetles over one by one to pick a tree, so now they are lined up in pairs facing the class.*

### **Douglas Fir and Beetle**

The Douglas fir is not attacked by this kind of beetle, although it does get attacked by something called a fir beetle. *Here's some Douglas fir trivia that you may want to talk about. Douglas fir is found on moist to very dry sites. They are sometimes referred to as "friendly fir" for their flat, soft needles. The thick bark of the Douglas fir can withstand low intensity fires. These trees can survive for many years. Banff National Park has the oldest known Douglas fir tree in the province, approximately 700 years old!!*. This pine beetle is out of luck so he/she will have to go back and sit with the class.

### **Trembling Aspen and Beetle**

*Get the tree to tremble and ask if it is trembling because it is scared of the beetle. Then talk about how the tree gets its name from the way its leaves tremble.* This beetle is also out of luck, as the beetle doesn't eat this kind of tree. The tree lives and the beetle starves and has to go back and sit with the rest of the class.

### **White Spruce and Beetle**

The spruce is known as "spiky spruce" because of its sharp, round pointy needles. This beetle is also out of luck. It has been known to attack spruce trees but doesn't survive as it gets "pitched" out or freezes under the bark because the bark is not thick enough. This beetle has to go and sit back with the rest of the class.

Now for the young and old pine trees. These are the trees that grow really well after a fire. They have a special kind of a cone that only opens up when it gets really hot.

### **Young Lodgepole Pine Tree and Beetle**

*Have the student hide a spray bottle containing water behind his/her back and instruct him/her beforehand about his/her role. He/she can squirt the beetle in the knee when you say to. This young tree can't run or hide or karate kick the beetle, so how do they defend themselves against the beetle? They have a secret weapon, a sap squirter! A young tree can produce a lot of sap and pitch out the beetle. Its's bark is alos not very thick so the young can't survive the cold winter. The young pine sprays the beetle on the knees and the beetle has to sit down with the rest of the class.*

### **Old Lodgepole Pine Tree and Beetle**

*Have the tree act old and decrepit. Give him/her an empty spray bottle. Older trees can't produce as much sap, so the beetle can attack the tree. Older tree tries to squirt beetle but the bottle is empty. The beetle gets to take the old tree away, to sit down with the rest of the class.*

*Now, the aspen, spruce, fir and young lodgepole pine trees should be left standing at the front, grouped together as a forest.*

Even after some older lodgepole pines have been killed by mountain pine beetle there is still a forest here with many different trees. Mountain pine beetles don't kill all of the trees. Killing some trees opens up the forest and lets in light so that other plants and new trees can grow. Beetles are also food for other animals.

While mountain pine beetle populations are at low levels, only the really weak, stressed old trees die. At this level natural enemies, limited habitat and climate can keep the population in check. When the population explodes predators are unable to keep the population in balance. The mountain pine beetle then expand into larger and larger areas until they run out of food or the temperature gets cold.

Old forests may be made up of almost all old lodgepole pine trees. Do you think the mountain pine beetles would like an old forest? Sure they would, because there are so many trees for them to eat and live in.

What do you think makes up a healthy forest, then? A healthy forest would be one that has many different types of trees of all ages, different plants, animals and some insects like mountain pine beetle, but not a lot of them. The forest should be in balance.

One way that Parks Canada is trying to keep forests healthy is to have prescribed/ controlled fires within the forest. The fires are planned and managed very carefully so that they don't get out of control and harm people or people's property. As a result of these fires, the forest becomes healthier because the fires create spots within the forest with different aged trees, and different kinds of trees.

**Evaluation:****Duration:** 5 minutes

Can you tell me what you learned today?

*The students should say they have learned about the parts of the mountain pine beetle and the life cycle of the beetle. Possible answers may be that the adult beetle has three main parts to its body, has a skeleton on the outside of its body, has six legs, compound eyes, four stages to its life cycle, etc. They should also come to the realization that a healthy forest won't have very many pine beetles. However, if a forest is old and composed mostly of old lodgepole pine trees, there may be many beetles.*

What can you do to help forests be healthy?

*Responses will vary. They may talk about helping to create forests with many different kinds of trees of differing ages. The students may mention the controlled fires, or even wildfires. They may talk about removing trees that are infected with mountain pine beetle.*

**Extensions to the Lesson:**

The next time you see a forest, try to guess if it is a healthy forest or an old forest. Remember what the differences are? If you see a fire burning in the forest, is it always bad? Talk to your parents and friends about what makes up a healthy forest and why healthy forests are important.

## **Suggested Related Resources:**

### ***Web Sites***

Parks Canada: [www.pc.gc.ca](http://www.pc.gc.ca)

Canadian Forest Service: [www.mpb.cfs.nrcan.gc.ca](http://www.mpb.cfs.nrcan.gc.ca)

[http://canadianforestry.com/html/education/cfa\\_kits\\_e.html](http://canadianforestry.com/html/education/cfa_kits_e.html)

Alberta Sustainable Resource Development: [www.gov.ab.ca/srd/forests/health/index](http://www.gov.ab.ca/srd/forests/health/index)

### ***Books***

Critters. 1992 AIMES.

### ***Activities***

FORED BC. *Fun in the Forests*. Primary Resource Package.

These are only some of the additional resources you may wish to use in order to expand the scope/research for this lesson.

## **Acknowledgements:**

Jackie Syroteuk/Wendy Karhoffer – Parks Canada

Kristen Schmitten/Jennifer Janzen – Writers

This lesson plan was funded through the Mountain Pine Beetle Initiative, a program administered by Natural Resources Canada and the Canadian Forest Service.