

# Mount Monadnock Educator's Guide



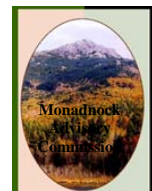
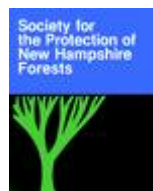
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Edited by Emily Beck

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## Tips and Tricks for Safe and Productive School Visits to Mount Monadnock

### ❖ **Think about the big picture:**

What are your objectives for the trip? How can this be integrated into a larger inquiry? What framework and standards are you addressing?

### ❖ **Choose activities to maximize learning goals:**

Plan classroom and site visit activities. When selecting gear, “less is more.” Bring the basics: measuring tapes, hand lenses and field guides. Supplement with items chosen for specific activities.

### ❖ **Incorporate stewardship into lesson plans and activity structures:**

Plan to divide the class into small groups with one adult for six to eight students. This ratio will promote investigation and inquiry and will have a smaller impact on other hikers on the mountain. Each group should carry a first aid kit, trail guide and radio or cell phone to communicate with other groups.

### ❖ **Model the behaviors you expect of you students and chaperones:**

Share your excitement and curiosity, it’s contagious! Foster close observation skills. Ask lots of questions. Be willing to admit that you don’t know all the answers.

### ❖ **Create shared expectations with students and chaperones:**

Incorporate pre-visit class activities and skill development into the curriculum. Share a detailed itinerary for the day or have students help develop the itinerary. Begin the hike by having the group brainstorm appropriate trail behavior.

### ❖ **Stay Safe:**

Staying safe begins with dressing appropriately for the weather including wearing sturdy shoes. If you plan on reaching the summit, expect the temperature to be ten to fifteen degrees colder and possibly windy. Carrying a raincoat and an extra layer will make for a more pleasant lunch break. Hydration is important, every member of the group should carry a water bottle with them. Visit [www.hikesafe.com](http://www.hikesafe.com) for additional information.

### ❖ **Plan Ahead**

All groups must make advanced reservations before their hike with the Monadnock office and discuss all planned activities with the Monadnock Manager.

## **Introduction to Mount Monadnock**

For residents of Jaffrey, Marlborough, Keene, Dublin, and other southwestern New Hampshire towns, Mount Monadnock stands as a prominent peak. Its dramatic presence has impressed and captivated local people for centuries, inspiring an abundance of folklore, art, music, and writing. Relatively small and easy to summit, at 3,165 feet, Monadnock is the popular hiking destination for over 95,000 visitors each year. That tally places Mount Monadnock as the second most climbed mountain in the world, after Mount Fuji.

The name Monadnock originated in the Abenaki language, meaning a mountain that stands alone. Mount Monadnock rises approximately 2,000 feet above the surrounding landscape offering hikers who reach its summit an impressive view. Figure 1. shows the relative isolation of Mount Monadnock to other summits with alpine environments.

The Mountain's steep altitudinal grade, latitudinal position between two ecoregions, a fire-induced timberline, and other conditions contribute to an abundance of plant communities. In fact, all three of New Hampshire's biomes - alpine tundra, boreal forest, and eastern-deciduous forest- can be found on the mountain. These biomes include plant communities that are typically found at more northern latitudes and higher altitudes.

## **Climate Change and Mount Monadnock**

Such unique features make Mount Monadnock ideal for scientific study and educational outreach in the region. In addition, Mount Monadnock can serve as a barometer of future changes for Northeastern forests. The mountain's cold-loving plant communities, such as the spruce-fir forests, will be monitored over time to measure the effects of climate change. As the climate warms, these communities might be affected on Mount Monadnock sooner than at more northern climates. Such data will inform scientists and resource managers of oncoming challenges facing the region's forests.

As climate changes occurs, local ecology across the Northeast will be threatened by different temperature regimes, weather patterns, and other conditions. A recent report of The Northeast Climate Impacts Assessment (NECIA) predicts that forest communities will change along with climate trends. The increased carbon dioxide that causes warming may promote faster growth and greater demands on soil nutrients, further altering local ecology. In these ways, the compounding effects of climate change will influence the ecology, economy, and recreation associated with Northeastern forests.

As the temperatures rise and growing conditions transform, plant and animal communities are expected to move northward in search of suitable habitat, and more southern species will move in to take their places. The report predicts that new combinations of plant species might assemble based on the environmental conditions. On Mount Monadnock, for example, the cold-loving red spruce might disappear from the mountain. In addition, red oak, which is more dominant below 2000', may increase in dominance higher up the mountain.

Changes in climate will also influence the spread of forest pests, pathogens, and invasive species. The hemlock wooly adelgid, an invasive insect that can decimate eastern hemlock forests, is currently spreading northward. It is kept at bay by cold winter temperatures, but warming trends might allow it to reach forests as far north as Canada.

## **Natural Communities**

Maples, oaks, and other hardwoods on the lower slopes give way to thick spruce forest. The rocky summit hosts the pale-flowered cinquefoil and low-bush blueberry. Natural community types are distinguished using three primary characteristics; a definite plant species composition, a consistent physical structure (such as forest, shrubland, grassland), and a specific set of environmental conditions such as nutrient level, moisture regime, soil type, and climate conditions.

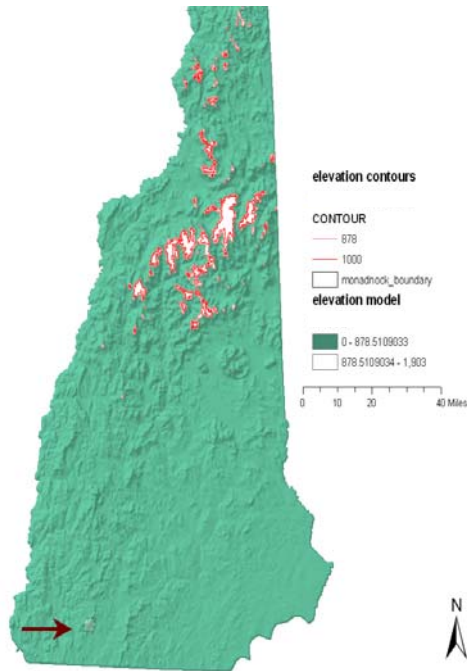


Figure 1. Alpine summits of New Hampshire, note the geographic isolation of Mount Monadnock. Map created by Emily Beck.

succession in order to reach their current level of biodiversity. These communities are vulnerable to extinction particularly on Mount Monadnock due to the high volume of foot traffic.

## Land Use History

A history of disturbance from grazing, fire, windstorms, and cutting has shaped the current vegetational patterns of Mount Monadnock. The treeless summit of Monadnock was once completely forested with the upper portions of the mountain covered with mature red spruce and the lower portions a mixed hardwood and spruce forest<sup>1</sup>. In the early 1800s, the lower slopes were cleared for cattle pasture. The now denuded summit is thought to be primarily the result of repetitive fires, possibly as a result of pasture clearing fires.

A major fire in 1800 that burned for two weeks killed the trees and burned off the humus. The great September gale of 1815 uprooted the remaining trees on the upper mountain which provided fuel wood for another fire in 1820 that was so intense it burned all of the organic material remaining on the summit less some large stumps. Additional smaller fires in 1842 and in the 1880s may have reached the summit as well<sup>1</sup>.

<sup>1</sup> Baldwin, H. 1977. The induced timberline of Mt. Monadnock, NH. *Bulletin of the Torrey Botanical Club* 104: 324-333.  
 Baldwin, H. I., editor. 1974. *Monadnock Guide*. 2nd ed. Society for the Protection of New Hampshire Forests, Concord, NH.  
 Nichols, W.F. 2002. *Rare Plant and Exemplary Natural Community Inventory of Mt. Monadnock State Park, Gay State Forest, and Adjacent Town of Jaffrey Lands*. New Hampshire Natural Heritage Bureau. Department of Resource and Economic Development Concord, NH.

In total, researchers working on the mountain have identified seven distinct natural communities within the 1,000-foot elevational band of the mountain that were studied (see Figure 2).

On the lower slopes, hemlock-beech-oak-pine forest is dominant and semi-rich mesic hardwood forests occur along some drainages. The lower middle slopes identified were red oak forest. The steep middle slopes are comprised of red oak-black birch/marginal woodfern talus forest/woodlands and the yellow birch variant of the northern-hardwood-spruce-fir forest, with patches of dry rich red oak-ironwood talus forest/woodland. The slopes above 2200 feet are primarily composed of montane spruce-fir forest. Above the (induced) treeline, subalpine rocky balds, red spruce/heath/cinquefoil rocky ridges and montane poor fen/bogs have been observed.

Both subalpine crevice communities found near Monadnock's summit—subalpine rocky bald and sheep laurel-Labrador tea heath-krummholz—are considered exemplary natural communities in New Hampshire because of their rarity. Crevice communities are small pockets of vegetation growing wherever soil has collected in the cracks and indentations of the bedrock. Crevice communities, which thrive on the rocky terrain on the top of Monadnock, are uniquely adapted to the extreme habitat of the mountain and have gone through many years of

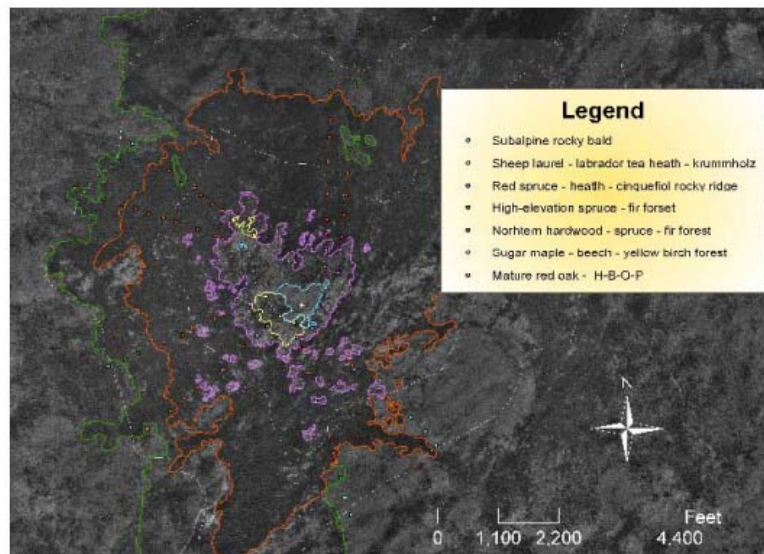


Figure 2. Plant communities between 2000' and tree line on Mount Monadnock. Map created by David Mallard.

With the abandonment of the pastures, the lower and middle slopes of Monadnock reverted back to forest while primary succession proceeded relatively rapidly on the denuded summit, with shrubs and alpine plants establishing in crevices<sup>1</sup>. The second growth forest on the lower slopes of Monadnock was logged in several locations early in the 1900's<sup>1</sup>. Much of these areas (below 2000 feet elevation) are currently being managed for timber production<sup>2</sup>.



Mount Monadnock, then and now. Photos courtesy of Kathleen M. Curtiss and Dave Mallard. Edited by Andrew Glikin.

### **Biodiversity and Mount Monadnock**

As a result of climate change, NECIA lists northern plant communities, such as spruce-fir forests, at risk. This forest type covers much of New Hampshire, Maine, Vermont, and New York and provides for the paper and pulp industry. It also harbors wildlife such as the snowshoe hare and the Canada lynx. The high-elevation spruce-fir forest found on Monadnock and other mountains provides nesting habitat for the Bicknell's thrush, a neotropical migrant. Changes in the forest composition could have negative repercussions on the wide variety of species that call Mount Monadnock home.

Biodiversity is closely tied to succession and the seral stage of the community. Successional processes are driven by the disturbance regimes of the region. Mount Monadnock is in a later seral stage, with many forests reaching maturity following the logging and fires of the early 1800's. A rapid red spruce die-off could reset the successional clock by increase the potential for fire on Mount Monadnock's slopes, which could in turn lead to a massive loss of soil and subsequently a lower tree line. However, if a change of natural community composition takes place more slowly, hardwoods that are better suited to warmer climates would likely replace red spruce.

Conservation planning to protect biodiversity must account for the role of disturbance and changes in successional patterns within the conservation area. Managers favor large reserves that can protect a diversity of habitats as studies have shown the diverse ecosystems are more resilient to disturbance. Large or contiguous reserves allow animals to move about more freely and create metapopulations. Smaller parcels of land can be just as useful, if the biotic elements of the ecosystem can move between the islands using habitat corridors.

Within the context of Mount Monadnock, this means that historic conservation efforts should be applauded for protecting the summit, as well as the lower slopes of the mountain. Current conservation efforts must address that fact that Monadnock could become an island in a sea of low elevation, fragmented, and developed lands. Charismatic species such as the bobcat will need to be able to roam from the southern cliffs of the mountain, through safe corridors, to other suitable habitats.

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<sup>2</sup> Society for the Protection of New Hampshire Forests (SPNHF). 2004. Management Plan for the Monadnock Reservation: Jaffery, Marlborough, and Dublin, NH. Concord, NH.

## Monadnock Scavenger Hunt

Dear Educator,

Thank you for choosing the MERE one-day Monadnock lesson! **The goal of this lesson is to help students understand climate change, and how it can easily impact the biodiversity of a mountain ecosystem.** We find that students often learn about climate change and how it can impact our planet globally. This lesson is designed to show them how it can impact us locally.

The lesson provided has been designed to be done in one day. There are just a couple of easy steps for you to follow in order to guide discussions and help students to get the best learning experience possible:

### **Before the hike:**

- Asks students what they know about climate change
  - What causes it? How will it impact our planet? Does it impact it both globally and locally? How?
- Ask students what they know about mountain ecosystems:
  - What will the ecosystems of Mount Monadnock look like? Will it change as we go up the mountain? How? What would Monadnock look like if it were flat?
- Divide them into small groups and hand out Worksheet and explain that it is a scavenger hunt that will help them notice the changes in the forest as we go up the mountain. Tell them that there are places to write down observations and draw pictures. Have them note anything else that's fun or shows human impacts to talk about later.
- Explain that the ecosystems of Mount Monadnock are sensitive, so please stay on the trail!

### **On top of the mountain:**

- Go over students findings:
  - How did the communities change as we climbed? How drastic were the changes? How many different communities were there?
- Allow students to debate the following discussion question:
  - WHY do the communities change as you go up the mountain?
- Show the attached map of the different communities of Monadnock. Have students discuss how different the communities are from top to bottom.
- Allow student to debate this last discussion question:
  - HOW will climate change affect this?

New Hampshire State Science Standards: Science Process Skills 1-4, Earth Space Science 4, and Life Science 1-3.

## Monadnock Scavenger Hunt

Dear Students,

Welcome to Monadnock! You are about to explore a very unique ecosystem. What makes it so unique, you might ask? Well, you're about to find that out! Your **GOAL** is to find the items on the list below. Each of these Items is numbered (in no specific order). There is a place to sketch what you've found or jot down notes about what it looks like. When you've completed your search, place the number that corresponds with the place on the mountain in the drawing on the last page. (ie, you find #3 first, put it in the first slot on the picture).

When hiking, remember you are traveling through a fragile community, so **please stay on the trail!** Have fun, and be ready to talk about your findings when you get to the top!

### The List:

1. Find a cluster (more than 5 really close to each other) of short trees that have flat needles packed really close to each other. HINT: These will be high up on the mountain and there will only be coniferous (pine) trees.

**Describe**

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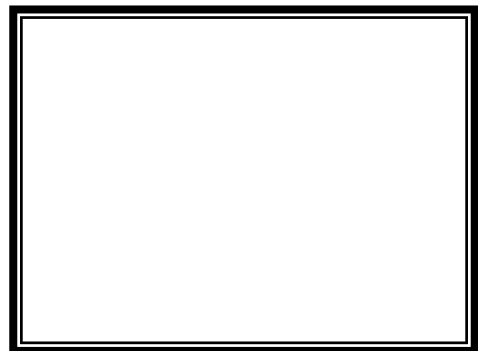
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**Draw**



2. Find a community with short coniferous trees mixed in with MANY small shrubs.

**Describe**

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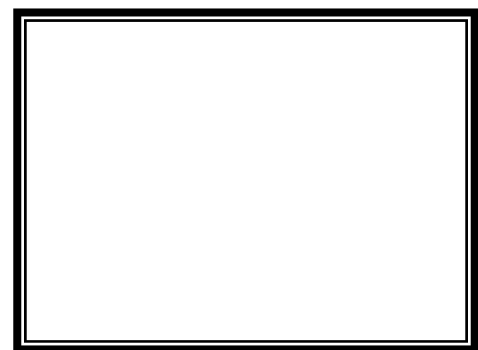
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**Draw**





3. Find a forest where most of the trees are deciduous (leaves fall off in autumn) and many of the tree trunks have very large diameters.

**Describe**

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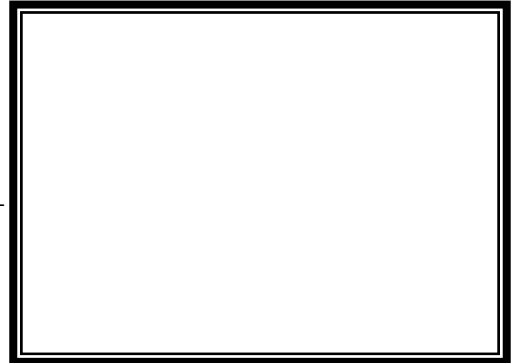
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**Draw**



4. Find an area where the following trees grow nearby each other:



- A tree with a leaf that looks like this:  
This is from a sugar maple tree, the trees that are used to make maple syrup!
- A tree with smooth bark that looks like an elephant's leg: This is a beech tree!
- A tree with papery bark whose twigs smell like root beer if you peel them: This is a Yellow Birch tree!
- Trees aren't as big and thick as before

**Describe**

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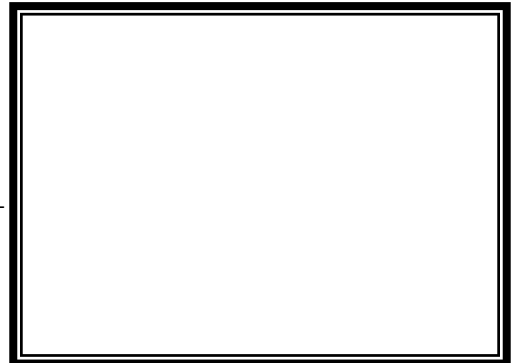
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**Draw**



5. Find a community made up mostly of small flowering plants and mosses, tucked between the rocks.

**Describe**

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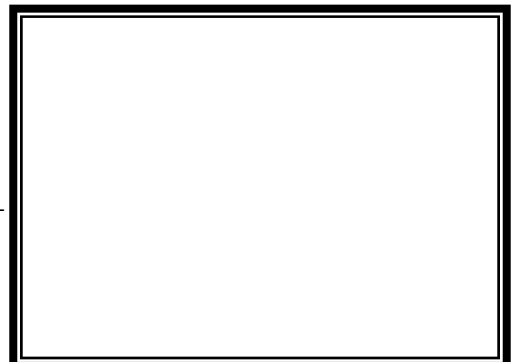
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**Draw**



6. Find a community that is made up entirely of short shrubs. There will be no trees here! There may be some flowering plants, but you won't be at the top just yet!

**Describe**

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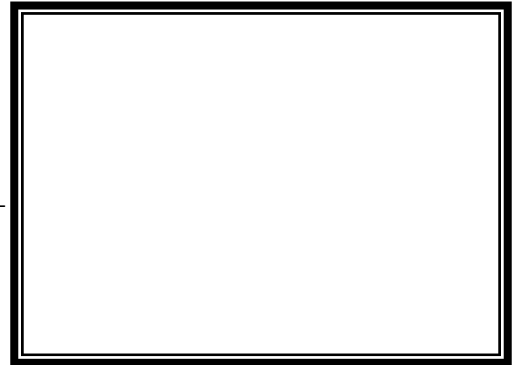
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**Draw**



**GOOD JOB!!!**

Now that you've found all the different types of communities on the mountain, it's time to place them on the map below, in the same place where you found them on your way up. For example, if number 4 was the last one you found, put it on the top place on the mountain.

Mount Monadnock!!

