

THE BWCA WILDERNESS KIT

Lesson Plan
and Materials



UNIT THREE



UNIT THREE: THE CHANGING FOREST

OVERVIEW

GRADES: 5-8

AGES: 11-14

TIME: 50 minutes

MATERIALS NEEDED:

1. Instructor Reference Sheet:
Narrator's script for
On the Stage of Succession
(laminated copy available
in kit)
2. Name cards for each
character in On the Stage
of Succession play (10)
3. Die (1 per group of
2-3 participants)
4. A Path Through Time
Change Cards
5. Station signs (5)
(one for each A Path
Through Time station)
6. A Path Through Time
Worksheet (master in
manual or on CD; make
copies as needed)
7. BWCAW Disturbance
Timeline
8. Unit Three Wilderness
Passport (master in manual
or on CD; make copies
as needed)
9. Unit Three Wilderness
Passport stamp and ink pad
10. Video "Winds of Change"

CONCEPTS AND KEY IDEAS:

1. Forests change over time, sometimes suddenly and sometimes imperceptibly.
2. Disturbances can be both human-caused and natural.

GOALS:

1. Participants will be able to define succession and summarize the stages of succession.
2. Participants will be able to give examples of dominant species for each stage of succession in the Boundary Waters Canoe Area Wilderness.
3. Participants will be able to list specific types of human-caused and natural disturbances that occur in the Boundary Waters Canoe Area Wilderness and make predictions about how the forest responds to each type of disturbance.
4. Participants will understand that the BWCAW landscape is a unique mosaic resulting from succession and disturbances that have occurred over time.

SKILLS:

1. Role-playing
2. Interpreting
3. Brainstorming in a large group
4. Working in a small group
5. Summarizing
6. Predicting
7. Analyzing
8. Reading
9. Writing

UNIT THREE: THE CHANGING FOREST



BACKGROUND (1 OF 2)

Forests are comprised of a dynamic web of **organisms** that change over time. This process of change is called **succession**. During different stages of succession, different **species** will thrive, often making way for the next species to “take root” and mature. As the composition of the forest changes, so too does the associated wildlife. In his book, *The Boundary Waters Wilderness Ecosystem*, Miron Heiseleman summarizes this process of constant change in the forest. “Change is a hallmark of forest communities. Trees, shrubs, herbs, mosses, and **lichens** grow and side, and each species modifies both its own environment and that of all other plants and animals as it becomes established, grows, and dies. Light, temperature, soil acidity, nutrient cycling rates and pathways, and the structure and composition of the forest community itself all change as forest stands pass through their life stages.”

Disturbances in this cycle of change can happen at any time and can be massive, such as a major forest fire, or the 1999 blowdown in the **BWCAW** in which 90 mile per hour winds blew down trees across 367,000 acres in the wilderness. Disturbances can also happen on a small scale, such as one individual falling tree that opens the **canopy** and allows the **understory** to receive needed light and space for different types of plants to grow. Historically, fire has played a regular role in the **BWCAW** as the major agent of change. It shaped the form of succession within the **BWCAW**, making way for forest **regeneration** and **eradicating** some insect blight. Without fire, the **BWCAW** would have a dramatically different forest **composition**.

In addition to fire, wind, drought, insects and human use are all types of disturbances that occur in the **BWCAW**. Periodic severe droughts in the **BWCAW** can cause the death of trees/plants and reduced berry crops. The dry conditions that occur can also weaken trees and plants and make them more susceptible to other disturbances such as insects and fire. It is sometimes this cumulative impact of disturbances that can have the greatest and most noticeable impact on the forest.

FIRE IN BWCAW

Between 1542 and 1971, over 1.7 million acres have burned as the result of wildfire. The intervals between wildfires during that time varied from 1-31 years, and in some years multiple fires burned. Before 1900, a fire tended to be large, burning anywhere from 10,000 to 100,000 acres—some even reached 400,000 acres. Due to fire suppression and changing land use around the **BWCAW**, the largest fire since 1900 covered 80 square miles. In the absence of naturally-occurring fire, the buildup of fuel, such as dead and downed wood, can impact the cycle of succession in the forest. Without fire, plants such as jack pine, which rely on the extreme heat of fire to open their cones and release their seeds, have difficulty regenerating. Sometimes prescribed burns are started to mimic natural wildfires that used to happen naturally before all fires were suppressed. Prescribed burns are fires that are intentionally set by qualified fire experts under very specific conditions. They are used to achieve a number of objectives, such as reducing the risk of wildfires by reducing fuel concentrations, improving wildlife habitat, and preparing seedbeds for growing new trees.



UNIT THREE: THE CHANGING FOREST

BACKGROUND (2 OF 2)

SIZING UP FIRE

We measure fire by drawing a line around the outermost areas that burned and calculating the area within that circle. However, within the fire boundaries there are likely to be many places the fire skipped, or burned over very lightly, and there may be spots where the fire burned very hot. Two consequences of this phenomenon: 1) the actual amount of land burned over is almost always less than the recorded size of a fire; and 2) the post-fire forest grows in a mosaic of communities characterized by different stages of succession. This is also true of major blowdowns.

DEFINING SUCCESSION

Primary succession is when, over a period of time, vegetation develops in an area that has had no previous vegetation community such as a sand dune, or rock cliff. There is a sequential pattern of different plants that grow for each forest type. Secondary succession occurs on landscapes where the natural vegetation has been removed or destroyed but the soil remains intact, such as a cleared pasture or burned-over forest.

Another example of the cumulative effect of disturbances is the windstorm of 1999 that blew down trees, which have now died, dried and are more likely to catch fire. Insect outbreaks and plant diseases have the same sort of effect as a drought – they weaken the trees and plants so that they are more likely to burn if a fire goes through the area. After a fire, a whole new succession process takes place and the cycle begins again. Disturbances can also be human-caused, such as over-use through recreation or development. Regardless of its size, a disturbance affects the nature of the forest and re-starts the process of succession. Depending on their size and intensity, the openings created by these disturbances can dramatically change the forest.

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PREPARATION AND INTRODUCTION

INTRODUCTION: (5 minutes)

1. Ask the following questions to assess the participants' knowledge and get them ready to learn.
 - What do you think the word succession means?
 - Have you ever watched succession happen? If so, describe it.
2. Define succession. Explain that the unit will explore the “story” of a forest and how forests change over time.

PREPARING FOR UNIT THREE:

1. Read through the unit and familiarize yourself with all of the materials before starting the activities.
2. Take the items out of the BWCA Wilderness Kit marked “Unit Three: The Changing Forest.”
3. Set up a chalkboard or large piece of paper that the entire group can see. You will use this for a quick brainstorm session between activities.
4. Set up A Path Through Time stations around the room with the Change cards at each station.
5. Make enough copies of the A Path Through Time worksheets for each team (2-3 participants per team, depending on the size of the group).



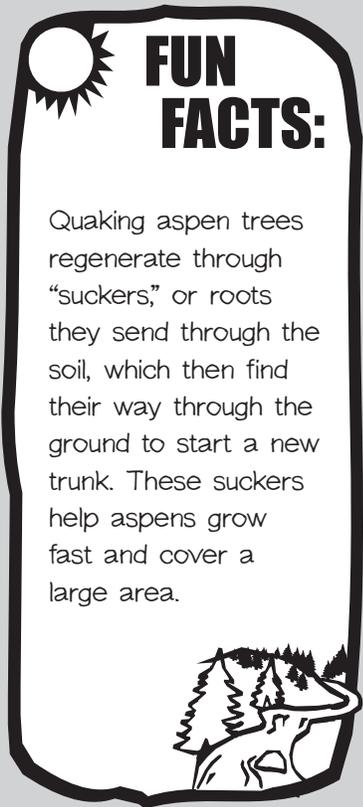
UNIT THREE: THE CHANGING FOREST

ACTIVITY ONE: ON THE STAGE OF SUCCESSION

TIME: 15 minutes

MATERIALS NEEDED:

1. Narrator's Script for On the Stage of Succession (laminated copy available in kit)
2. Name cards for each character in On the Stage of Succession play (10)



FUN FACTS:

Quaking aspen trees regenerate through "suckers," or roots they send through the soil, which then find their way through the ground to start a new trunk. These suckers help aspens grow fast and cover a large area.

OBJECTIVES:

1. Participants will summarize the stages of succession through a short role play.
2. Participants will list examples of dominant species for each stage of succession in the BWCAW.

INSTRUCTIONS:

1. Ask for 10 volunteers from the group.
2. Give each volunteer a role and a namecard.
 - Be creative as you hand out namecards. For example, ask who feels bright. Give that person the Sun. Who feels like a fast grower? Give that person the Quaking Aspen tree.
3. Explain that these volunteers will demonstrate a forest going through succession.
4. Prompt the group to notice what factors change the forest composition as the play unfolds.
5. Read through the narrator's script once, helping the actors act out their roles as a practice round.
6. Each actor does an action when his or her name is read that corresponds to the words in the play.
 - For example, when it reads "the sun rose and set many times," whoever plays the Sun should stand on a chair and step down many times. Encourage the actors to be dramatic. This is their moment of fame on stage!
7. Read through the script again (as time permits) for the "real" play.

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ACTIVITY ONE: ON THE STAGE OF SUCCESSION

8. Review the play with the group.
9. Ask all the actors to stand in the order in which they dominated.
10. Which plants came early or late and why?
11. Review the stages of succession and ask what factors spurred the different stages. (Sun, shade, rain, soil.)

THE CAST (10 MEMBERS) AND THEIR SUGGESTED ACTIONS:

(2 people): Wildflowers and grasses— **Goldenrod** and **Cotton Grass**
(sway back and forth)

(3 people): Shrubs—**Beaked Hazel** and **Juneberry** and **Speckled Alder**
(on knees, arms moving back and forth at shoulder level like treading water)

(2 people): Young forest community—**Quaking Aspen** and **Jack Pine**
(crouching or standing with arms moving up and down like reaching for the sky)

(2 people): Mature Forest community —**Balsam Fir** and **White Cedar**
(stand with hands on hips, and legs shoulder-width apart)

(1 person): **Sun** (stand up and down on a chair)

Each actor should play out his or her suggested actions. Feel free to add different actions. Actors should listen to the narrator for cues. For example, as the narrator describes how the Speckled Alder could not survive, the Speckled Alder should wither and die. Use your and the participants' imagination to create fun movements.

SUCCESSION AND DISTURBANCE

Forests will progress toward “maturity,” or later stages of succession, unless a disturbance occurs. Individual trees may grow and die, but the overall characteristics of the forest will follow the succession pattern for that type of forest. Disturbances ‘restart’ the process but not always at the beginning; it depends on the type and severity of disturbance.



UNIT THREE: THE CHANGING FOREST

INSTRUCTOR REFERENCE SHEET

NARRATOR'S SCRIPT

Once upon a time there was an area that looked like a field that was full of grasses and low plants, such as **Cotton Grass**, and pretty flowers like **Goldenrod**. It was a serene place where small mammals lived and the wind blew through the **Cotton Grass** and **Goldenrod**, swaying them ever so gently. Years passed.

The **Sun** rose and set many times on this lovely meadow. Slowly, as the winds blew and seeds from other plants dropped onto the fertile soil, things started to change. **Beaked Hazel** and **Juneberry** and **Speckled Alder** began to cover the area. These young trees, or saplings, began to inch their way toward the **Sun**, growing taller and taller. These plants were actually woody shrubs, which grow no taller than 15 feet, but they took up space and blocked the **Sun** from the lower plants. Eventually these shorter grasses and plants, like **Goldenrod** and **Cotton Grass**, began to die. Different animals ate the berries of the **Juneberry**, and warblers and other songbirds could be heard singing from the branches. But again, things began to change.

Years later, after the **Sun** rose and set many times, other trees began to grow, trees that would grow larger with bigger trunks. **Quaking Aspen** and **Paper Birch** saplings took root and began to reach higher and higher in this changing forest. They grew to be 50-60 feet tall and provided shade for the plants beneath. Now, as the forest changed, the forest floor became cooler because of the shade. Some plants, like the **Speckled Alder**, didn't like this and couldn't survive. Others thrived and soon enough (after the **Sun** rose

and set many times) different trees took hold and began to grow.

Small sprigs of evergreen began to reach toward the sun. **Balsam Fir** and **White Cedar** stood tall among the **Quaking Aspen**. Because they were more shade tolerant, they could grow underneath the **Aspen** and **Jack Pine** until they overtook them. Soon the **Pine** and **Aspen** reached maturity and died, leaving more room for the **Balsam** and **Cedar** to mature. The forest floor supported no more **Goldenrod** or **Cotton Grass**. Now new small plants thrived, the ones which could live with such shade and soil conditions that had been created over time.

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ACTIVITY TWO: A PATH THROUGH TIME

OBJECTIVES:

1. Participants will describe human-caused and natural disturbances.
2. Participants will track and describe changes over time for an imaginary forest.

INSTRUCTIONS:

1. Ask the group:
 - What factors modify the stages of succession?
 - What causes a disturbance?
2. Make a list, with the group's help, on a chalkboard or piece of paper of both human-caused and natural disturbances.
3. Explain that participants will play a game demonstrating how these disturbances affect the forest.
4. Split the group into teams of 2-3 people. Each team represents a forest in the BWCAW.
5. Set out each of the stations so that they are spread out around the room.
6. Give each team a die. The die has 6 sides with a picture of a disturbance that can happen in a forest. (Fire – appears on two sides, wind, insects, human use, and drought).

TIME: 20 minutes

MATERIALS NEEDED:

1. A Path Through Time Change Cards for each station
2. Die (8)
3. Station signs (5) (one for each A Path Through Time station)
4. A Path Through Time Worksheet (master in manual or on CD, make copies as needed)
5. BWCAW Disturbance Timeline

INSTRUCTOR'S NOTE:

The symbol of fire occurs twice on each die. It represents the large effect fire has on ecosystems. It has been the most influential disturbance in the BWCAW.



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ACTIVITY TWO: A PATH THROUGH TIME

7. Instruct participants to roll their die, go to the corresponding station, pick a card and read it.
 - There are five stations – one for each type of disturbance. At each station are Change Cards with different scenarios for that particular type of disturbance.
8. Tell participants to record or paraphrase a description of what happens to their forest at each station on their A Path Through Time Worksheets and continue their journey.
9. Play the game for 15 minutes and then gather the group.
10. As the participants are playing the game, pull out the BWCAW Disturbance Timeline and put it in a place where all participants can see it.
11. Ask each group to summarize its forest's story.
 - What were some disturbances that happened to your forest?
 - What was a large-scale disturbance versus a small-scale disturbance?
12. When the game is finished, refer to the timeline.
 - Read aloud, or have participants read aloud, the different stages the BWCAW has experienced.
 - Have participants point out where they see disturbances.
 - Use the timeline to evaluate which disturbances are the most influential or seem to cause the most change.

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INSTRUCTOR REFERENCE SHEET (1 OF 2)

A PATH THROUGH TIME CHANGE CARDS

An intense crown fire roared through your forest. The fire climbed the branches of the lower trees and burned the tops of the taller, older trees. The forest now has many standing dead and charred trees which will either fall with a strong wind or in a few years.

A surface fire burned steadily in your forest. All the smaller trees and ground cover were destroyed. The fire burned the decaying plants on the ground, creating room for new plant life and restoring important minerals to the soil.

Lightening struck a big pine tree and started a fire in your forest. The Forest Service controlled the fire before it burned many acres. Dead and downed wood accumulated on the ground and will serve as 'fuel' for future fires.

A prescribed burn has been designated in your forest. Forest Service crews will check weather (wind direction and speed), and fire lines will be constructed so that the fire can be controlled. This fire will help burn off the dead and downed wood and other fuel, as well as regenerate the soil for future plants to grow.

Campers left their campfire smoldering when they left the campsite. A strong wind blew that evening, sending sparks into a pile of nearby twigs and needles. The pile caught fire and started a ground fire. It burned the plants on the ground and charred the trunks of many trees.

A huge fire roared through the wilderness. Strong winds caused the fire to leap to stands of trees. This created what looked like islands of small fires up to half a mile away.

A derecho (straight line winds of 90+ miles per hour) blew through your forest. Many trees were snapped in half. Your forest is much brighter now, as many of the taller trees that provided shade have been toppled. These downed trees also will create a future fuel supply for fires.

It is not a windy day in your forest. Nothing much has changed.

During a windy thunderstorm, a huge white pine came toppling down. Its roots and the soil covering it are now exposed. The seedlings of trees that lived in its shade finally get to see the sun.

Spruce budworms, a type of caterpillar, have affected many trees in your forest. They have eaten the new needles that grow each spring, affecting the health of the lower branches and the new trees trying to grow.

Bark beetles have found their way into some of the injured trees in your forest. They help in the decomposition process (breaking down wood to become soil) and provide a tasty meal for woodpeckers!



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INSTRUCTOR REFERENCE SHEET (2 OF 2)

A PATH THROUGH TIME CHANGE CARDS

Forest tent caterpillars are moving through your forest. They devour so many of the leaves on the trees that it looks like winter in the middle of summer; the trees are bare! This will affect the trees' ability to use the sun's energy to grow. Many trees won't survive the year.

It's a popular year in the BWCAW. Canoeists and hikers love to use your forest. Unfortunately, their use has been hard on the area. They've collected lots of firewood around the campsites, leaving the ground almost bare, and the plants on the ground trampled. There are no leaves or wood to decompose and add nutrients to the soil. And the ground is so compacted from lots of feet walking on it that no seeds will be able to take root and grow.

Mountain bikers are using the old logging roads in your forest. One particular road runs parallel to a beautiful stream. When it's rainy and muddy, the perfect time to mountain bike, the trail gets torn up. Pretty soon the hillside is eroding into the stream, clouding it and affecting the organisms that live there.

Six overnight paddlers in your forest are following the guidelines on their permit. They are only collecting dead and downed wood far away from their campsite and building small fires in the fire grates. They have little impact on your forest.

It's been a hot and dry summer in your forest. Your trees have to search deep in their roots for water. They may not survive the winter.

Not much snow has fallen this winter in your forest. In fact, the snowfall is well below average. The lack of moisture makes your forest susceptible to an early summer forest fire.

There has been little rain in your forest, and the berry crop notices. Many of your berry-producing trees aren't producing. The birds and mammals that rely on the berries will be hungry.



UNIT THREE: THE CHANGING FOREST

ACTIVITY TWO:
A PATH THROUGH TIME WORKSHEET

NAME _____

First Station:

Second Station:

Third Station:





Fourth Station:

Fifth Station:

Sixth Station:

What happened in your forest over time?



UNIT THREE: THE CHANGING FOREST



UNIT CLOSING

1. Review the stages of succession and how a forest changes without disturbances.
2. Ask the group:
 - Do some disturbances increase the likelihood of other disturbances occurring? (Yes. For example, many years of drought can increase the chance of fire; wind storms can increase the chance of fire.)
 - What disturbances are linked to each other (wind and fire, people and fire, drought and fire, or insects and wind)?
3. Describe the factors that affect a forest, whether they are disturbances or a lack of disturbances. Refer to the succession skit. Ask the group questions such as:
 - What factors would reverse succession to the Cotton Grass?
 - Which disturbances seem to impact the forest the most?
4. Ask the group if they think fire is necessary and why? (Yes. Fire is necessary for the succession of some plants and has played a major role in the BWCAW. Fire returns nutrients to the soil by burning dead and downed wood; creates openings for new vegetation to grow; and releases seeds from fire-adapted trees such as the jack pine.)
5. Does an entire forest look the same? Have the participants explain their decision.

TIME: 10 minutes

“Fire was the great recycling agent before logging and fire control changed the natural systems.”

-Miron Heinseleman,
*The Boundary Waters Wilderness
Ecosystem* (p. 75)



UNIT THREE: THE CHANGING FOREST

WILDERNESS PASSPORT

MATERIALS NEEDED:

1. Unit Three Wilderness Passport (master in manual or on CD; make copies as needed.)
2. Unit Three Wilderness Passport stamp and ink pad

FUN FACTS:

Many jack pine cones remain sealed until the heat of a fire melts the resin, releasing seeds to the ground. Seeds in the jack pine cones can remain “viable,” or able to germinate for 25 years!

A northern white cedar on Basswood Lake in the BWCAW is more than 1,200 years old!



OBJECTIVES:

1. Participants will list the disturbances which affect the BWCAW forest.
2. Participants will define “succession” and give an example of what that looks like in the BWCAW.
3. Participants will create a diagram that illustrates succession in a forest.

INSTRUCTIONS:

1. Give each participant a copy of the Unit Three Wilderness Passport (master in manual or on CD).
2. Ask participants to complete the Unit Three Wilderness Passport.
3. Stamp each participant’s passport when the section is complete.



WILDERNESS PASSPORT

UNIT THREE: THE CHANGING FOREST

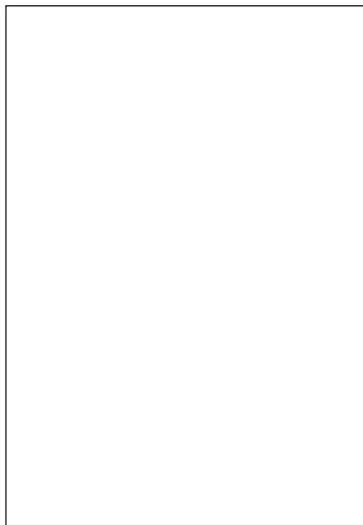
NAME _____

1. List as many **disturbances** as you can that affect the BWCAW forests.

2. Define **succession** and give an example of what that would look like in the BWCAW.



3. Create a diagram that illustrates **succession** in a forest.



UNIT THREE STAMP HERE



UNIT THREE: THE CHANGING FOREST



EXTENSIONS

1. Arthur Carhart National Wilderness Training Center's "Wilderness and Land Ethic Curriculum." Additional information may be found at www.wilderness.net/carhart/.
2. Watch video "Winds of Change," which includes footage of the 1999 blowdown in the BWCAW. (10 minutes)
3. Create a model of a mixed forest in the Boundary Waters Canoe Area Wilderness. What would happen over time? Show disturbances and their effects.
4. Research the most recent fire in the BWCAW. Find out when it happened, how many acres burned, what type of fire it was, and predict what plants will first colonize in that area.
5. Invite a wildland firefighter to speak about fighting fires or a Forest Service employee to describe controlled burns.



UNIT THREE: THE CHANGING FOREST

MINNESOTA GRADUATION STANDARDS

MIDDLE:

Read, Listen, and View (Learning Area 1)

NON-FICTION

1. Comprehend, interpret, and evaluate information from a variety of nonfiction formats in reading, listening, and viewing.

MIDDLE:

Mathematical Concepts and Applications (Learning Area 4)

Patterns and Functions

1. Recognize, analyze, and generalize patterns found in data from lists, graphs, and tables.

MIDDLE:

Inquiry and Research (Learning Area 5)

DIRECT OBSERVATION

1. Gather information to answer a scientific or social science question through direct observations, including framing a question; collecting and recording data; displaying data in appropriate format; looking for patterns in observable data; relating findings to new situations or large group findings; answering a question or presenting a position using data; and identifying areas for further investigation.

MIDDLE:

Scientific Concepts and Applications (Learning Area 6)

Earth Systems: Understand the concepts of change and constancy in the earth's history and theories of origin through evidence found in fossils, rocks and layers, land forms, and natural events.

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ADDITIONAL INFORMATION & RESOURCES

- **Project Learning Tree Curriculum, The Changing Forest: Forest Ecology 1996.** Background information on succession, fire, and forest management.
- **www.wilderness.net/wildlink/activityzonedirectory/curriculumtch/fireecology.htm:** a wildernessinformation website link to curriculum. This site includes a fire ecology lesson plan with a link to a fire management game from the Forest Service. Type “fire” on the home page of www.wilderness.net and you will receive other related links.
- **www.fs.fed.us/rm/fire_game:** website for fire ecology game.
- **www.superiornationalforest.org:** Superior National Forest website complete with history and current information on the BWCAW, including information on prescribed burns.

FOR MORE INFORMATION:

The BWCA Wilderness Kit was jointly produced by the Boundary Waters Wilderness Foundation and the United States Forest Service-Superior National Forest. Both are available to answer questions regarding content, instruction, and materials of the kit.

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