



Survival Scenarios

Worksheet and Answer Key



Survival Scenarios

In this worksheet, you will predict and describe what could happen to aspen trees in different scenarios. Use the information below and your knowledge about plant reproduction to answer the questions that follow. Write your answers on a separate sheet of paper.

Background Information

Aspens can reproduce both sexually and asexually. In sexual reproduction, there are both male and female trees. Small flowers appear on both trees in the early spring, and are wind pollinated. The cotton-like seeds spread in the wind, but are only viable (able to reproduce) for a short time. A seed can only germinate (sprout) if it reaches wet or moist soil in a favorable location.

Asexual reproduction has a much higher success rate than sexual reproduction. The specific conditions required for a seed to germinate limit the number of trees produced. However, asexual reproduction occurs as the root system of aspens produce shoots and suckers (young trees). Signals to sprout new trees are sent to the root system whenever old trees die, there is a fire, or more water becomes available. A grouping of trees that are all connected to the same root system below ground is called a clone. Within a clone, all trees are genetically identical.

Aspen clones can range in size. Smaller clones are only about one acre in size, or large ones can spread up to 100 acres, such as the Pando Forest located in Fishlake National Forest in Utah. Aspen clones can also live for thousands of years: the Pando Forest is estimated at 80,000 years old! A single grove of aspen trees can contain just one clone, or several. In Zion National Park, aspens can be found in the higher elevations, particularly at Lava Point.

In a natural process called succession, aspens will naturally age and die. This change creates favorable conditions for other trees to take over, such as ponderosa pine. Ponderosa pines reproduce sexually, dispersing their seeds when cones drop to the ground or are spread by animals. As ponderosa pine trees fill an area, they provide shade, creating unfavorable conditions for aspens.

1. State at least two reasons why aspens more commonly reproduce asexually versus sexually.

Scenario A: Disease

Rangers at Zion National Park start to notice leaves on some of the aspen trees at Lava Point were turning brown in the middle of summer. Upon closer investigation, a parasitic insect called the wood borer has moved into the area and is killing trees. Biologists study the grove, which contains two different clones, and notice there are no saplings.

2. What do you think will happen to the remaining trees? Why?
3. How might this situation be different if the aspens were not clones (and had produced sexually instead of asexually)?

Scenario B: Drought

Rainfall over the past three years has been below average. The snowpack in the winter has also decreased significantly. Rangers notice about 10% of the aspen trees throughout the park have died off, and there are almost no new saplings.

4. Does the aspen grove still have the capability to reproduce?
5. In times of drought, is it better for aspens to reproduce asexually or sexually? Why?
6. What do you think will happen to the root system if the drought continues?
7. What do you think will happen to the clones if there is an increase in precipitation?

Scenario C: Fire

It has been a very dry winter with little snow or rain. In early July, a lightning strike starts a large-scale forest fire. The area burned was located high on the plateau, populated with an aspen grove, and some ponderosa pine. After the fire, half of the aspen grove and only a few hearty ponderosa pines remain. All the ponderosa pine cones were lost in the fire.

8. Will the ponderosa pines be able to reproduce again soon after the fire? Why or why not?
9. Will the land recover? Explain which trees will return first and why.
10. Will asexual reproduction (as opposed to sexual reproduction) help or hinder the aspens to grow back?

Survival Scenarios Answer Key

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Background Information

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Asexual reproduction has a much higher success rate than sexual reproduction. The specific conditions required for a seed to germinate limit the number of trees produced. However, asexual reproduction occurs as the root system of aspens produce shoots and suckers (young trees). Signals to sprout new trees are sent to the root system whenever old trees die, there is a fire, or more water becomes available. A grouping of trees that are all connected to the same root system below ground is called a clone. Within a clone, all trees are genetically identical.

Aspen clones can range in size. Smaller clones are only about one acre in size, or large ones can spread up to 100 acres, such as the Pando Forest located in Fishlake National Forest in Utah. Aspen clones can also live for thousands of years: the Pando Forest is estimated at 80,000 years old! A single grove of aspen trees can contain just one clone, or several. In Zion National Park, aspens can be found in the higher elevations, particularly at Lava Point.

In a natural process called succession, aspens will naturally age and die. This change creates favorable conditions for other trees to take over, such as ponderosa pine. Ponderosa pines reproduce sexually, dispersing their seeds when cones drop to the ground or are spread by animals. As ponderosa pine trees fill an area, they provide shade, creating unfavorable conditions for aspens.

1. State at least two reasons why aspens more commonly reproduce asexually versus sexually.

Aspens are more successful with asexual reproduction because it has a higher chance of success compared to sexual reproduction. Sexual reproduction requires a combination of perfect circumstances (right time of year, moist soil to land on) while asexual reproduction can happen at any point throughout the summer, particularly during damaging events (i.e. fire, disease, storms).

Scenario A: Disease

Rangers at Zion National Park start to notice leaves on some of the aspen trees at Lava Point were turning brown in the middle of summer. Upon closer investigation, a parasitic insect called the wood borer has moved into the area and is killing trees. Biologists study the grove, which contains two different clones, and notice there are no saplings.

2. What do you think will happen to the remaining trees? Why?

The remaining trees will probably also be killed or at least weakened by the wood borer. If one set of clones is particularly susceptible though, the other set of clones may not be affected. The trees will have to reproduce sexually if they are unable to send up new saplings.

3. How might this situation be different if the aspens were not clones (and had produced sexually instead of asexually)?

Having genetic variation (through sexual reproduction), may help the aspens survive. The wood borer may prefer the genetic makeup of certain trees. If the wood borer is successful with one clone, the whole forest could be destroyed. However, with genetic variation, singular trees may have better defenses against the wood borer.

Scenario B: Drought

Rainfall over the past three years has been below average. The snowpack in the winter has also decreased significantly. Rangers notice about 10% of the aspen trees throughout the park have died off, and there are almost no new saplings.

4. Does the aspen grove still have the capability to reproduce?

Yes, they have the capability to reproduce but may be waiting for more favorable (wetter) circumstances.

5. In times of drought, is it better for aspens to reproduce asexually or sexually? Why?

Asexually. When aspen seeds disperse in sexual reproduction, they need to land on moist soil in order to take root—and drought conditions are not favorable to this. Even if it is dry, an aspen tree can send up shoots and quickly start reproducing again when the rain does return.

6. What do you think will happen to the root system if the drought continues?

The root system could certainly shrink in size, and send up fewer clones to conserve water. If the drought continues long enough, the root system will stop producing shoots and may become dormant. Prolonged drought can eventually kill off the root system of an entire clone.

7. What do you think will happen to the clones if there is an increase in precipitation?

Once there is an increase in precipitation, then the roots will be able to send up new shoots (clones) and the root system will start to expand again. If the rains come at the right time of the year, then it is possible that the aspen could also reproduce sexually using seed dispersal.

Scenario C: Fire

It has been a very dry winter with little snow or rain. In early July, a lightning strike starts a large-scale forest fire. The area burned was located high on the plateau, populated with an aspen grove, and some ponderosa pine. After the fire, half of the aspen grove and only a few hearty ponderosa pines remain. All the ponderosa pine cones were lost in the fire.

8. Will the ponderosa pines be able to reproduce again soon after the fire? Why or why not?

It will be very difficult for the ponderosa pines to reproduce after the fire because their seeds (in the pinecones) were all destroyed and ponderosa pines only reproduce sexually. However, ponderosa pines are resilient after fires and will be able to produce new cones for the future.

9. Will the land recover? Explain which trees will return first and why.

Yes, the land will recover. Fire is a natural process that forests go through which allows different plants take hold at different times. The aspens will be one of the first trees to reproduce again and quickly through asexual reproduction. Several years later, ponderosa pine will eventually return when the aspen create more favorable growing conditions. In the natural succession of a forest, ponderosa pines follow aspens.

10. Will asexual reproduction (as opposed to sexual reproduction) help or hinder the aspens to grow back?

Being able to reproduce asexually will help the aspens grow back. Their seeds were not destroyed like those of the ponderosa pines, and the aspens can send new shoots up from the surviving trees and root system. The aspens will not have to wait to grow new seeds or for more favorable soil conditions like the ponderosa pine. It also helps the aspen to be able to reproduce both ways because even if the fire was severe enough to destroy the roots, spreading seeds sexually from nearby trees will help the grove recover.