Changing Climate

Seasonal Shifts

Middle School Guide

REACH Up

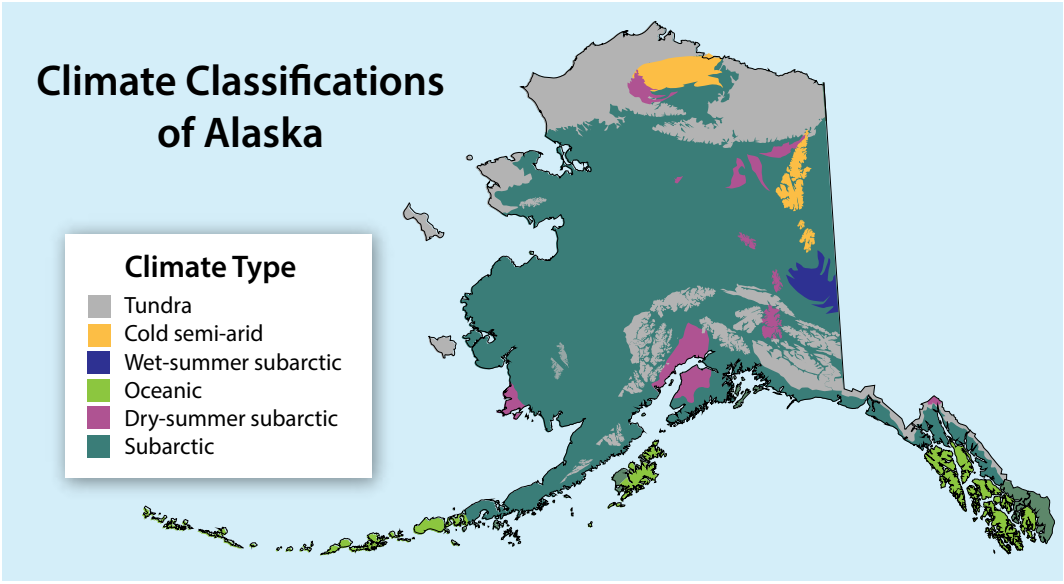
Raising Educational Achievement through Cultural Heritage Up

Changing Climate

What is Climate?

Climate is the long-term average of weather conditions that occur in a particular region. The Bering Strait region of Alaska includes subarctic and tundra climates. Subarctic climates are characterized as having their coldest months average below 0°C (32°F) and at least one month that averages above 10°C (50°F). Much of Alaska has a subarctic climate in which there is no significant difference in the amount of precipitation between seasons. Some areas get most of their precipitation in winter (dry summer subarctic), while other areas get most of their precipitation in summer (wet summer subarctic.) The tundra climate is characterized by temperatures that average below 10°C (50°F) in the warmest months. The tundra climate is a subcategory of polar and alpine climates; the other subcategory of polar climate is an ice cap climate, where all twelve months of the year average below 0°C (32°F). Which climate classification describes your community?

Residents across the Bering Strait region report changes to the local climate. Scientists, both local and distant, are working to understand this climate change. The changes have been so extensive and persistent that a New Arctic is emerging. The New Arctic is warmer, with less sea ice and shorter winters. In the New Arctic, permafrost is thawing and glaciers are shrinking. Measuring and understanding climate change requires collecting data about the weather and environmental conditions in the area over a long period of time. Both ***qualitative data*** (the use of words to describe what is observed) and ***quantitative data*** (the use of numbers to describe what is observed) are used in climate science. Qualitative data might include descriptions of visual environmental observations, oral histories of extreme weather events, and photographs of sea ice conditions. Quantitative data about weather, such as temperature, wind speed, and snow depth can be gathered using instruments. What qualitative and quantitative environmental observations do you make? When and why do you observe weather?



Map based on Wikimedia map "Köppen Climate Types of Alaska." *Source: WorldClim.org.*

How is Climate Change Impacting Seasons?

Elders and scientists have been observing the seasons for many generations. Their observations tell us that the seasons are shifting. Spring thaw arrives earlier, freeze up is later, and winters are warmer than they used to be. Changes in the seasons are caused by changes in the climate and physical environment, such as warming temperatures and less snow and sea ice.

What is Phenology?

Elders and scientists have tracked the timing of important seasonal events for many years. This is called ***phenology***. Phenology is the study of timing in nature. It is like nature's calendar. Some examples are: when plants green up each spring; when berries ripen each summer; and when salmon, birds, and other animals migrate each season.

Migrating snow geese prepare to land. Earlier spring conditions along their migratory route encourage them to migrate north earlier. *Photo: Dave Menke, USFWS digital library.*

Phenology is important to survival. The timing of important life events for many living things depends on the timing of the seasons. For example, the timing of bird migration is related to spring thaw. Over many generations, birds such as geese and swans have arrived in Alaska when the snow and ice have melted and the first green plants are available to eat. Nesting is timed so that eggs hatch when the most nutritious and abundant food is available for young nestlings to grow. Birds depart when the landscape begins to freeze, and food and water are no longer available. Can geese, swans, and other birds respond to shifting seasons and changing phenology? Elders and scientists are studying them to find out.

Seasonal Shifts

Phenology is also important to subsistence, cultural traditions, and safety. For many generations, elders carefully studied phenology. They use this knowledge to teach us when to hunt, fish, and gather subsistence foods. Their knowledge of phenology teaches us when it was safe to travel on frozen rivers, when to find subsistence foods in different locations, and when to stay off the sea ice. How will Alaskan people and communities respond to shifting seasons and changing phenology?

Knut Kielland, Sam Demientieff, and Dave Norton wrestle with a snowmachine that got stuck when crossing an ice bridge over open water on Luke's Slough on the Tanana River, February 12, 2010. *Photo: Karen Brewster, UAF Oral History Program.*

Dwarf Alder catkins bloom earlier with warmer late winter temperatures in Kotzebue. *Photo: Putt Clark, REACH Up.*

Ask an Expert

1. Watch the video *Seasonal Shifts* available at *www.k12reach.org/videos.php.*

2. Interview elders or cultural knowledge bearers in your community. Some questions you may want to ask:
   - Have you noticed any changes in the seasons over your lifetime? If so, how have the seasons changed?
   - Have you noticed any changes in when plants green up, flower, or when berries ripen each year?
   - Have you noticed any changes in when and where animals move or have their young?
   - Has the timing of break up or freeze up changed? If so, has this changed safety and travel?
   - Have people in our community made any changes to their subsistence activities to adjust to shifting seasons?

3. If the person you interview speaks an Alaska Native language, ask them what language and dialect(s) they are familiar with. Ask them to please translate the following words:

   - fall
   - rain
   - river
   - snow
   - spring
   - summer
   - tundra
   - winter

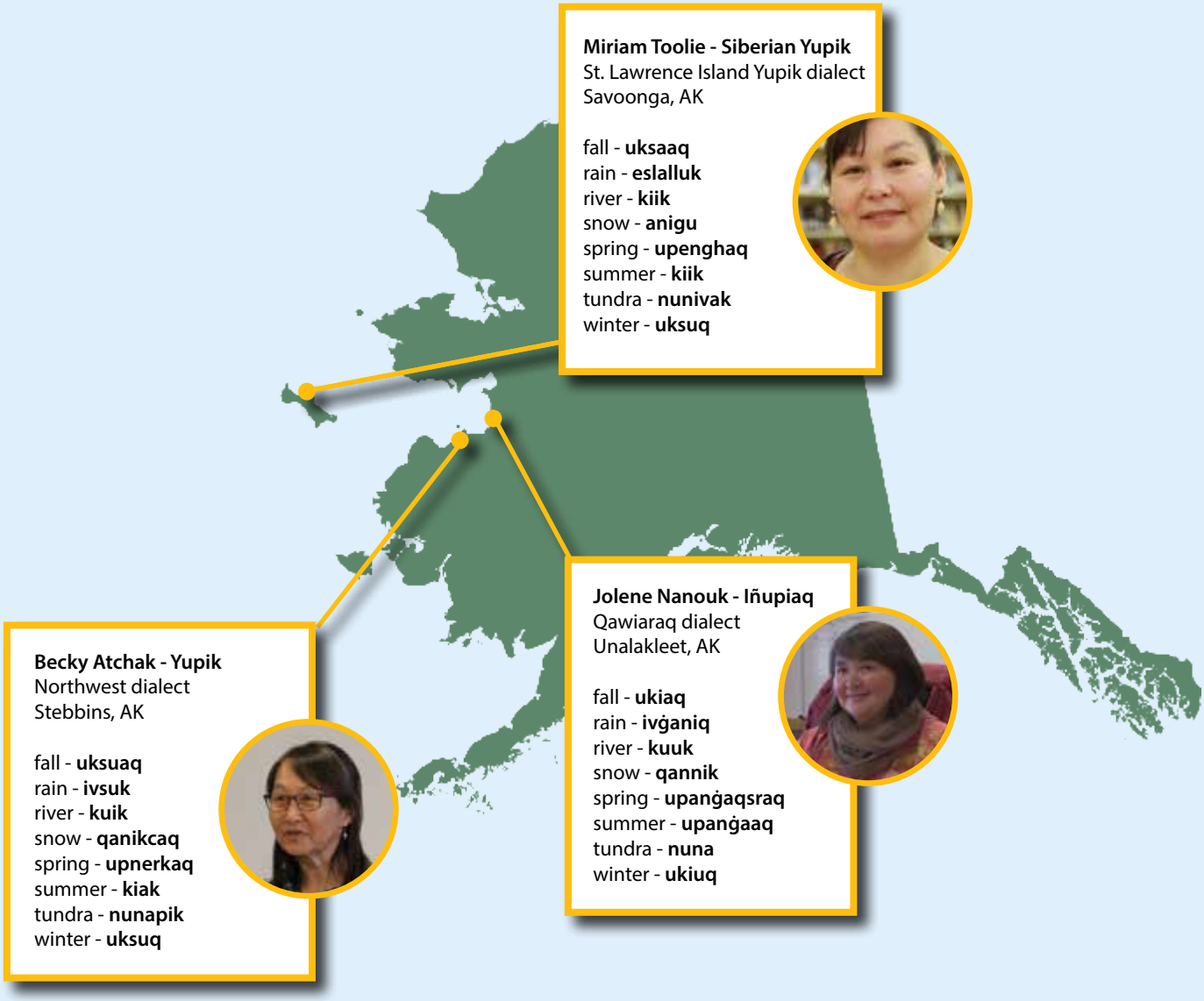
Paul Nagaruk, Elim, discusses his observations about seasonal changes. *Photo: Sean Tevebaugh, REACH Up.*

Compare your words with the translations on the Seasonal Shifts Vocabulary page in this guide. Are any of the terms the same or different?

Seasonal Shifts Vocabulary

Would you like to know Alaska Native language terms related to seasons?

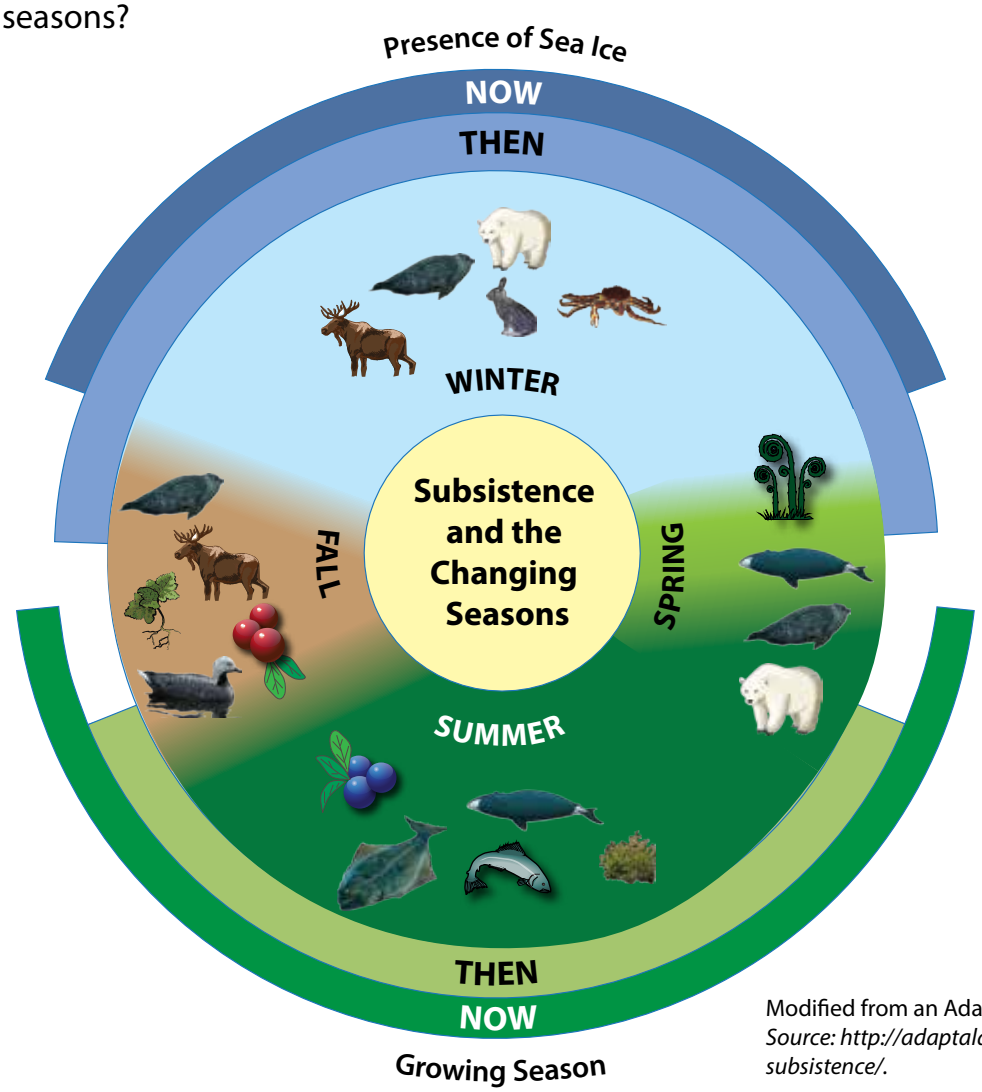
Work with your classmates to practice seasonal vocabulary words in English and the indigenous language of your community. Your teacher will give you vocabulary cards with the English word and an illustration on one side. Write the corresponding indigenous term on the blank line on the back of each card. Use the words that you learned from a local elder or cultural knowledge bearer, or choose the translation below that is closest to your community.



Subsistence Through the Seasons

Look carefully at the subsistence calendar below. It shows some subsistence foods for each season. There are two rings around the outside of the circle. The dark green ring represents the growing season (the time that plants can grow), and the dark blue ring represents the timing of when sea ice is present. The light green and blue lines depict the length of the growing season and sea ice presence in the past. Notice how they have changed. These changes can impact phenology and subsistence activities.

What subsistence foods and seasonal activities do you think could be the most impacted by these changes? What can you do to adapt subsistence and seasonal activities to changing seasons?



Modified from an Adapt Alaska graphic.
Source: http://adaptalaska.org/poster-subsistence/.

What is Phenology?

Materials

- Marker chips in two colors

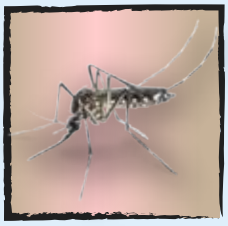
Procedure

1. Look at the list of events. Some are examples of phenology and some are not. Choose one color of marker to indicate "Yes, this is phenology" and the other color to show "No, this is not phenology."
2. Read through the examples and place a marker on each picture to show whether you think each example is phenology or not.

When the first flower in the tundra blooms

When the river breaks up

When I travel for a basketball game

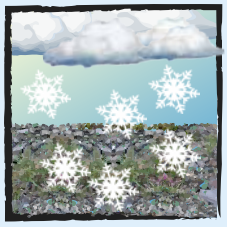


First mosquito of the year

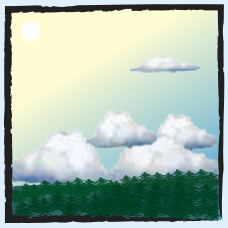
How many birds I see fly over the school

How many salmon are in the smokehouse at fish camp

When the caribou have their young



Date of the first snowfall

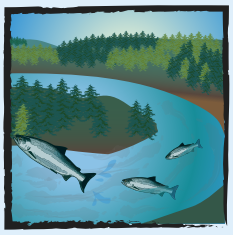


Date of the summer solstice (the longest day of the year)

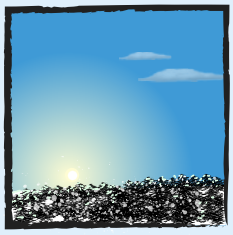
Date when school gets out for summer vacation

When bears wake up from hibernation

Last group of swans spotted flying over the river in the fall



First salmon swimming upstream



Date of the winter solstice (shortest day of the year)

The number of times it rains in the summer

Date the sea ice is safe to travel

Number of caribou killed by hunters this year

Date the berries are ripe in my traditional picking spot

Discuss

1. Share your results with your classmates.
2. If there is a different opinion about the answers, discuss the ones you chose.
3. Can you think of more examples of phenology that are important in your community?
4. What examples of phenology are most important to your life?

Phenology is Changing

Phenology is changing with the changing climate. Across Alaska, seasons are shifting. Spring thaw is happening earlier than it used to. Rivers are breaking up earlier in spring, and freezing later in fall and winter. Elders and scientists have observed that some living things are changing, too. Plants are greening up and flowering earlier. Some birds are arriving earlier, and leaving later. Insects hatch and berries ripen at different times than in the past. Can all living things respond to changes in phenology? Elders, scientists, and Alaskan communities are studying them to find out.

Bearberry in the tundra. *Photo: USFWS digital library.*

Changing phenology can have ripple effects throughout the food web. Many parts of Alaska ecosystems are changing, and not everything is changing at the same rate or in the same direction. This can lead to mismatches in timing for animals, plants and people. For example:

- If birds arrive and build their nests at the same time they have in the past, but spring has arrived earlier, then their eggs may hatch when there is not enough nutritious food for chicks to eat.
- If rivers break up earlier and freeze later, it can be dangerous or impossible for people to travel at times when they have traveled in the past.
- If animals are no longer present in traditional hunting and fishing areas when they used to be, or if the landscape is not safe for travel, people may not have the subsistence foods they had in the past.

Studying how plants and animals respond to shifting seasons can help us plan for climate change impacts to habitats, wildlife and subsistence.

Long-term Data

Living things are adapted to survive the climate and phenology (timing) that existed in the past. In order to study if and how living things might adapt to shifting seasons, we need to study observations and data collected over a long period of time. This is called a ***long-term data set***. Using long-term data sets collected by elders, scientists and community members in Alaska, we can investigate questions, such as: **Is the phenology of rivers around our communities changing with the climate?**

Spring Break Up

Break up is an exciting time in many Alaskan communities. Spring has arrived. Frozen rivers break apart and snow melts. Water begins to flow again, migratory animals return, and mud is everywhere. It can be a difficult and sometimes dangerous time to travel because the snow and ice are no longer safe, and the ground has not dried yet.

Many Alaskans notice the date when the ice breaks up on rivers in their communities, and some keep careful records of this date over time. These observations can build a long-term data set to help us study changing phenology.

This is the official tripod for the Nenana Ice Classic. The tripod is attached to a clock on the shore by a cable. When the ice under the tripod breaks or starts to move, the tripod moves, pulling the cable and stopping the clock. *Photo: James Brooks, https://www.flickr.com/photos/jkbrooks85/3384528606.*

The Tanana and Yukon Rivers have very good long-term data sets of break up. People have recorded when the ice on these rivers starts to break up for over 100 years as part of two annual competitions. Since 1917, a contest called the Nenana Ice Classic on the Tanana River in central Alaska has paid several million dollars in winnings to the people who come closest to guessing the exact date and time when the river ice will break up. A similar tradition exists on the Yukon River in Dawson City, Canada. There, breakup dates have been recorded since 1896! River ice breakup is more than just a competition. It shows us how breakup dates in Nenana and Dawson City have changed over time. We can use the long-term data sets collected by these communities to study changes in climate and phenology.

Break Up on Two Alaskan Rivers

Materials

- Student Worksheet (or graph paper)
- Scissors
- Transparent tape
- Pencil
- Ruler (or straight edge)

Part 1: Studying a Sample Graph

Study the sample graph on your worksheet to practice finding patterns in quantitative data.

Part 2: Looking at the Trend

We will use two graphs to look for trends in river phenology in Alaska. The graphs show the break up dates for the Yukon and Tanana Rivers. Like the sample graph, the x-axis shows the year. The y-axis shows the date of break up. The ***line of best fit***, also called the ***trendline***, has been drawn for you.

Your teacher will assign you to Team Yukon or Team Tanana. Study the graph for your river carefully. Look for a pattern, and answer the questions below. You may need to use the lines on the graph to estimate the years and break up dates in between the ones that are labeled.

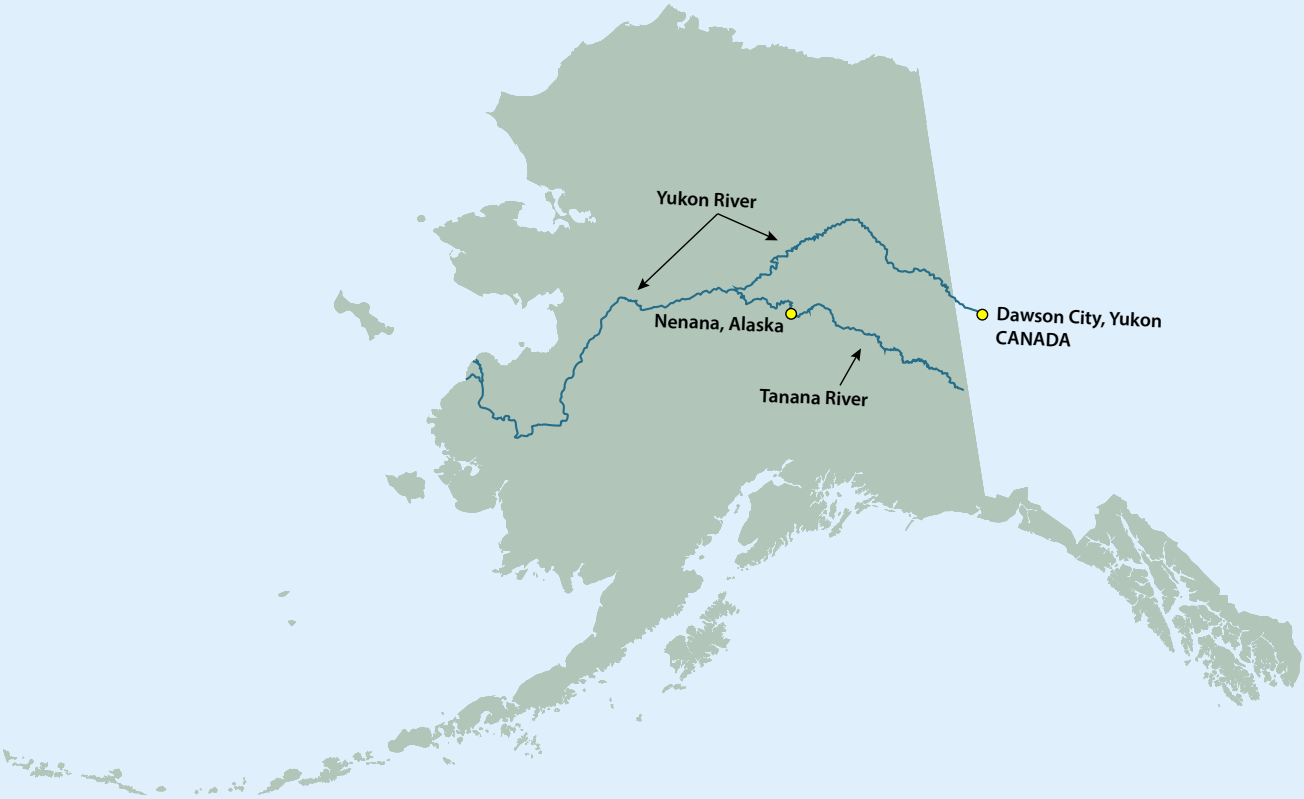
1. In what year was the latest break up recorded?
2. In what year (or years) were the earliest break ups recorded?
3. Describe the slope of the trendline. Is it sloping down showing a trend toward an earlier breakup? Is it sloping up showing a trend toward a later breakup? Or is it level showing no change in the phenology of breakup over time?

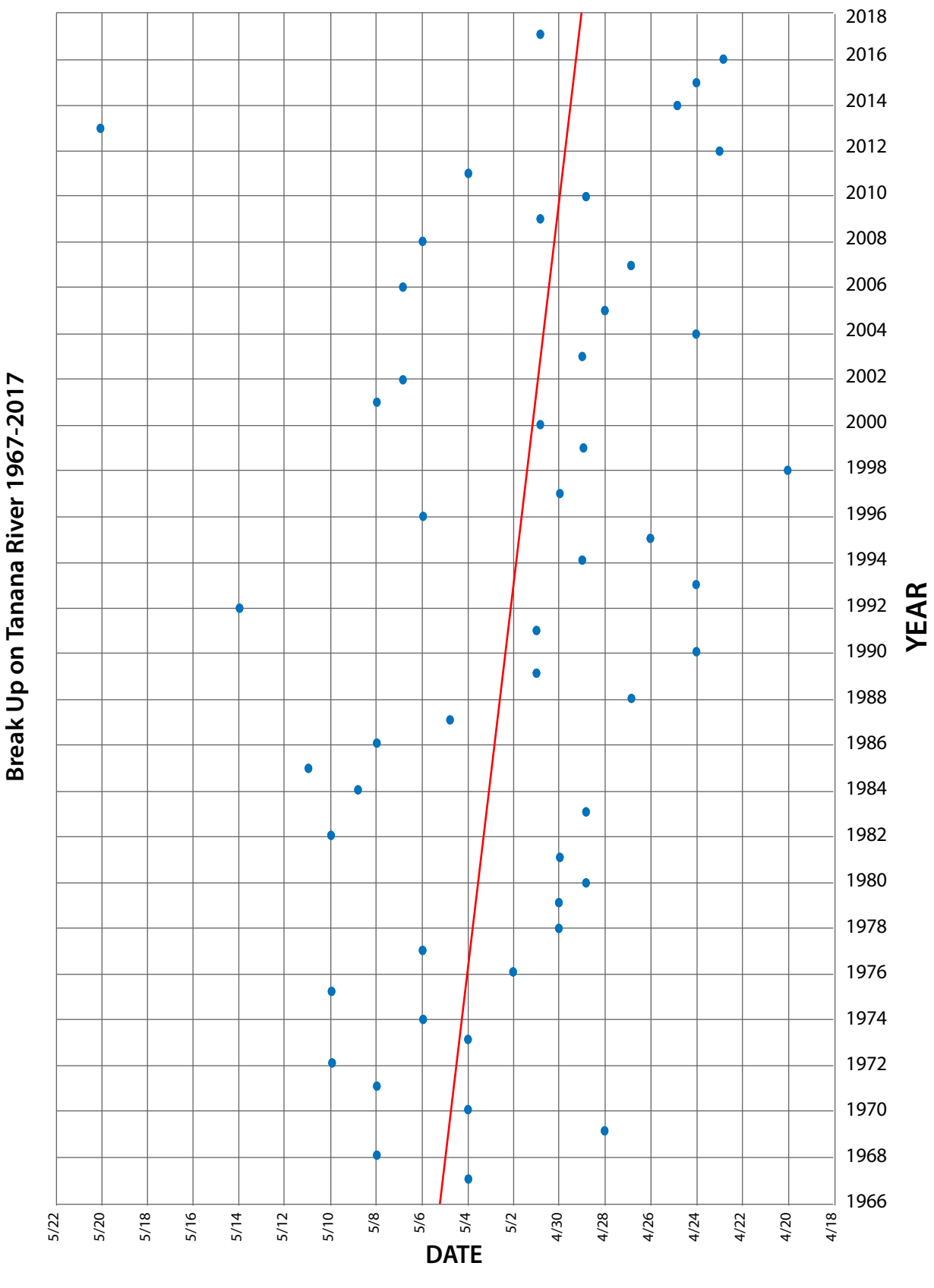
Break up along a road in Galena, next to the Yukon River.
Photo: Ed Plumb, National Weather Service.

Part 3: Forecasting Break Up

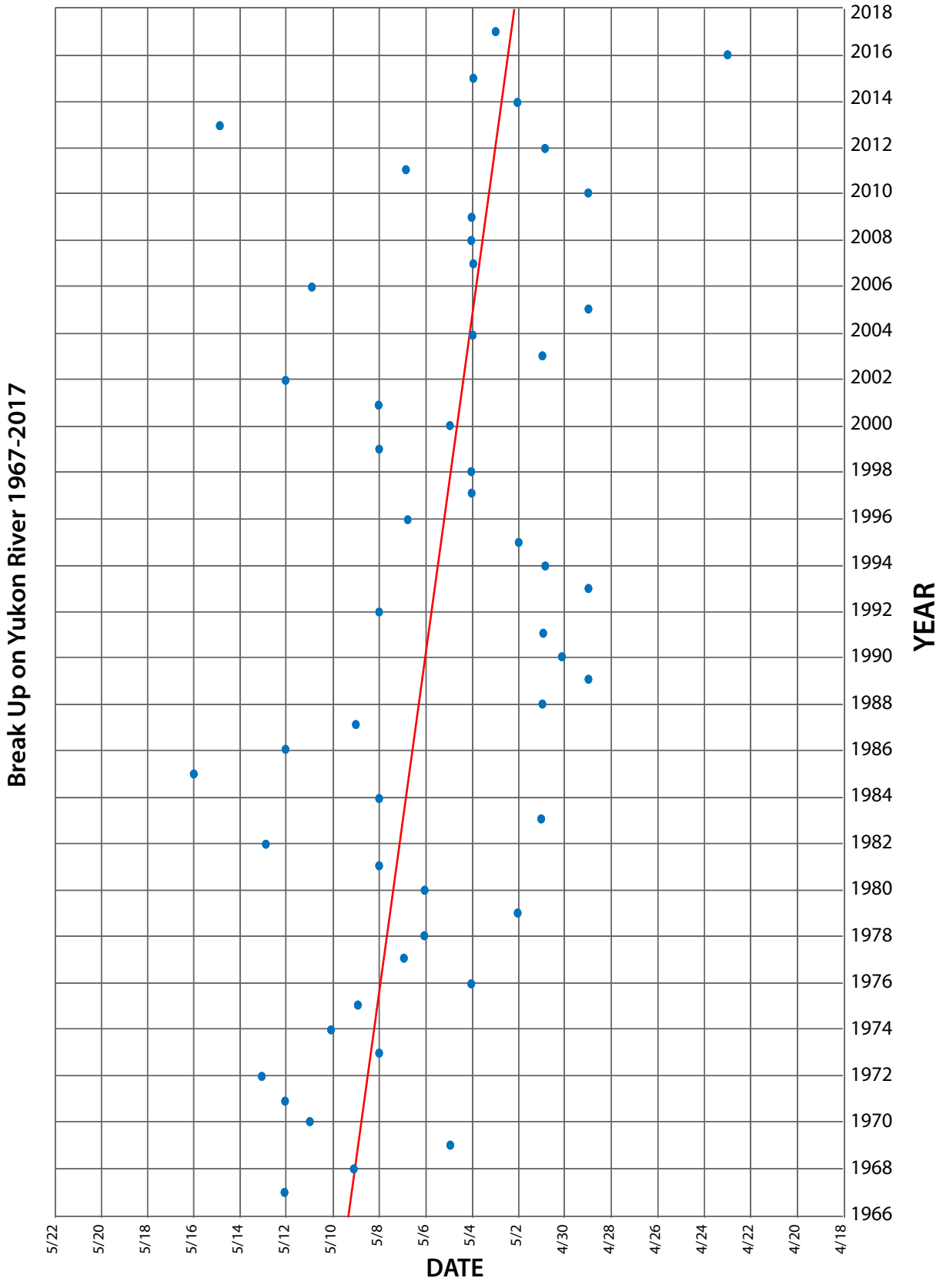
If this trend continues, what will break up look like when you are an elder?

1. Your teacher will give you a blank piece of graph paper. Place it to the right of your river graph. Carefully align the graph paper so it extends the lines on the graph. Make sure the bottom line of the blank graph lines up with the x-axis. Gently tape the graphs together.
2. Extend the x-axis by 50 years, using the same scale as the existing graph. Label the even years, starting with 2020 and ending with 2068.
3. Next, use your ruler and pencil to extend the trendline onto the graph paper to 2068.
4. Plot a data point where the trendline intersects with the line for 2068.
5. Use your finger to trace a line back to the y-axis; read the date for the forecasted break up in 2068. Remember, your data point may fall between the labeled dates. What is the new break up date for your river?
6. Share your results with the rest of the class.
7. Describe one way that this could change life in the communities along this river.





Note: graph is .8 cm.



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