Climate Change In My Community

Climate Change on File: Trees as Environmental Secretaries
Taryn Dunivant

Learning Goals:

- Trees hold a record of past climatic conditions and environmental events
    - For trees, the width of growth rings is correlated to the annual precipitation
        - Trees rely on water for growth
        - Growth rings are wider in wet years and narrow in dry/drought years
- Precipitation in Kansas is variable year to year with some extreme years
- By studying trees we can understand the major changes in climate over a long period of time and deep time (dendroclimatology)

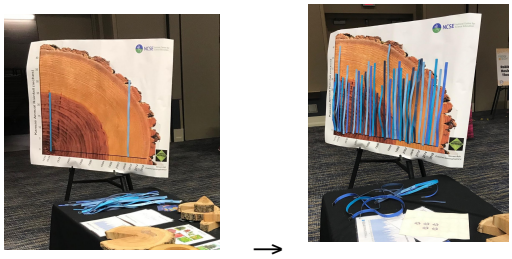
Other take-away concepts:

- Bar graphs
    - How a graph works and how to read it
    - Reading dates and putting them in order (timeline)
- How to use a hand lens
- Tree anatomy
    - Two major tissue types are phloem (sugars) and xylem (water/wood)
    - Temperate trees change the size of their cells depending on the season (large in spring when wet and small in summer when dry) and stop growing in winter. This is why we get light and dark wood in each growth ring. So when counting the rings you only count the dark or light colored wood.
    - Direction of growth is outward. Center of the tree is when the tree was born.
- Local tree identification
    - ID characters: bark, leaves, flowers, growth patterns (concentric, size of rings)
- Difference between native and invasive trees
    - Importance of native trees
    - Changes in climate can be an advantage for invasive trees
- When were the local drought years or heavy rain years
- Environmental events recorded in trees
    - Earthquakes, lightning, forest fires, megadroughts, monsoons
- Ecological impacts recorded in trees
    - Over-crowding, disease, insect infestations
- Climatic conditions recorded in trees
    - High winds, precipitation, CO_2 levels, temperature, seasonality

Activity Components

Interactive Precipitation Poster:

- Visitor selects any bar/strip from the pile
- Have them read the date and annual precipitation
- Allow visitor to figure out where it belongs on the graph and place it
- Encourage visitor to make observations about their selected year and compare to other years
- Make tree growth ring width connection with precipitation
- Graph will build over time as visitors add. Can randomly take bars off or reset the graph at any time.



Tree Specimens:

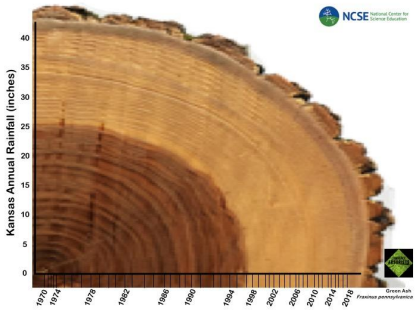
- Visitor can touch tree specimens
- Have visitor count growth rings and make observations (use hand lens)
- Discuss tree anatomy, growth rings, recorded climate changes and events, research, dendroclimatology
- Discuss differences between the trees, tree ID, native vs. invasive

Community Data:

- NOAA annual precipitation (Source: https://www.ncdc.noaa.gov/cdo-web/datasets)
    - Loaded into Excel to create graphs
- Local tree trunk cross-sections (Potential sources: Local arborist, scrap wood, field collecting, herbarium, researcher)

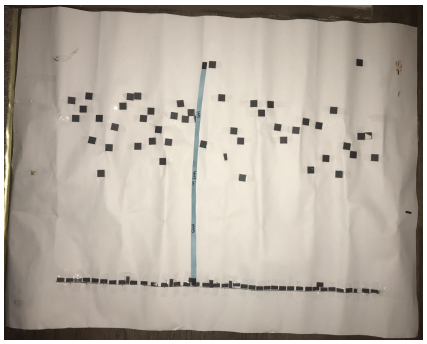
Supplies and Construction:

- **Interactive Graph**
  - Large Poster - 3’ x 4’ with scaled axes and image of cross-section with Tree ID (Print Shop)



  - Graph Bars – measured strips of cardstock. Write the year on the back of the strip as well as the rainfall in inches/cm from the NOAA data set.

  - Sticky magnets - two on the back of the poster for each bar, so that magnetic surface faces the front (I used taped to secure the magnets on the poster). Another magnet to the top and bottom of the bar, might consider adding a third magnet in the center of the bar. (I used pre-cut squares with sticky backs, however, consider using a roll of magnetic strips with sticky backs. I believe it would be easier to lay the x-axis and can cut to be the exact size and waste less.)



  - Remember to consider how the poster will be displayed. Having a cardboard backing to attach it to is great support. Here are three options for displaying the poster. The most effective option was attaching the poster to a secure cardboard backing and placing on the easel.



Hints for designing the graph and making the bars: Since the tree was 50 years old I took the annual precipitation for the past 50 years from my NOAA data. I found the highest value of precipitation and then I knew what my maximum value would be on the y-axis and scaled from there. I designed my x-axis to correlate the year with the actual growth ring. So the distance between years represents the width of the growth rings and is not uniform. The tree on the graph is a local native tree and I took a photo of my specimen and used that image. (Bonus: actual specimen on the table to relate to). I designed the poster using PowerPoint but it could also be accomplished in Illustrator. Once the poster is printed, measure the length of the y-axis and divide by the maximum value. This will gave the unit per inch to make the bars accurate in length. For example, if one inch is 3 cm, then a year with 20 inches of precipitation would have a bar that is 60 cm long. So with a little math, I was able to make each strip of paper the correct length for each year. I used my Excel document with the data set to make things quicker. I kept the width of the bars uniform. I lined them all up in order on the back of the poster to set the magnets correctly.

- **Tree Specimens**
    - Preparation: I sanded one side of the wood to be smooth and spray painted it with clear spray paint. This helps the rings pop and be more visible, as well as to protect the surface. (Bonus: The glossy smooth wood is nice to touch and draws people in)
    - Cross-sections of tree trunks to count growth rings and discuss anatomy. (I had a local arborist donate three tree cross-sections for me. One was native to Kansas, one was invasive from China, and the third was a pine tree native to North America. Great variety.)
    - Optional: Add 3-D rhinestone gem stickers to the surface, one for each growth ring. Best to glue them down.

- **Hand Lens**
  - Kids love using them and help them see details in the wood and count the rings

 (Bought a 20 pack on Amazon)

- **Informational sheets - print outs (PDF)**
  - Full bar graph of precipitation data set from NOAA (1895-2018)
    - Can use graph print outs to connect growth rings to precipitation for any of the tree specimens
    - Can also discuss a longer period of time
  - Tree anatomy
    - Tissues: phloem, xylem
    - Outward growth of trees
    - Growth rings, narrow vs. wide, precipitation correlation
  - Tree Identification
    - Bark, leaves, flowers/cones, difference in growth ring size
    - Native, local importance/connection
  - Dendroclimatology
    - Deep time study of changes in climate using trees
    - Fossils + dead trees/sub-fossils + lumber + living trees can all be connected to gain a larger picture
  - Types of events that get recorded and what that looks like (extra)
  - Research studies using growth rings (extra)
    - Example: Tibetan Junipers – Since these trees live 3,000 years, Scientists reconstructed a precipitation record of over 3,500 years. Overall, found with increasing temperatures driven by climate change, there is an increase in the precipitation.

Engagement Questions/Statements:

- Would you help me build my graph?
- Want to check out my trees?
- Do you like trees?
- I have tree science over here!

- Want to see how trees grow?

Open ended questions and ideas for where to take them:

- What is your favorite tree?
    - Importance of trees
    - Name some common trees, local trees
    - Trees provide wood, fruits, chocolate, spices, shade, flowers, paper, habitats
- What year were you born? (kids)
    - Can go to that year on the graph
- How old are you? (kids)
    - Can go to a cross-section and count backward from the outer ring and mention this is when you were born. The tree grew this much since or the tree was this big before.
- What do you know about trees?
    - Can count growth rings to see how old a tree is. The center of the tree is the year that the tree was born and it grows outward. (ID and anatomy)