Dendrochronology

Name:	Class/Period:	Date:

Part A: Background Information

During the introductory slideshow, respond to the prompts below:

1) What is dendrochronology?

2) What is the age of the tree depicted on the "Common Knowledge" slide? What assumption(s)/prior knowledge did you use to make your age determination?

3) What was probably the wettest year experienced by the tree depicted on the "Common Knowledge" slide? What was the driest? What assumption(s)/prior knowledge did you use to determine your responses?

4) In the Ozark Highlands, what is the dominant limiting factor on tree growth?

5) The pith is considered to be a complete annual ring. TRUE FALSE (Highlight the correct answer.)

6) Describe the differences between earlywood and latewood.

7) Why are annual tree growth rings easy to distinguish from each other? Use your knowledge of earlywood and latewood in your response.

8) Which of the three tree-sampling methods described could be used on a living tree without killing it?

9) List some of the characteristics/results of a stand-replacing fire?

10) List some of the characteristics/results of a surface fire?

11) What is a "catface?"

Part B: Stand-Replacing Fire Timeline

This part of the lesson will determine the history of stand-replacing fire for the Deschutes National Forest study site introduced in the slideshow. Information about the study site's dominant tree species can be found in **Table 1**.

Table 1: Tree Information for the Deschutes National Forest

Information for the dominant tree species found in the Deschutes National Forest study site in Oregon.
"LpP" or "Lp Pine" = Lodgepole Pine (information link)
"PP" or "P pine" = Ponderosa Pine (information link)

- **IMPORTANT:** For this dataset, dendrochronologists determined that any trees that began growth within a 20-year period are in the same cohort. (*Cohort - a group of individuals of the same age, recruited into a population at the same time.*)
- 11 increment cores will be used for this part of the activity.
- Prepare a tree "timeline" chart by using the "Stand-Replacing Fire Timeline Template" link provided by your instructor.
    - After opening the spreadsheet, make your own Google Sheets copy for reference and submission.
    - Refer to the instructor's demonstration or this demonstration video for the steps to develop your timeline: **"STAND-REPLACING" DEMONSTRATION VIDEO (link)**
        - Steps in the video:
            1. Enter your name or your group's name in the appropriate spreadsheet cell(s).
            2. Enter your class period.
            3. Open the image file for the increment cores.
                - In cell "A1" of the template, a link is provided to access the images.
                - The link is also provided here: "Tree Increment Core Images (USFS Fireworks - pdf)."

4. Enter the core number and species code for each increment core in their corresponding cells.
5. Using the dot code (**Table 2**), determine the years for the earliest and final growth rings for each increment core. The bark does not count as a ring.
6. Record the timeline for each increment core by using the "Fill color" tool (with a color of your choice) to highlight the cells from the earliest to the latest year.
7. Type in the earliest and final growth ring years in the corresponding cells if a reference year is not already included.

- Once the timeline has been completed, respond to the prompts for **Part B**.

Table 2: Increment Core Dot Code

Explanation of the **dot code** seen on the increment cores which will help you determine each tree's timeline.
⁞ - "4 dots" represents a millennium year (1000 years).
⋮ - "3 dots" represents a century year (100 years).
: - "2 dots" represents a half-century year (50 years).
. - "1 dot" represents a decade (10 years).

12) What is a cohort?

13) Do the trees represented by the increment cores form a cohort? Explain.

14) How might a fire have allowed this cohort to begin?

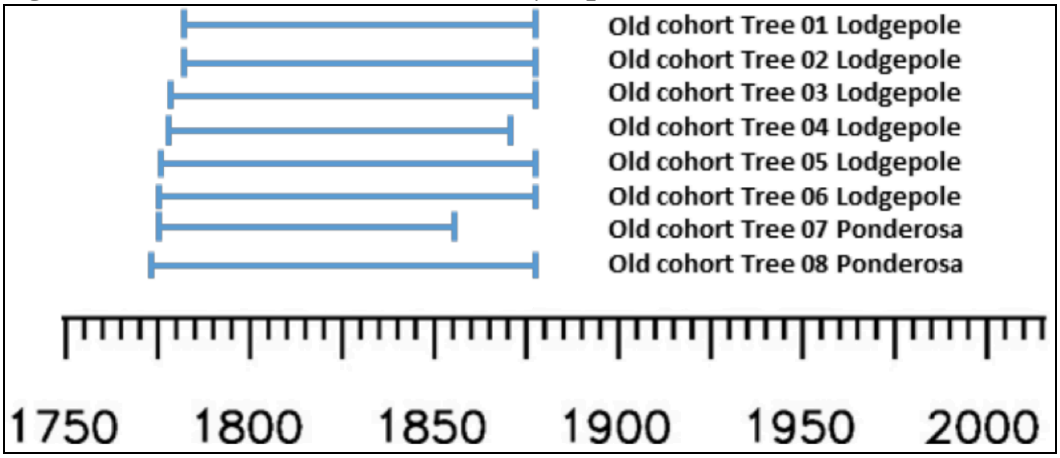
15) What other events could have started the cohort?

16) How could you be certain that fire was the cause? What evidence would you need?

17) A fire regime is the pattern of fire frequency and severity/intensity over time. The increment cores suggest that the study site had a stand-replacing fire regime. How certain can you be about that? Explain.

- Suppose that you visit the study site and uncover 8 fallen, buried logs. These logs were not sampled in the earlier study, so they could provide new data. The logs appear to be very old. Their bark is gone, but they are not rotten. Many of the logs have black **char** on the outside of the wood. (*Char - wood that has been converted to charcoal or carbon ("blackened") as a result of exposure to heat.*) Increment cores are collected from the logs. The earliest and most recent years are determined for each core. These logs are found to be part of a cohort, the "Old Cohort" for this lesson. The timeline for this "Old Cohort" can be found in **Figure 1**.

Figure 1: "Old Cohort" Fire Timeline (adapted from USFS FireWorks Curriculum)



18) When did the "Old Cohort" start growing? Give a range of years. (Be sure to familiarize yourself with the time scale.)

19) What may have caused the "Old Cohort" to start growing? Is there any evidence for that explanation?

20) When did the "Old Cohort" die? Give a range of years.

21) What probably caused so many trees in the "Old Cohort" to die at one time? Is there any evidence for your explanation?

22) Explain how the "Old Cohort" provides evidence of a possible event that permitted the cohort depicted on your timeline to start growing?

23) Does the "Old Cohort" support the idea that the study site had a stand-replacing fire regime? Are you more certain than you were for question 17)? Explain.

Part C: Fire-Scar History Chart

This part of the lesson investigates low-intensity surface fires of the Deschutes National Forest study site. A fire-scar history chart provides information about the low-intensity fire regime of a site. Information about the study site's dominant tree species can be found in **Table 1 (above)**.

- 11 cross sections will be used for this part of the activity.
- Prepare a fire-scar history chart by downloading this "Fire-Scar History Chart Template (Execl."
    - After opening the Excel spreadsheet, make your own copy for reference and submission. If you are using a Chromebook,
    - Refer to the instructor's demonstration or this demonstration video for the steps to develop your timeline: **"FIRE-SCAR" DEMONSTRATION VIDEO (link)**
        - Steps in the video:
            1. Enter your name or your group's name in the appropriate spreadsheet cell(s).
            2. Enter your class period.
            3. Open the images file for the cross sections.
                - In cell "A1" of the template, a link is provided to access the images.
                - The link is also provided here: "Tree Cross Section (Cookie) Book (USFS Fireworks - pdf)."
            4. Enter the tree number, species, number of fire scars, and average fire interval for each cross section in the appropriate cells.
            5. Using the years provided for the "Inner ring" and "Outer ring," create a timeline for each cross section by using the "Fill color" tool to highlight the cells from the earliest to the latest year.
            6. Type in the earliest and final years in the corresponding cells if a reference year is not already included.
            7. On each cross section's timeline, highlight individual cells that had fire scars using a color that contrasts with the timeline color and type in the years of the fire scars if a reference year is not already included.

- Once the fire-scar history chart has been completed, respond to the prompts for **Part C**.

24) What could cause fires to scar some trees in a study site and not others?

25) List every year when at least one tree had a fire scar.

26) Count the number of years when a fire occurred.

27) Determine the intervals between years when a fire occurred, the fire intervals. The number of fire intervals will be one less than the number of years with a fire. For example, if fires occurred in 2005, 2010, and 2020, there would be two fire intervals of:

- 5 years (2010 - 2005 = 5) and
- 10 years (2020 - 2010 = 10).

28) What is the <u>minimum</u> fire interval for this dataset? Include the years for this interval.

29) What is the <u>maximum</u> fire interval for this dataset? Include the years for this interval.

30) Calculate the mean fire interval [MFI] for this dataset.

31) Using Map 1 and Map 2 in Step 4, determine the estimated mean fire interval [MFI] for the Deschutes National Forest study site.

32) How does the MFI you calculated in 29) compare to the value you determined from Map 2? List a possible explanation for the similarity or difference in values.

33) Explain how the fire-scar history chart for the study site provides more information than the data from a single tree, such as "Tree 02."

Part D: Fire-Scar History Chart from the Ozark Highlands

Dendrochronological methods that you are familiar with were used to investigate the historic occurrence of fires at a study site within the J.T. Nickel Family Nature and Wildlife Preserve in Oklahoma (refer to **Map 1**). The study site was found in the Ozark Highlands ecoregion which is different from the Pumice Plateau ecoregion where the study site for **Part B** and **Part C** was located. In the Ozark Highlands, deciduous trees like Post Oak and coniferous trees like Shortleaf Pine are both widespread (see **Table 3**).

Table 3: Tree Information for the J.T. Nickel Family Nature and Wildlife Preserve

Information for the dominant tree species found in the J.T. Nickel Family Nature and Wildlife Preserve study site in Oklahoma.
Shortleaf Pine (link)
Post Oak (link)
Blackjack Oak (link)
Black Hickory (link)

The fire-scar data from the study can be found in **Figure 2**. The results of this Ozark Highlands study are summarized in **Table 4**.

Figure 2: Fire-Scar History Chart from the Tully Hollow Study Site at the J.T. Nickels Family Nature and Wildlife Preserve (Oklahoma)

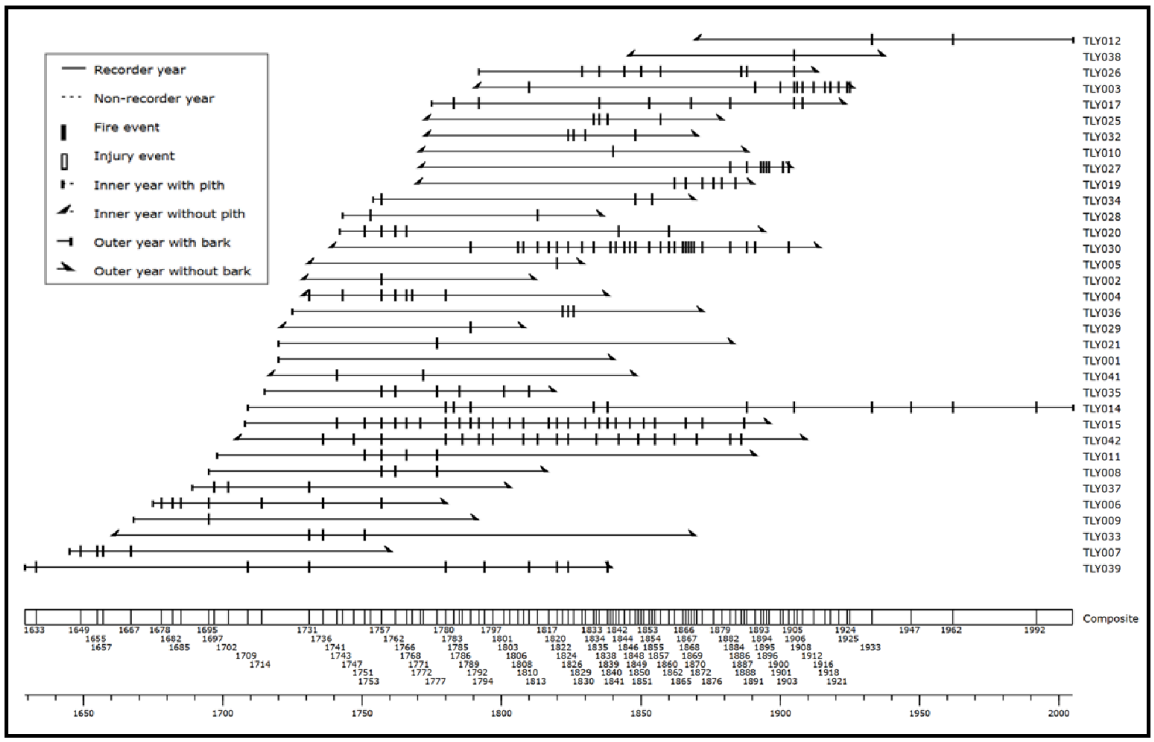


Table 4: Tully Hollow Study Site Results Summary

• The tree-ring record spanned 292 years (1633-1925).
• 324 fire scars were identified from 34 sample trees (Shortleaf Pine)
• Mean Fire Intervals for Different Cultural Eras
○ Native American (1650-1779) MFI: 5 years
○ Native American Migration I (1780-1829) MFI: 2.5 years
○ Native American Migration II (1830-1889) MFI: 1.7 years
○ Euro-American Settlement (1890-1924) MFI: 2.2 years
○ Fire Suppression (1925-1992) MFI: 17 years

34) Does Figure 2 support the claim that fires were a common occurrence at the J.T. Nickel Family Nature and Wildlife Preserve? Explain using your knowledge of dendrochronology.

35) Using Map 1 and Map 2 in Step 4, determine Map 2's estimated mean fire interval [MFI] for the Tully Hollow study site.

36) How does the five MFIs in Table 4 compare to the value you determined from Map 2 for prompt 35)? Identify a possible explanation for the similarities or differences in values.

37) Describe the change in MFI after 1924 as a result of the changing public perception of fire in the United States.

38) The Nature Conservancy (TNC) which oversees stewardship activities at the J.T. Nickel Family Nature and Wildlife Preserve has used prescribed fire for over 60 years as a vital tool for ecosystem restoration and wildfire risk reduction on the lands that it manages. They employ and collaborate with trained professionals to conduct prescribed burns that foster native plant regrowth, promote biodiversity by suppressing invasives and woody shrubs, and maintain healthy forests and grasslands that depend on natural fire cycles. At this preserve, the TNC conducts prescribed burns with a MFI of 2-5 years on many areas in an effort to promote vegetative community similar to what was present before the Fire Suppression cultural era. For example, an area burned in 2025 will undergo another prescribed fire sometime between 2027 and 2030. Using your understanding of dendrochronology, fire history, and the results from the Tully Hollow study, justify the TNC's frequency of prescribed burns at the J.T. Nickel Family Nature and Wildlife Preserve.

Part E: Lesson Submission

Follow the directions provided by the instructor for the submission/evaluation of:

- The student worksheet
- The "Stand-Replacing Timeline" spreadsheet
- The "Fire-Scar History Chart" spreadsheet