Dr. Michael J Passow Names in your group:

**“Phenology and Climate Patterns”**

 **Phenology** refers to the study of natural events, and has been a very useful way to understand climate change. It is especially useful to re-construct in a broad way climates before accurate instrument records were kept. For example, medieval monks kept records of grain and grape harvests which provide us a glimpse of “good” and “bad” growing seasons many centuries ago.

 In this first activity, you will be asked to “**mine data**” provided about Hudson River ice closing between 1789 and 1856. At that time before railroads, sailing and steamships were the main form of transportation between New York City and Albany. These data come from *The New York Almanac and Weather Book for the Year 1857*. (Such books were very popular before the Internet.)

1. **Examine the accompanying table and notes. What patterns or special events can you find? Write 2 – 3 paragraphs about important facts and patterns you observe, and create at least two questions for further study. Attach your analysis to your report.**
2. **What other types of evidence could you use to learn more about the climate of the Hudson Valley during this time period? That is, what types of “proxy data” could you use? Where might you be able to get such data?**
3. Today, the Hudson River is never fully closed by ice, so shipping can take place year-round.
**What might be two reasons for this ability to have continuous river traffic? What evidence supports your reasons?**

 In this second activity, you will access two web sites to learn more about how phenology helps us understand the Earth System.

 Open <http://www.uwgb.edu/biodiversity/phenology/index.asp>. This website is created by Dr. Gary Fewless, Herbarium Curator at the Cofrin Center for Biodiversity, University of Wisconsin-Green Bay. Since its founding in 1970, UWGB has been one the nation’s leading environmental science research and teaching centers.

 **4) After browsing through the website resources write 3 -4 paragraphs about phenology, and
 the stories provided by Dr. Fewless. Explain why you chose these examples.**

 Open <https://www.usanpn.org/>. This is the USA National Phenology Network, a program designed to link science research and citizen-scientists like you.

1. Browse through the resources provided by USA-NPN and **write 2- 3 paragraphs about the information available. Explain why these were of most interest to you.**

 NOAA (National Oceanic and Atmospheric Administration) has developed an online Climate Resilience Toolkit <https://toolkit.climate.gov/tool/usa-national-phenology-network>. NOAA partners on this project with other government agencies and the USA-NPN.

1. **Examine the Topics linked on the right-hand side. Select two of these of special interest to you and write brief summaries of what is available in these resources. Tell why these interest you.**
2. **If time permits, watch one or more of the Training/Tutorials videos. Write a brief “reaction paper” describing what you learned from the video.**

Enrichment Activities

1. The Hudson River Ice Closings studied in the first part of this lesson took place during a period in Climate History known as the “Little Ice Age.”
**Use online or other resources to learn more about the Little Ice Age. Try to find at least three examples of how conditions during that time influenced artists and writers. (For example: How was the origin of the “Frankenstein” story related to severe climate conditions?)**
2. No matter where you live, seasonal changes take place in your neighborhood. **Think about some of these, and then create a plan for a phenology research project that would be done in your home** **area.** P**rovide the questions to be studied, the types of evidence you would need to collect to answer your questions, the time period over which you would need to collect the data, and an example of how knowing these answers can be used to benefit your community.**

Additional Resources
The GLOBE Program (<http://www.globe.gov/web/guest/home>)
 [Lilac Phenology](http://www.globe.gov/do-globe/globe-teachers-guide/biosphere?p_p_id=globegovteacherguideportlet_WAR_globegovcmsportlet_INSTANCE_4CcA&p_p_lifecycle=0&p_p_state=normal&p_p_mode=view&p_p_col_id=column-1&p_p_col_count=1&_globegovteacherguideportlet_WAR_globegovcmsportlet_INSTANCE_4CcA_protocolCat=2513280) [Phenological Gardens](http://www.globe.gov/do-globe/globe-teachers-guide/biosphere?p_p_id=globegovteacherguideportlet_WAR_globegovcmsportlet_INSTANCE_4CcA&p_p_lifecycle=0&p_p_state=normal&p_p_mode=view&p_p_col_id=column-1&p_p_col_count=1&_globegovteacherguideportlet_WAR_globegovcmsportlet_INSTANCE_4CcA_protocolCat=2513270)

Selected NGSS Science and Engineering Practices
 Asking Questions and Defining Problems; Analyzing and Interpreting Data; Constructing Explanations; Engaging in Argument from Evidence

Selected NGSS Crosscutting Concepts
 Patterns; Scale, Proportion, and Quantity; Stability and Change

Selected Disciplinary Core Ideas
 ESS2.A Earth Materials and Systems; ESS2.D Weather and Climate; ESS3.D Global Climate Change; LS2.C Ecosystem Dynamics, Functioning, and Resilience

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| **Hudson River Closings by Ice** |  |  |
| Source: *The New York Almanac and Weather Book for the Year 1857* |
|  |  |  |  |
| Winter | River closed or obstructed by ice | River open or free of ice | # of days closed |
| 1789-90 | Feb 3, 1790 | Mar 27, 1790 | 52 |
| 1790-91 | Dec 8, 1790 | Mar 17, 1791 | 99 |
| 1791-92 | Dec 8, 1791 | Early Mar 1792 | about 90 |
| 1792-93 | Dec 12, 1792 | Mar 6, 1793 | 84 |
| 1793-94 | Dec 26, 1793 | Mar 17, 1794 | 81 |
| 1794-95 | Jan 12, 1795 | 1st sloop arrived at NY from Albany Mar 29, 1795 | about 77 |
| 1795-96 | Jan 28, 1796 | [Blank = no record for opening] |   |
| 1796-97 | Nov 28,1796 |   |   |
| 1797-98 | Nov 28,1797 |   |   |
| 1798-99 | Nov 29, 1798 |   |   |
| 1799-1800 | Jan 6, 1800 | Feb 28, 1800 | 53 |
| 1800-01 | Jan 3, 1801 |   |   |
| 1801-02 | Feb 3, 1802 | Mar 19, 1802 | 44 |
| 1802-03 | Dec 16, 1802 |   |   |
| 1803-04 | Jan 12, 1804 | Apr 6, 1804 | 84 |
| 1804-05 | Dec 13, 1804 |   |   |
| 1805-06 | Jan 9, 1806 | Feb 20, 1806 | 42 |
| 1806-07 | Dec 11, 1806 | Apr 8, 1807 | 121 |
| 1807-08 | Jan 4, 1808 | Mar 10, 1808 | 65 |
| 1808-09 | Dec 9, 1808 |   |   |
| 1809-10 | Jan 19, 1810 |   |   |
| 1810-11 | Dec 14, 1810 | Mar 10, 1811 | 86 |
| 1811-12 | Dec 20, 1811 | Mar 16, 1812 | 86 |
| 1812-13 | Dec 21, 1812 | Mar 12, 1813 | 83 |
| 1813-14 | Dec 22, 1813 |   |   |
| 1814-15 | Dec 10, 1814 |   |   |
| 1815-16 | Dec 2, 1815 |   |   |
| 1816-17 | Dec 16, 1816 |   |   |
| 1817-18 | Dec 7, 1817 | Mar 25, 1818 | 108 |
| 1818-19 | Dec 14, 1818 | Apr 3, 1819 | 110 |
| 1819-20 | Dec 13, 1819 | Mar 25, 1820 | 102 |
| 1820-21 | Nov 13, 1820 | Mar 15, 1821 | 123 |
| 1821-22 | Dec 13, 1821 | Mar 15, 1822 | 92 |
| 1822-23 | Dec 24, 1822 | Mar 24, 1823 | 90 |
| 1823-24 | Dec 16, 1823 | Mar 3, 1824 | 78 |
| 1824-25 | Jan 5, 1825 | Mar 6, 1825 | 60 |
| 1825-26 | Dec 13, 1825 | Feb 26, 1826 | 75 |
| 1826-27 | Dec 24, 1826 | Mar 20, 1827 | 86 |
| 1827-28 | Nov 25, 1827 | Feb 8, 1828 | 73 |
| 1828-29 | Dec 23, 1828 | Apr 1, 1829 | 100 |
| 1829-30 | Jan 11, 1830 | Mar 15, 1830 | 63 |
| 1830-31 | Dec 23, 1830 | Mar 15, 1831 | 82 |
| 1831-32 | Dec 5, 1831 | Mar 25, 1832 | 111 |
| 1832-33 | Dec 21, 1832 | Mar 21, 1833 | 83 |
| 1833-34 | Dec 13, 1833 | Feb 24, 1834 | 73 |
| 1834-35 | Dec 15, 1834 | Mar 25, 1835 | 100 |
| 1835-36 | Nov 30, 1835 | Apr 4, 1836 | 125 |
| 1836-37 | Dec 7, 1836 | Mar 28, 1837 | 111 |
| 1837-38 | Dec 13, 1837 | Mar 19, 1838 | 94 |
| 1838-39 | Nov 25, 1838 | Mar 21, 1839 | 116 |
| 1839-40 | Dec 18, 1839 | Feb 21, 1840 | 65 |
| 1840-41 | Dec 5, 1840 | Mar 24, 1841 | 109 |
| 1841-42 | Dec 19, 1841 | Feb 4, 1842 | 47 |
| 1842-43 | Nov 29, 1842 | Apr 13, 1843 | 136 |
| 1843-44 | Dec 9, 1843 | Mar 14, 1844 | 95 |
| 1844-45 | Dec 11, 1844 | Feb 24, 1845 | 74 |
| 1845-46 | Dec 4, 1845 | Mar 15, 1846 | 100 |
| 1846-47 | Dec 15, 1846 | Apr 6, 1847 | 112 |
| 1847-48 | Dec 24, 1847 | Mar 22, 1848 | 89 |
| 1848-49 | Dec 27, 1848 | Mar 19, 1849 | 82 |
| 1849-50 | Dec 25, 1849 | Mar 9, 1850 | 73 |
| 1850-51 | Dec 17, 1850 | Feb 25, 1851 | 69 |
| 1851-52 | Dec 13, 1851 | Mar 28, 1852 | 105 |
| 1852-53 | Dec 22, 1852 | Mar 21, 1853 | 91 |
| 1853-54 | Dec 30, 1853 | Mar 16, 1854 | 77 |
| 1854-55 | Dec 18, 1854 | Mar 20, 1855 | 92 |
| 1855-56 | Dec 26, 1855 | Apr 10, 1856 | 106 |
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| "Remarkable Incidents Connects with the Changes of Temperature" |  |  |  |
| (Source: *The New York Almanac and Weather Book for the Year 1857)* |  |  |
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| Date | Comments |
| Jan 19, 1792 | Ice lodged in the East River, allowing several people to walk over it to and from New York to Brooklyn |
| Dec 24, 1796 | Ice from New York to Staten Island |
| Jan 7, 1797 | Ice closed the passage between the Battery and Governor's Island. It moved away with the next tide. |
| Dec 24, 1797 | Ice closed the East river. Several people crossed on foot. |
| Dec 22, 1800 | The river at Albany is open and quite free of ice. |
| Jan 6, 1805 | East River is closed by ice. |
| Jan 22-23, 1805 | Several people crossed the Hudson from New York to Hoboken. |
| Mar 10, 1810 | The steamboat makes her first trip to Albany. |
| 1817-18 | This winter was long and intensely cold. On Mar 3, 1818, the ice moved in a body downward for some distance and there remained stationary. The river was not clear until Mar 25. |
| 1820 | The river was closed on Nov 13, opened on the 20th, and finally closed on Dec 1. This was one of the four winters during a century in which the Hudson between Paulus Hook and New York was crossed on ice; the other three were 1740-41, 1765-66, and 1779-80. |
| Jan 25, 1821 | The coldest day in thirty years. Thermometer 7 deg below 0. |
| Jan 12, 1824 | The river was clear of ice and remained so for several hours. |
| 1830-31 | River opened in consequence of heavy rains and closed Jan 10, 1831. |
| 1842 | In consequence of the heavy rains, the river opened in front of the City of Albany on Jan 8, and can hardly be said to have closed again during the season. However, the ice continued to pile up downstream and rendered the river impassable |
| Jan 20, 1852 | Thousands of people crossed the ixce from Brooklyn to and from Manhattan. |
| 1856 | People, horses, and wagons crossed between Brooklyn, New York, and Jersey City on several days in Jan and Feb. |