Lesson Plan: Teaching Phenology in Plants (Leaf-out) through Climate-related Examples

As a **high school** or **undergraduate Biological Sciences** teacher, you can use this set of computer-based tools to help you in teaching the **phenology of plants**, and **phenological events in plants** such as **leaf-out**.

This lesson plan allows students to understand phenology and phenological events in plants and animals. Further, the activities help students to determine the possible relationship between climate and phenological events such as leaf-out in plants. The exercises stimulate thinking about the possible impact of climate change on these periodic life-cycle events.

Thus, the use of this lesson plan allows you to integrate the teaching of a climate science topic with a core topic in the Biological Sciences.

Use this lesson plan to help your students find answers to:

- *What is phenology?*
- *Name some phenological events in plants and animals.*
- *What are the climate-related factors that may affect leaf-out in plants?*
- *Which phenological events in plants could be affected by a change in the average spring temperature?*

About the Lesson Plan

Grade Level	High school, Undergraduate
Discipline	Biological Sciences

Topic(s) in Discipline	Phenology in Plants, Phenological Events in Plants, Life-cycle Events in Plants, Leaf-out in Plants
Climate Topic	Climate and the Biosphere
Location	Global, USA
Access	Online, Offline
Language(s)	English
Approximate Time Required	100 – 110 min

1 Contents

1. Reading (30 – 40 min)	A reading that introduces the topic of phenology, its significance, and the link between plant phenology and climate. http://budburst.org/phenology-defined
2. Classroom/Laboratory Activity (~60 min)	A classroom/laboratory activity to explore the possible role of climate-related environmental factors in the timing of leaf-out in plants (specifically, red maple leaf-out in New England). https://extension.umaine.edu/signs-of-the-seasons/resources-for-educators/red-maple-leaf-out/

3. Suggested questions/assignments for learning evaluation

- What is phenology?
- Name some phenological events in plants and animals.
- What are the climate-related factors that may affect leaf-out in plants?
- Which phenological events in plants could be affected by a change in the average spring temperature?

2 Step-by-step User Guide

Here is a step-by-step guide to using this lesson plan in the classroom/laboratory. We have suggested these steps as a possible plan of action. You may customize the lesson plan according to your preferences and requirements.

1. Introduce the topic by using a reading

- Introduce the topic of phenology, its significance, and the link between plant phenology and climate by using the reading, "About Phenology" from Budburst, a project of Chicago Botanic Garden.

  The reading can be accessed at http://budburst.org/phenology-defined.

- Discuss a few phenological events (periodic life-cycle events) in plants and animals.

2. Conduct a classroom/laboratory activity

Explore the topic further by conducting a hands-on activity, "The Timing of Red Maple Leaf-out", from Signs of the Seasons: A New England Phenology Program, the University of Maine Cooperative Extension.

In this activity, students will create and analyze graphs by using data for the timing of red maple leaf-out in New England. They will discuss the potential role of environmental factors such as climate change on leaf-out.

The classroom/laboratory activity can be accessed at https://extension.umaine.edu/signs-of-the-seasons/resources-for-educators/red-maple-leaf-out/.

- Download the activity files from https://extension.umaine.edu/signs-of-the-seasons/wp-content/uploads/sites/6/2014/09/Red-Maple-Leaf_-SA.pdf and https://extension.umaine.edu/signs-of-the-seasons/wp-content/uploads/sites/6/2014/08/Red-Maple_-Student-Activity-Sheet.docx.

- Conduct the activities described in the downloaded Teacher's Guide.

3. Questions/Assignments

Use the tools and the concepts learned so far to discuss and determine answers to the following questions:

- *What is phenology?*
- *Name some phenological events in plants and animals.*
- *What are the climate-related factors that may affect leaf-out in plants?*
- *Which phenological events in plants could be affected by a change in the average spring temperature?*

3 Learning Outcomes

The tools in this lesson plan will enable students to:

- define phenology
- enumerate various phenological events in plants and animals
- analyze data on life-cycle events in plants
- interpret data on life-cycle events in plants
- discuss the possible link between climate and phenological events in plants
- discuss the potential impact of climate change on periodic life-cycle events in plants

4 Additional Resources

If you or your students would like to explore the topic further, these additional resources will be useful.

1. **Classroom/Laboratory Activity** — Several resources for classroom/laboratory activities "Signs of the Seasons: A New England Phenology Program", from the University of Maine Cooperative Extension:

   https://extension.umaine.edu/signs-of-the-seasons/resources-for-educators/

2. **Visualization** — Visualization tool from USA National Phenology Network:

https://www.usanpn.org/data/visualizations

5 Credits/Copyrights

All the teaching tools in our collated list are owned by the corresponding creators/authors/organizations as listed on their websites. Please view the individual copyright and ownership details for each tool by following the individual links provided.
We have selected and analyzed the tools that align with the overall objective of our project and have provided the corresponding links. We do not claim ownership of or responsibility/liability for any of the listed tools.

1. **Reading, "About Phenology"**	Budburst, a project of Chicago Botanic Garden
2. **Classroom/Laboratory Activity, "The Timing of Red Maple Leaf-out"**	Elissa Koskela (University of Maine Cooperative Extension) and Dr. Molly Schauffler (University of Maine Climate Change Institute and RiSE Center); Signs of the Seasons: A New England Phenology Program, University of Maine Cooperative Extension
3. **Additional Resources**	Signs of the Seasons: A New England Phenology Program, University of Maine Cooperative Extension; USA National Phenology Network