

## Flipped IN-CLASS Lesson Plan Template

Topic or concept:  
Plant Water Relations

Basic objectives for preparatory work:

- 1) Identify the different pathways for water movement in plants
- 2) List and discuss the different drivers of water movement in plants
- 3) Identify and define the mechanisms of hydraulic decline during drought

Advanced objectives for classwork & after class work:

Analyze, describe and discuss results from a figure taken from the primary literature on plant water relations

	Time planned	Activity and rationale	Resources needed
Beginning of class period	5 mins	Pair & Share activity: "What do plants need most of the water they uptake for?"	Slide with question

	Time planned	Activity and rationale	Resources needed
Middle of period	<i>Example: 20 mins</i>	Mini-lecture based on Q&A from preparatory activities (pre-class online quiz). Clarify misconceptions and offer new info.	Lecture prep/slides
Middle of period	<i>Example: 40 mins</i>	Think, pair and share. Students will have to first describe on their own two figures that I will be providing from the primary literature following guidelines that are provided to them at the start of the course (5 min). They will then pair with a student and share their findings (5 min). I will open the discussion up to the class for a check in (this is a large lecture of >130 students; 5 min). Then I will have each student think of the implications of such results by providing them with a question they will have to answer (10 min). They will then pair with a student and share/discuss their findings (10 min). This will help them practice solving problems and articulating solutions. I will open the discussion up to the class for a check in (5 min).	Figures from primary literature and discussion question on a slide.
End of period	<i>Example: 10 mins</i>	RSQC (Recall, Summarize, Question, Review, Connect, Comment). Students solidify understanding in preparation for doing advanced work at home.	RSQC template handouts

	Time planned	Activity and rationale	Resources needed

### Flipped AFTER CLASS Work Plan Template

Advanced learning objective	Activity and rationale	Instructions to students
Analyze, describe and discuss results from a figure taken from the primary literature on plant water relations	Annotated problem solving. Two figures will be provided from the primary literature. One will have results described and interpreted for the students to familiarize themselves with what is expected from them. The other figure will be left for them to describe and interpret before the next class.	Describe and interpret the figure based on learnings from the plant water relations class, and format it in the same way as the example provided to you. You may work together; just be sure that YOU can describe and interpret this type of figure independently as the exam will be similar to this work.

## GUIDED PRACTICE

Class: Plant Water Relations

Date assigned:

Date due:

Time estimate to complete this assignment: 60 min

### Overview/Introduction

What is this lesson about? Why do we care?

While everyone knows plants need water to grow, you will learn here the surprising physiological reason behind why plants need so much water. You will learn about the structure and properties of water, the mechanisms for water movement in plants and what happens to plant water transport during drought.

With climate change, droughts are predicted to increase in severity and longevity, especially in our state of California. These droughts have severe agricultural and economic implications, and threaten our natural ecosystems, biodiversity, and human health. Understanding how plants respond to drought is a major challenge in plant sciences.

### Learning Objectives

Basic objectives

- 1) Why do plants need so much water?
- 2) Explain the cohesion-tension theory of water movement
- 3) List and discuss the different drivers of water movement in plants

Advanced objectives

- 1) Identify the different pathways for water movement in plants
- 2) Identify and define the mechanisms of hydraulic decline during drought
- 3) Reflect on the different factors that influence transpiration ( $E = D \times g \times VPD$ )

## Preparatory Activities and Resources:

1. Give detailed, action-oriented instructions for completing the Guided Practice assignment. Keep in mind that the activities should be minimal, simple, engaging, productive, and failure tolerant (see Talbert, 2017, pg. 135)

Students will complete pre-class quizzes on the topic. They will be able to take the quiz twice.

2. Give a “playlist” of resources such as readings, videos, audio, or other content delivery methods that provide students the content to work with.

Students will be provided with four short videos where I lecture on 1) why plants need so much water, 2) structure and properties of water, 3) mechanisms for water movement in plants (tension-cohesion theory), and 4) plant water transport during drought.

Students will also be provided with detailed notes on these four topics, with blanks for them to fill out by listening to the videos.

Exercises: Please complete by \_\_\_\_\_.

- Quiz will have to be completed by 9am the day of the class.

## Questions?

Students can post on a discussion forum that will be created in canvas to ask other students for help. Students will also be encouraged to attend my office hours.

## ADVANCED PRACTICE

This is given for students to complete after the class meeting in which they work together.

Class: Plant Water Relations

Date assigned:

Date due:

Time estimate to complete this assignment: 30 min

### Learning Objectives

#### Advanced objectives

List 3-4 learning objectives that you expect students to need help mastering in class and after class.

- 1) Identify the different pathways for water movement in plants
- 2) List and discuss the different drivers of water movement in plants
- 3) Identify and define the mechanisms of hydraulic decline during drought
- 4) Analyze, describe and discuss results from a figure taken from the primary literature on plant water relations

### Activities & deliverables

Describe and interpret the figure based on learnings from the plant water relations class, and format it in the same way as the example provided to you. You may work together; just be sure that YOU can describe and interpret this type of figure independently as the exam will be similar to this work.

Assignment will be due by 9am before the next class meeting. Please upload assignment to the link posted in canvas.

### Resources:

1. Give a "playlist" of resources to help students complete the assignment

Students will be given a figure that has been described and discussed in a similar way they are expected to do it for other figure interpretation. Students will be able to use class notes provided to them prior to class, as well as lecture videos posted to canvas to help them understand the primary literature.

### Questions?

Students can post on a discussion forum that will be created in canvas to ask other students for help. Students will also be encouraged to attend my office hours.