

Chill Out

Students manage a bog through a season of spring frost threats.

How do growers decide whether there is a risk of crop damage from a spring frost—and what do they do about it?

Lesson Overview

In this lesson, students encounter an important seasonal challenge to growers: spring frost. Their task is to use information provided to decide whether a risk of frost exists and, if so, take appropriate action, spraying the bogs with water to prevent frost damage to the flower buds.

The lesson begins with an overview of information about the healthy development of a harvest, as well as the risk of damage due to spring frosts. The overview also includes the often surprising fact that spraying plants with water is a helpful defense against damage that could be brought on by spring frost.

After this overview, students manage this potential threat. They determine whether a given night's forecast represents a threat to the developing bud (the bud grows less tolerant of cold as it develops), and, if so, at what temperature they should set equipment to respond to the threat. They must take into account the fact that although it might seem easier to water defensively on every evening, overwatering also presents unique threats to the health of the vine and crop.

After encountering each of three situations, students receive feedback on their choices. After the final situation, students reflect on how well, overall, they have managed the frost threat.

This lesson makes use of a classroom discussion forum, a Growers' Association meeting. This parallels the real-world support that growers have in the form of agricultural organizations, and also provides an opportunity for problem-centered discussion across teams of students. The Growers' Association meeting is used throughout the Challenges Await You section.

Expect this lesson to take two sessions of class time. It may be especially challenging for younger students. Therefore, the lesson offers two different

challenge levels, as indicated in the resources (see **Materials**). The simplified and advanced versions (for younger or older students, respectively) differ in the amount of information that students must weigh to make a decision.

Background

Throughout the year, various threats to all or parts of the cranberry plant may translate to a less than optimal crop. One key aspect of the grower's role is to anticipate these threats, monitor the bog and its environment, and take action when necessary. Sometimes, the action is relatively simple—such as turning on sprinklers at the right time—but the decision-making behind it is complex. In springtime, for example, there is no one temperature that signifies that a frost will threaten the bog. Instead, the tender buds—which are vulnerable to damage by frost—have different temperature tolerances based on how far they have developed. The more advanced they are, the less tolerant they are of cold (and so they must be protected at higher temperatures). Growers must know what is happening on the bog and the overall development of the buds in order to identify when dropping temperatures pose a problem. In addition to the bud development stage, other factors determine risk of damage, including location and variety:

Location: Temperature on the planted area of the bog is critical, as opposed to the temperature of upland areas. For example, the lower areas of the bog in which the vine is planted can be subject to temperatures ten or more degree Fahrenheit colder than the upland areas. Special monitoring is therefore required.

Variety of cranberry: While all buds become more sensitive to lower temperatures as they develop, different varieties are at risk of injury at different temperatures. In addition, different phases in development also determine each variety's particular temperature sensitivity. To manage a threat, growers spray the bogs with water for the duration of the intolerable temperatures (a few hours, a day, etc.). Although at first it may seem counterintuitive to spray water on the plant—after all, it will freeze —this is effective because as water freezes, the ice-water system stays at a constant temperature: 32 degrees Fahrenheit. Thus, the constant water bath provides a buffer from even colder temperatures. In addition, the ice itself is a wind barrier, creating a second protection for the plant.

It may seem a good idea to regularly spray the plants with water so that growers need not monitor temperatures. In fact, this is not the case. Too much water, especially in the spring, can foster disease and pest growth. Also, water is a precious resource and must be managed carefully. It is of prime importance,

therefore, for growers to know if and it is truly necessary to spray water on the plants. They must realize when the temperature is a definite threat to the buds.

Growers must use their knowledge of the bud's development, weather forecasts, and a bit of foresight to determine the trigger temperature at which they will turn on the water. Usually, this is about 3-5 degrees Fahrenheit higher than the minimum temperature the buds can tolerate at their given stage of development.

Some growers are fortunate to have high-tech resources to assist them. These resources might include automatic temperature alarms, temperature-triggered irrigation systems, and/or remote access to control valves that set the watering system to respond to pre-determined conditions. Automatic phone call systems set up by agencies that support agriculture can also serve to alert growers to the need for action. Less convenient options require more personal monitoring and a physical presence on site.

If all goes well, the buds make it through this vulnerable time. If, however, there is damage, it can be recognized by plant color as well as actual bud condition. Walking the bogs is an integral part of keeping tabs on what's happening, so that growers can adapt to the on-site, in-the-moment conditions.

The following information addresses the differences between the advanced version and the simplified versions of the challenges:

1. *For older students (advanced version)*, the resources provide information on upland temperatures as well as the temperatures in the planted areas. In the real world, temperatures on the lower, planted regions can typically be lower (by 10 degrees F or even more) than the upland. This level of complexity will make the situation more challenging for students, and will require that they practice the skill of sifting through more information than they need for what is relevant to a problem. *For younger students (simplified version)*, this detail is not added. Students are provided with planted area temperatures only.
2. *For older students (advanced version)*, the different bogs are planted with different cranberry varieties. The tolerance of different bud stages varies with variety, so students must attend to detail to manage the situations properly. This difference between bogs can also add an opportunity for deeper discussion in the Growers' Association meeting. *For younger students (simplified version)* all students examine the same data, for the same variety of cranberry. This enables you to run a streamlined whole class discussion to support students as they work.

3. *For older students (advanced version)*, the same temperatures may or may not mean the same risk to both bogs, because the bogs are growing different varieties. The advanced challenge offers an opportunity for students to experience a more realistic model of the real world. *For younger students (simplified version)*, there are no differences between the two bogs, and therefore the appropriate response is the same, making it more likely that all students will be able to track the classroom information and discussion without confusion

Note: For additional detail, please review the information in the *Exploring Cranberries* Web resources listed for this lesson.

Exploring Cranberries Web resources:

Challenges Await You Introductory Presentation

Chill Out Teacher Resource Presentation Advanced or Simplified

Note: Whether advanced or simplified, each Chill Out Teacher Resource Presentation includes the following content:

- *Part 1: Managing Spring Frost*
- *Part 2: What Happened? (Situations 1-3)*

Student Handouts:

Spring Frost Management Log (1 per student or student pair; student pairs should be the partners who adopted a bog together)

Growers' Association Info Brief, Chill Out: A Grower's Guide to Managing Spring Frost

Student Web Resources:

Risky Situations Student Resource Presentation(s):

EITHER—for advanced implementation of this lesson—

A Risky Situation? Student Resource, Version 1: Blue Sky Bog **and** A Risky Situation Student Resource, Version 1: Sunrise Bog

OR—for simplified implementation of this lesson

A Risky Situation? Student Resource, Version 2

Preparation

1. Determine which version of the lesson you will implement for your class. This lesson is designed for all students to use an advanced version or for all students to use a simplified version. Of course, you are free to adapt the lesson as you see fit, but the teacher resources were developed to support whole group implementation of one or the other version.
2. Preview the Chill Out Teacher Resource Presentation to become familiar with its flow. There are several slides that involve clicking to trigger the appearance or disappearance of information, and/or animation. It will be helpful if you are aware of these points in the presentation before you show it to the class.
3. Arrange classroom furniture to be conducive to the Growers' Association meeting format, as well as for pairs to work together.
4. Arrange to project the Chill Out Teacher Resource Presentation and *Risky Situations?*, to the whole class.
5. Make copies of Spring Frost Management Log and Growers' Association Brief, *Chill Out: A Grower's Guide to Managing Spring Frost*.

Lesson

1. Run the Challenges Await You Introductory Presentation. Afterwards, discuss some of the main points before focusing student attention on what's going on in the spring. Some helpful questions include:
 - The video begins by saying that the work for the next harvest begins right after the fall harvest. How is this so? What points from the video back up this idea?
 - What are some of the things that can happen throughout the year to threaten a good harvest?
 - What are some of the ways growers can meet these challenges?
2. Draw students' attention to the spring, in particular. Be sure they note that spring frost is an issue. Discuss why the spring frost can be a problem. Tell students that their challenge as growers is now to manage this threat. Review the idea that the response to a spring frost threat is to provide the bogs with a constant spray of water *only* when the temperature drops to a risky level.

3. Tell students that they are going to have to make decisions about three evenings of potential spring frost. For each evening, they will need to examine the weather forecast and information about their bog to determine if there's a threat and, if so, at what temperature they should ensure that their sprinkler system is turned on.
4. Call the group together for a Growers' Association meeting. Present Part 1(Managing Spring Frost) of the Chill Out Teacher Resource Presentation, which provides detailed information about frost threats and how to manage them.
5. Distribute (to each pair or student) the Growers' Association Brief, A Grower's Guide to Managing Spring Frost. Tell students that the information they need to make it through the spring frost season with a healthy bog is in the brochure. Read and discuss.
6. Distribute the Spring Frost Management Log sheet so students can track their decisions for each situation.
7. *If implementing advanced version:* Direct students to open their bog's A Risky Situation? Presentation (Version 1, Blue Sky Bog or Version 1, Sunrise Bog).

If implementing simplified version: Direct all students to open A Risky Situation? Presentation Version 2.

All versions of lesson: Direct students to consider Risky Situation #1 only. Provide students with 10-15 minutes to respond to this situation. In this time, they should read the brief and determine whether there is a threat and, if so, what to do about it and when. They should also complete their Spring Frost Management Logs for Risky Situation 1.

8. Reconvene the Growers' Association meeting, discuss the challenge, students' solutions, and the reasons for their decisions. Present the Situation 1 slides from Part 2 (What Happened?) of Chill Out Teacher Resource Presentation. Stop after Risky Situation # 1.

Advanced version: All students will review both bogs' situations. As their particular bog situation is reviewed, students should record the results in the appropriate space on their logs.

Simplified version: There is only one, generic Risky Situation 1. All students should record the results in their logs.

Remind students that even if they did not prevent frost damage at this time, all is not lost, and they still have a chance to be successful.

9. In a similar fashion, run through the next two threat situations, alternating student work time with Growers' Association discussion and feedback opportunities. After the third threat, ask students to sum up how they did. Discuss any remaining areas of confusion before moving on.
10. Have students write reflections in their logs about their experience and the information they gathered during this phase of running the bog. What surprised them about spring frost concern? What might they do differently? What would they advise to other would-be growers regarding how to manage the bog?
11. Congratulate all students, reminding them that some damage does not mean it is time to give up. They just have to be all the more on the lookout for other threats that they can manage for the rest of the growing season.

You may wish to proceed to another challenge. While it is not necessary to follow a particular order, in a given year, the next challenge that the grower would most likely face is managing insect pest populations.