MAKING TREES FROM TEST TUBES

A high school lesson plan provided by the University of Guelph

75 MINUTES
+ TAKE HOME ASSIGNMENTS
SBI3U, SBI4U

This lesson plan gives students the opportunity to learn about plant tissue culture and how it can be used to propagate crops in abundance. Students will expand their knowledge about the process of micropropagation and the various plant hormones that react to make this possible. Students are able to work together while applying individual creativity to better understand implications of plant biodiversity loss and sudden declines in yield.

This lesson plan surrounds Episode 2 of The Why and How Podcast "How can test tubes make 10 million trees?" The podcast looks to answer big questions in agriculture, food, and the environment through casual conversations rooted in research. It is hosted by undergraduate students and published by the Ontario Agricultural College of the University of Guelph.

Curriculum Alignments and Expectations

- Analyse, on the basis of research, some of the social and ethical implications of research in genetics and genomics
- Evaluate, on the basis of research, the importance of some recent contributions to knowledge, techniques, and technologies related to genetic processes
- Investigate various techniques of plant propagation (e.g., leaf cutting, stem cutting, root cutting, seed germination)
- Describe reproductive technologies such as cloning, artificial insemination, and in vitro fertilization
- Describe some examples of genetic modification, and explain how it is applied in industry and agriculture

Learning Objectives

- Learn about micropropagation and the steps involved
- Critically assess the role of science in restoring biodiversity
- Build research communication skills

Assessment Strategies and Success Criteria

- Class and small group discussion
- Open ended questions
- Researching and summarizing of Information
- Reflection and debriefing

Cross Curricular Links

- Communications Technology- demonstrate an understanding of and apply the interpersonal and communication skills necessary to work in a team environment.
- Career studies- Communicating with Others and Interpersonal Relations

Materials

- Computer lab with internet access or suitable devices to conduct research
- Double sided tape and wall space
- Classroom A/V capabilities

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TEACHER NOTES

Pre-Lesson Discussion

1. Before students listen to the podcast, have a discussion with students to investigate their current level of understanding toward scientific plant propagation.

    - *Have you ever heard the term plant tissue culture? What is it/what do you think it is? What is the purpose of plant tissue culture?*
    - *Do you think science can be used to bring back plants from extinction or multiply plants in the thousands within hours?*

Take-Home Work: Cloning Trees

2. Assign students to listen to the podcast as homework (31 minutes) and to define the following terms discussed in the episode, some terms may require additional online research to provide a definition.

    - Plant tissue culture
    - Micropropagation
    - Super nutrient solution
    - In vitro environment
    - Vegetative propagation
      i) Grafting
      ii) Cutting
      iii) Layering
      iv) Suckering
    - Auxins and Cytokines

In-Class Lesson

3. **Activity 1: Setting the Stage**

    In a class discussion, ask them to explain the difference between similar terms they researched as part of their take-home work. Break class into smaller groups of approximately four students per group. Ask students to discuss the following questions amongst themselves,

    - *If and how did your perception of plant science and plant tissue culture change after listening to the podcast?*
    - *How could this technology/method benefit society?*

4. **Activity 2: Tissue Culture Communication**

    Required Materials: Computer lab with internet access or suitable devices to conduct research.

    Note: This activity can alternatively be assigned as a take home group project.

    Kevin mentioned bananas and orchids and a variety of horticultural crops that are grown with plant tissue culture. Assign groups of students of 4 or less and ask them to pick a crop or plant to research its history of being grown and if plant tissue culture is used. Be sure to ask students to consider their sources and ensure they are sourcing information from a reputable source backed by science and/or research.

    Plants grown using tissue culture include asparagus, cucumber, grapevine, banana, alfalfa, citrus, sugarcane, tomato, strawberry, maize, cannabis, dahlia, rosa, iris, hyacinth, freesia, begonia.

    Ask students to include information such

as:
i) Statistics found on usage, consumption or economic impact
ii) Dates – when was it started
iii) Stakeholders – companies, researchers, distributors, customers
iv) A simplified outline of the propagation process

Have students compile their findings into a poster including any relevant pictures, graphs and illustrations from the research. Ask them to include sourcing of where they found the reputable information used to create the poster.

5. **Activity 3: Compare, Contrast and Communicate Methods of Food Production**

Required Materials: Double sided tape, walls

Ask student groups hang their poster around the classroom. Allow the students to walk around the classroom and view each poster. Ask students to record questions they have about each poster and be prepared to discuss them in small groups. This should take no more than 30 minutes depending on the size of your class and number of posters to view.

Divide the class into groups where each member represents a different food production poster.

Each student should share what they found out about the crop or plant, produced by plant tissue culture that they are representing. Followed by group members asking their prepared questions about their poster content.

Begin a deeper discussion by asking if research findings and/or interpretation differ between representative & group members.

Continue the discussion by referencing the story of hazelnuts told by James in the podcast. Divide the class in groups and ask each group to identify one plant (ornamental or food) that could be scaled up in production using micropropagation. Have students talk with each other about the economic and social implications that would arise from being able to grow the crop/plant quicker and on a larger scale.

Discussion notes:

- *Can you think of potential downsides to plant tissue culture?*

  i) requires skilled labour
  ii) expensive initial investment
  iii) plants may be less resilient to diseases if the original specimen is compromised
  iv) others...

- *What are some benefits of plant tissue culture?*

  i) you can clone rare plants
  ii) makes large scale production possible
  iii) higher plant success/survival rate (vs. seeds, cuttings)

6. **Debrief and Reflection**

Hand out small pieces of paper and ask

students to anonymously write one thing they are taking away from the podcast or accompanying activities. Collect the responses and read a few of them aloud. Continue with a larger group debrief if needed.

7. **Activity 4: Career Exploration (Optional)**

   Required materials: A/V capabilities

   To help your students better understand plant tissue culture and how it is used in industry, watch this video of a tissue culture lab (4 minutes).

   Ask students to play close attention to the different tasks involved in tissue culture at this organization. *What kinds of careers might exist at this facility or other connected facilities?*

   - Greenhouse manager
   - Lab manager
   - Equipment and supplies procurement coordinator
   - Marketing manager
   - Sales representative
   - Lab technician

   James and Kevin mentioned a few career paths for individuals studying plant tissue culture and are interested in doing work to advance its' possibilities. Discuss some career fields young researchers could break into after graduating.

   - Government researcher or policy advisor
   - Genetic Technologist
   - Product developer
   - Greenhouse/ Plant Propagation Consultant

Additional Resources

- Transcript of podcast episode
- Gosling Research Institute for Plant Preservation (GRIPP)
- Visit us by registering for an on-campus experience and take part in a hands-on plant propagation workshop from GRIPP by selecting the session "Plant Preservation at GRIPP" on your request form

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