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| **Lesson Title :** Designing the Challenge | **Unit #:****1** | **Lesson #:****2** | **Activity #:****4** |
| **Activity Title: Grafting Cacti** |

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| **Estimated Lesson Duration:** | **One week** |
| **Estimated Activity Duration:** | **Three days** |

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| **Setting:** |  |

The classroom or lab will be used for the activity. The computer lab will be used for research.

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| **Activity Objectives:**  |

Students will be able to construct an argument based on scientific evidence as to how specialized structures of a plant can be used to influence the growth of an organism.

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| **Activity Guiding Questions:** |

**What types of edible plants can grow in a given USDA zone?**

**Are the edible plants healthy? Any particular health benefits?**

**Are the edible plants healthier than plants that grow in this region?**

**Can the vascular systems of the plants be connected?**

**Is there any trick to connecting vascular tissue?**

**Are there alternatives to genetically modifying plants to improve their usefulness to humans?**

**What are the incentives to using cactus fruit over regular fruit?**

**Can cactus fruit be grown anywhere in the world?**

| **Next Generation Science Standards (NGSS)**  |
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| **Science and Engineering Practices (Check all that apply)**  | **Crosscutting Concepts (Check all that apply)** |
| ☒ Asking questions (for science) and defining problems (for engineering) | ☐ Patterns |
| ☐ Developing and using models | ☒ Cause and effect |
| ☒ Planning and carrying out investigations | ☐ Scale, proportion, and quantity |
| ☒ Analyzing and interpreting data | ☐ Systems and system models |
| ☐ Using mathematics and computational thinking | ☐ Energy and matter: Flows, cycles, and conservation |
| ☒ Constructing explanations (for science) and designing solutions (for engineering) | ☒ Structure and function.  |
| ☐ Engaging in argument from evidence | ☐ Stability and change.  |
| ☒ Obtaining, evaluating, and communicating information  |  |

| **Ohio’s Learning Standards for Science (OLS)** |
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| **Expectations for Learning - Cognitive Demands (Check all that apply)** |
| ☒ Designing Technological/Engineering Solutions Using Science concepts **(T)** |
| ☒ Demonstrating Science Knowledge **(D)** |
| ☒ Interpreting and Communicating Science Concepts **(C)** |
| ☒ Recalling Accurate Science **(R)** |

| **Ohio’s Learning Standards for Math (OLS) and/or** **Common Core State Standards -- Mathematics (CCSS)** |
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| **Standards for Mathematical Practice (Check all that apply)** |
| ☐ Make sense of problems and persevere in solving them | ☐ Useappropriate tools strategically |
| ☐ Reason abstractly and quantitatively | ☐ Attendto precision |
| ☐ Construct viable arguments and critique the reasoning of others | ☐ Look for and make use of structure |
| ☐ Model with mathematics | ☐ Look for and express regularity in repeated reasoning |

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| **Unit Academic Standards (NGSS, OLS and/or CCSS):** |

**MS-LS4-5.** Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.

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| **MS-LS1-5.** Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.  |

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| **MS-LS1-4.** Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.  |

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| **Materials**: (Link Handouts, Power Points, Resources, Websites, Supplies) |

[Student Worksheet](https://docs.google.com/a/stspp.com/viewer?a=v&pid=sites&srcid=c3RzcHAuY29tfG1yLWJydW5uZXItMjAxNnxneDozNzFiMzUyMmFmYzEyODZl)

[Student Follow Up Report](https://docs.google.com/a/stspp.com/viewer?a=v&pid=sites&srcid=c3RzcHAuY29tfG1yLWJydW5uZXItMjAxNnxneDplODFhY2MwMGU3MjBlMzk)

[Video Finale](https://docs.google.com/a/stspp.com/viewer?a=v&pid=sites&srcid=c3RzcHAuY29tfG1yLWJydW5uZXItMjAxNnxneDo3ZDM1MmRiNDc2YTYzMTA2)

Camera and/or video camera

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| **Teacher Advance Preparation:** |

Take pictures throughout this process. At least a few of each group at various stages. Assign a student to do this if needed. The pictures will be needed for the video later.

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| **Activity Procedures:** |

Pass out Student work sheet to students.

Remind students to do nothing with their plant until they have everything completed. Follow instructions exactly. Remind students to never touch the cacti without gloves. If they get Glochid on their hands, never put their finger in their mouth or eyes. Pull out the Glochid with tweezers and wash hands.

Allow students time to complete assignment. Take pictures and video.

Once students are finished, wait a week and give them part 1 of the student follow up worksheet. Be sure that they are taking pictures.

Wait another week for part 2.

Be sure that they are taking pictures.

Wait another week for the final analysis on the follow up worksheet.

Be sure that they are taking pictures.

Once everything is complete, Give students the sheet ‘Video Finale’. Students should be use a video camera to report their findings. Suggest that they may use any format that they would like and to be creative. They could pretend to be a news station or some other such thing.

**Formative Assessments:** Link the items in the Activities that will be used as formative assessments.

Observations throughout the activities.

**Summative Assessments:** These are optional; there may be summative assessments at the end of a set of Activities or only at the end of the entire Unit.

Video Finale and the end of unit test.

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| **Differentiation:** Describe how you modified parts of the Lesson to support the needs of different learners.Refer to Activity Template for details. |

Group students based on what they can do, not their grades necessarily. I try to have a student who is great with hands on things, one that is good with math, one that is good with reasoning/science and one that is a reader. This allows for students to have an area they are ‘experts’ with and gives them a sense of being a part of a team, rather than a member of a group.

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| **Reflection:** Reflect upon the successes and shortcomings of the lesson. |

Students should explain their procedure to another group first and see if the other group understands what they are going to be doing. One of the problems was that students wanted to jump in without first knowing what they would be doing. It helped to have the students mark on the plant where they were going to cut first. Warn any student who doesn’t have a large piece of plant before letting them cut. Larger portions of the scion tend to work better than smaller portions.