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| **Lesson Title :**  **Lesson 2 - Optimization Processes** | **Unit #:**  **1** | **Lesson #:**  **2** | **Activity #:**  **4** |
| **Activity Title:**  **Activity 4 - Optimizing Life** |

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| **Estimated Lesson Duration:** | **Approximately 8 days** |
| **Estimated Activity Duration:** | **Approximately 6 days** |

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| **Setting:** | **Standard Classroom, Ryle High School, Groups of 3 to 4** |

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| **Activity Objectives:** |

Students will be able to:

* Create a model demonstrating the process of natural selection.
* Record their findings/observations in an engineering journal format.
* Present their system in front of the class as a group.

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| **Activity Guiding Questions:** |

What specific challenges do organisms face in their environments?

What options do organisms that are less fit have for survival?

How does nature guide evolution?

How can we show the process of natural selection/evolution using computer-based logic?

| **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)** | | |
| **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):** |

**NGSS HS-LS4-2, HS-LS4-3, HS-LS4-4, HS-LS4-5**

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

Project main handout/instructions/rubric: [Optimizing Life.docx](file:///C:\Users\debbie\Downloads\Optimizing%20Life.docx) (still need to create rubric)

Organism Research Table: [Organism Research Table.docx](file:///C:\Users\debbie\Downloads\Organism%20Research%20Table.docx)

Project Rubric: [Project Rubric.docx](file:///C:\Users\debbie\Downloads\Project%20Rubric.docx)

Computer Access (either in a computer lab or with a laptop/chromebook cart)

Posterboard or large sheets of Poster Paper

Markers

Rulers and Metersticks

Microsoft PowerPoint or Google Slides

Post-it Notes

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| **Teacher Advance Preparation:** |

Physical prep work is limited – the teacher just needs to ensure that they have all materials available in the classroom for students to make use of. Having desks or tables arranged into pods will also make it easier for students to work on creating their systems.

The teacher should also determine students groups and groups of organisms ahead of time. Groups of 3 will work best for students. When choosing groups of organisms for students to work on, students should choose similar organisms that still have some obvious physical/behavioral differences (Darwin’s finches, for example.

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| **Activity Procedures:** |

Day 1: Pass out and go over project instructions with the class, paying special attention to the constraints spelled out for them for the project. Then, work through one example (Darwin’s Finches) as a class to demonstrate what the flow chart/algorithm system might look like. Finally, assign student groups and the organisms they will be working on.

Day 2: Pass out “organism research table” to students and have them use computers to complete. Once finished and students have a good understanding of similarities/differences among their organisms, have them come up with several IF/THEN statements they could use to separate these organisms in their system. For example: “IF there are seeds available, THEN the birds will eat them. IF NOT, THEN the birds will look for a different food source”. Have students come up with as many as possible so they have options to choose from. All of today’s findings should be recorded in the group’s engineering PowerPoint as discussed on the project instruction page. Collect a copy of student if/then statements for review.

Day 3: Have students choose if/then statements from yesterday that they can use to begin creating their systems. Allow students to begin creating a rough draft of their whole system. Students could do this with pencil and paper, or you can make post-it notes of different colors and shapes available to them to “build” their system on their tables. Continue to stress that they document the work they are doing in their PowerPoints, and circle the room offering advice, observations, and help as needed.

Day 4: Have students finish their rough drafts. Once done, have students check-in with the teacher. Assign students an unknown organism/condition (for example, a new organism slightly different from what they were assigned, or a change in weather that could affect the if/then statements they used if too specific) and ask students to evaluate how/if it fits into their system. Encourage students to figure out what changes need to be made and have students refine their system if needed. Students continue to document the process in their PowerPoints.

Day 5: Ask students to use their finished drafts to create their final posters. Students should finish their Powerpoints and decide how presentations will go (ie, who will present what, in what order will they talk, etc). Have students practice overnight for homework!

Day 6: Have groups present their systems to class – both their posters and PowerPoints. As students present, use the Project Rubric to assess their presentation skills. Collect a copy of the posters and PowerPoints for grading.

Day 7: Unit Quiz.

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

-Class practice w/ Darwin’s Finches

-If/then statement activity

-Rough draft of system

-Mystery organism/condition activity.

**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.

Together, these will demonstrate students ability to explain and model the process of natural selection.

-Final Poster

-Final PowerPoint

-Presentation

-Unit Quiz

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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. |

-Preferential grouping: students with certain special needs will be grouped with stronger students to help guide them through the project. These “stronger students” are not necessarily just the smartest one, but are students who will do a good job incorporate the specials needs students into the group and helping them learn what we are doing.

-Private presentations: if a student has an IEP for an anxiety or communication disorder that makes it difficult to present in front of the class, they will be able to schedule a time to present to me one-on-one. This ensures that they are still responsible for that portion of the project, but puts them in a situation where they will be more comfortable.

-Manipulated Number of Assigned Organisms: exceptional groups can easily be given an extra organism or two to keep them working and on task, or can be assigned organisms much more similar to each other and harder to split up. Lower-level groups, on the other hand, can be given easier organisms to work with to keep them from getting overwhelmed.

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

I was very happy with how this project went, and found the planned out timetable to be perfectly paced. Sticking to that gives students plenty to do each day without overwhelming them, while at the same time giving them enough time to complete what you’ve asked of them. Students were very engaged in this project and seemed to enjoy working on it in groups, and I feel like they got out of it what I wanted them to get (and the data backs that up).  
One thing that did impact our completion of the project was that, due to the timing in the year, we had several snow days during the course of the project. I ended up using one extra day during the course of the project, just because we had to spend some extra time playing “catch up” from these snow days – remembering what we were in the process of doing and where we left off, for example. I do feel like the project timetable is flexible enough to give you plenty of room to make changes like this as needed, though.