**Unit Plan: Superbugs + Computational Thinking**

**Major Themes for the Unit**

* Scientific themes: Natural Selection
* Scientific practice: Modeling and Computational Thinking
* SSI: Antibiotic Resistance

**Driving Question**: How can antibiotic resistance be mitigated?

**Concepts needed to explore the driving question**

* Science concepts (Examples: carbon cycling, photosynthesis)
	+ Natural selection- random mutation, initial variation, selective pressure, favorable trait, differential survival, reproduction, population shift
	+ Antibiotic function
	+ Antibiotic resistance mechanisms
* What social ideas and concerns influence negotiation of the issue?
	+ Over prescription of antibiotics
	+ Usage of antibiotics in food production
	+ Policy and economics related to antibiotic usage

**Unit-level performance expectations**

* Develop a conceptual understanding of natural selection that accounts for a) genetic variation associated with particular traits, b) selective pressure that leads to differential reproductive success linked to these traits, and c) changes in trait frequencies within the population.
* Develop algorithmic explanations of natural selection in microbe, animal, and plant contexts.
* Use contextual algorithms to create a generalized natural selection algorithmic explanation for use in new natural selection contexts.
* Use algorithms as a basis for reasoning about novel problem situations.
* Demonstrate socio-scientific reasoning in response to complex SSI.
	+ Identify and discuss sources of issue complexity.
	+ Identify areas of uncertainty and ask related questions.
	+ Analyze the issue from multiple perspectives.
	+ Identify and discuss ways in which scientific evidence can inform issue resolution as well as limits on the use of scientific evidence.

**Unit assessment(s)**

* Algorithmic explanations of natural selection in the context of the laboratory investigation, the mountain sheep investigation, and the field mustard investigation– Formative
* Application of NS algorithms to propose a policy for mitigating antibiotic resistance – Formative & Summative
* Application of Socio-scientific Reasoning in the context of a policy recommendation - Formative & Summative
* Natural Selection Test; multiple choice (CINS) plus open-ended item (Opfer, Nehm & Ha, 2012) – Summative

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**Lesson sequence**

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| Lesson (time) | Lesson Focus | Activities | Materials |
| 1 (45 min) | Introduce antibiotic resistance as a significant issue; create initial natural selection algorithm | Discussion, Lecture, Presentation, Algorithm creation | Lesson Plan 1Students- Natural Selection Algorithm Handout; Know Your Sources Handout and Exploring Cases Handout  |
| 2 (90 min) | ABR lab; introduce computational thinking; how antibiotics work | Data Collection, Lecture, Discussion, Group algorithm creation | Lesson Plan 2Teacher- CT intro Power Point; antibiotics Power Point; Lab Guide for Instructors; Example Getting Ready Algorithms; [Link to the video](https://youtu.be/S9wvZkCSAU8); Intro to CT Video TranscriptStudents- Lab Packet; Antibiotics Handout |
| 3 (90 min) | ABR lab; Big-horned sheep investigation; create sheep algorithm | Data Collection, Evidence analysis, algorithm creation | Lesson Plan 3Teacher- Sheep Evidence Power Point; Antibiotics Power PointStudents- Lab packet; Sheep Evidence Evaluation Handout; Sheep Example Algorithms; Sheep Student Algorithm Handout  |
| 4 (90 min) | ABR lab data collection and analysis; mechanisms of bacterial resistance; create bacteria algorithm | Data collection, Data analysis, Lecture, Discussion, algorithm creation | Lesson Plan 4Teacher- Antibiotics Power Point Students- Lab packet; Bacterial Algorithm Handout; Resistance Handout |
| 5 (45 min) | Field mustard investigation; create mustard algorithm | Evidence analysis, algorithm creation | Lesson Plan 5Teacher- Field Mustard Power PointStudents- Field Mustard Evidence Evaluation Handout; Mustard Algorithm Handout |
| 6 (90 min) | Create generalized algorithms | Lecture, Discussion, Group algorithm creation, Peer feedback | Lesson Plan 6 Teacher- General Algorithms Power Point; [Link to the video](https://youtu.be/14omwM-3Y1Y); General Algorithm Video TranscriptStudents- General Algorithm Handout |
| 7 (45 min) | Lateral gene transfer and review | Lecture, Discussion | Lesson Plan 7Teacher- Antibiotics Power Point |
| 8 (90 min) | Policy Proposal introduction and work time | Discussion, Work time | Lesson Plan 8 Students- Perspectives Jigsaw Activity Handout, Policy Instructions; Resources Handout |
| 9 (90+min) | Policy proposal presentations; Summative test including a final natural selection algorithm | Presentations, Test | Lesson Plan 9Students- Natural Selection Algorithm Handout |