FUTURELAB+

Unit Flow Chart

CTE Biotechnology Pathway / Ag/Environmental

YEARS

YEAR 1

- Crowdsourcing Innovations in Biotechnology
- Taking Action in Your Community: Health Equity
- Nucleic Acids and Proteins: Disease Treatment Innovations
- Behind the Scenes of Scientific Breakthroughs

YEAR 2

- Solution Seeking Microbes
- Alternative Proteins
- Plants to Pharmaceuticals
- Community Science

LESSON PLANS

Problem Overview	Superhero Microbes	LAB: Yogurt Fermentation	Microbes and Food (Menu)	Antibiotics, Resistance, and Combating Disease	Bacterial Defense	Uses of CRISPR and Bioethical Decision-Making	LAB: Detecting *Wolbachia*: A Microbe to Control Disease	Microbes and Balance in the Environment	Design Thinking to Identify Challenges	Microbes to the Rescue (PBL)
Showcase how microbes might be used to solve a real-world problem at a "Micro-Con"	*Act as microbiologists to study an environmentally-impactful bacteria, and create comics to showcase its superpowers.*	*Take on the role of a food scientist to observe the process of fermentation by making their own kefir yogurt.*	*Learn about microbe-produced alternatives to food products and careers in food production.*	*Explore antibiotic resistance and phage therapy, and apply this learning to clinical case studies.*	*Learn about molecular defenses used by microbes, and how these are used in key biotechnology tools.*	*Consider frameworks of ethical decision making and discuss complex bioethical case studies.*	*Perform PCR on an insect's DNA to determine if it is infected with* Wolbachia.	*Explore how microbes can mitigate global challenges, such as climate change.*	*Apply the principles of design thinking to develop microbe-based solutions to a community challenge.*	*Participate in a mock microbe convention to network, learn from peers, and connect to local scientists.*
45 TOTAL DAYS	5 DAYS	5 DAYS	3 DAYS	3 DAYS	6 DAYS	3 DAYS	5 DAYS	4 DAYS	5 DAYS	6 DAYS
INSTRUCTIONAL ACTIVITIES										
	Superhero Microbes *Students use a dichotomous key to determine which microbe they are, and develop a microbe concept map.* —— **Microbe Structures and Functions** *Students observe microscope slides, build physical models of bacteria, and create a chart showing how structures and function relate.* —— **Superhero Microbe Comic Strip** *Students showcase a microbe's genetic origin and "superpower" to overcoming challenges.*	**Kefir Yogurt Experiment** *Students design and conduct an investigation to determine how a particular variable affects kefir yogurt fermentation.* —— **SMART Goals for Testable Questions** *Students read an interview with a scientist about how she uses SMART goals to guide her research, and use what they learn to write their own testable question about the microbiome.*	**Microbial Agriculture** *Students learn about food production and projected population growth, and then research how microbes could solve food shortages.* —— **Microbial Menu** *Students create a poster advertising a microbe-influenced food item.*	**Antibiotic Resistance Simulation** *Students learn about antibiotic resistant "superbugs", and use a digital simulation to explain why following prescriptions is essential.* —— **Phage Therapy** *Students read about the mechanism of phage therapy and connect it to the steps of drug development.* —— **Clinical Trials** *Students use a handout with criteria for safe clinical trials to critique a case study.*	**Bacterial struggles and defenses** *Students explore how bacteria protect themselves from external threats and connect these defenses to superhero powers.* —— **Model CRISPR-Cas9** *Students use paper to simulate how a 3D protein is deactivated by CRISPR-Cas9.* —— **Microbial Impacts Presentations** *Students read about the impact of phage-bacteria relationships on humans and the environment, and present an analysis to the class.*	**Bioethics Mini Report** *Students apply their own values and principles of bioethics to a case study they brainstormed, and report out their thinking in small groups.* —— **Compare Other Group's Bioethics Analysis** *Student groups create a bioethical decision to represent multiple stakeholders, and then evaluate another group's decision based on the Belmont bioethical framework.*	***Wolbachia* PCR** *Students perform DNA extraction, PCR, and gel electrophoresis on an insect of their choice to detect the presence or absence of a gene specific to* Wolbachia *bacteria.* —— **Impact of *Wolbachia* Explanation** *Students conduct research and use experimental results to write an explanation of how infection with* Wolbachia *bacteria can be used to solve problems, such as insect-borne disease.*	**Graphing CO2 and Temperature levels** *Students graph, analyze, and make future CO2 and CO2/temperature data predictions from a simulation.* —— **Microbial Reduction of CO2** *Students read about microbes that can decrease CO2 emissions and how they are used in certain companies.* —— **Inequitable Outcomes of Climate Change** *Students read about how climate change targets certain populations, and create a short message to promote knowledge around the topic.*	**Partner Design Thinking** *Students interview a classmate to determine their pain points and use design thinking to iterate solutions.* —— **Defining a Microbial Challenge** *Students define an environmental, food production, or health community challenge that can be solved with microbial intervention.* —— **Micro-Con Project Interviews** *Students interview the community about proposed solutions.*	**Brainstorm Solutions to Community Challenges** *Students work in pairs to develop solutions and design a "booth" to showcase their ideas to classmates.* —— **Pitching Your Solution** *Students design an elevator pitch, costumes, and communication strategies around their microbial solution.* —— **Micro-Con Unit Project Presentation** *Students present their solutions, provide others with feedback, and reflect on their experiences.*