

Unit Flow Chart

CTE Biotechnology Pathway / Plant to Pharmaceutical

YEARS		YEAR 1					YEAR 2			
		Crowdsourcing Innovations in Biotechnology	Taking Action in Your Community: Health Equity	Nucleic Acids and Proteins: Disease Treatment Innovations	Behind the Scenes of Scientific Breakthroughs		Solution Seeking Microbes	Alternative Proteins	Plant to Pharmaceutical	Community Science
LESSON PLANS										
Problem Overview <i>Develop a sales pitch for a drug derived from a plant with medicinal properties.</i> 45 TOTAL DAYS	Biodiversity on Earth <i>Use mapping tools to investigate relationships among human stakeholders, ecosystems, and plant-based medicine.</i> 5 DAYS	Ethical Collaboration <i>Connect intellectual property to ethical collaboration practices, and connect ecosystem health and human health to biodiversity.</i> 6 DAYS	Botanical Collections and iNaturalist <i>Create a class botanical collection and use evolutionary analysis to hypothesize relationships and medicinal properties.</i> 4 DAYS	The Role of Traditional Ecological Knowledge in Drug Development <i>Investigate approaches to preventative healthcare.</i> 5 DAYS	LAB: Drug Discovery using Plant Extracts <i>Explore how bioactive compounds are found in nature.</i> 5 DAYS	Plants and Disease <i>Form Project Teams, determine individual roles, and explore compounds for drug development.</i> 5 DAYS	Plant Medicine Product Development <i>Collaborate on Project Teams to model a plant-based medicine, and plan to scale and manufacture the medicine.</i> 5 DAYS	Product Development: Collaboration, Feedback, and Revision <i>Communicate within and across Project Teams to evaluate and improve their products.</i> 5 DAYS	Product Showcase <i>Use models and marketing plans to provide evidence for why a drug should be produced by a biotech company.</i> 5 DAYS	
INSTRUCTIONAL ACTIVITIES	Biodiversity Impacts <i>Students use a mapping tool to learn about biodiversity and its connection to human health.</i> Case Study: Amazon Rain Forest Carbon <i>Students consider the work of scientists in the Amazon Basin who are observing the carbon cycle at large and small scales.</i> Ecosystem Changes <i>Groups complete and share findings from a timelapse observation of an ecosystem.</i>	Who Owns That? <i>Students explore real-life examples of intellectual property and their connections to biotechnology and drug development.</i> Philosophical Chairs Discussion <i>Students discuss the ethics of resource extraction and reflect on the perspectives and evidence from their peers.</i> Nagoya Protocol <i>Students evaluate the Nagoya protocol, including its application for ethical collaboration in the drug development process.</i>	Botanists <i>Students explore the profile of a plant scientist and connect her research with biodiversity and drug development.</i> Plant Specimens <i>Students follow botanical sample protocols to collect and press plants, and then conduct research on their specimens.</i> Evolutionary Hypothesis <i>Students use phylogenies and physical or ecological similarities to group plants into a tree, and suggest potential medicinal properties.</i>	Holistic healing and TEK <i>Students learn about Indigenous approaches to healing, and Traditional Ecological Knowledge (TEK) as it applies to benefits sharing.</i> Medicinal Plant Profile <i>Students research a plant's bioactivity, preparation, ecological niche, and connection to TEK.</i> Community Garden Design <i>Students use human-centered engineering to create a patient profile, and design a community garden based on their chosen medicinal plants.</i>	Bioactive Compound Extraction <i>Students prepare a plant sample, and then use the protocol to extract bioactive compounds.</i> Kirby Bauer Assay <i>Students use a protocol to check for antibiotic properties.</i> Further Plant Research <i>Students combine their lab results and additional research to decide if the specimen has potential as a pharmaceutical.</i>	Plants and Human Health Pitch <i>Students research a medicinal plant and the associated disease and community impacted, and pitch the plant to their peers.</i> Project Team Research <i>Students self-assess for career skills and assume roles to form a Project Team in which they will model a drug and its production.</i> Project Team Presentations <i>Students collaborate to evaluate research and communicate their findings through slide presentations.</i>	Communications Sub-Team <i>Students define the patient populations for their plant-based medicines and format for their final pitches.</i> Finance Sub-Team <i>Students create a Benefits Sharing Agreement around diverse IP, and compare manufacturing and production strategies for their medicines.</i> Molecular Modeling Sub-Team <i>Students analyze the interactions of a plant-based compound with other biomolecules and specific cellular structures.</i>	Providing Feedback <i>Sub-Teams (of the same role) seek feedback from peers within their Project Team, or other Sub-Teams.</i> Revision <i>Students refine their initial work from Lesson 7 in response to peer feedback.</i> Presentation <i>Students prepare to pitch their plant based-medicines, scaling plans, and molecular models to their identified target audiences.</i>	Project Team Presentations <i>Students share their final product pitches, and showcase elements of their career from their Sub-Teams.</i> Feedback and Celebrations <i>Students provide feedback to Project Team peers, and celebrate other Project Teams' projects.</i> Individual Performance Review and Reflection <i>Students reflect on their performances, and learning, and share perspectives with teacher.</i>	