EDCI 627
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How can biological methods be effectively used to convert biomass to biofuel to meet our energy needs?
Student Activities

Based on the driving question, the allotted time and the available resources, consider the kinds of investigations students are likely to conduct and the amount of time needed for each. Map the various required and optional activities to a **realistic timeline**.

Answer the following questions:
- When will the unit be taught and how long will it last?
The unit will be taught at various points during the school year based on teacher preference. Most likely, it would follow photosynthesis and cellular respiration. It could go directly before or after a unit on gene expression (transcription and translation).

- How you will prepare the students and the environment?
Students will be prepared by practicing 21st century and science process skills throughout the year. Students will collaborate on numerous activities and labs throughout the year. They will be familiar with the expectations of groups work, safety, and internet research.
The environment will be prepared by collecting all of the foreseeable materials beforehand. If students devise experiments that require extra materials, a hardware or convenience store trip may be necessary.

- What entry event will you use to introduce the driving question/unit to the students? How will you ensure it captures their attention and initiates the inquiry process?
The entry event will be a series of Aftermath Video Clips from National Geographic. The video clips are overly dramatic to help ensure attention. Guided questions will be used in-between clips to maintain attention and prompt student discussion and inquiry. The discussion after the video will be centered around how these issues impact our lives and what role the local resources may play in solving problems related to our energy needs. I will ensure it captures their attention by monitoring the class to make sure they all pay attention. Finally, students will submit a question at the end of the first day given the prompt...What question/s do you have about using biomass as a fuel?

- Based on your driving question, what kinds of investigations do you expect your students to propose and/or undertake (provide specific examples)?
o How will you ensure that the problem is explored from multiple perspectives?
Students will have a choice in the variables they manipulate for their enzyme reactions and toothpick lab. Students will be able to search and choose which reactions they investigate and present to the rest of the class. Students will be able to choose the facts and mode of presentation for their final biomass to biofuels conversion piece of advertisement.

- What kinds of data will students need to collect and analyze to address the driving question?
They will collect data on the initial conditions and products produced during their enzyme catalyzed reactions. They will analyze this data to create graphs and presentations to communicate the results based on the variables they tested. Also, students will collect information about specific reactions important to biomass to biofuels conversion. Internet resources and contact with a content area expert will provide data to help students address the driving question.

- What evidence will students have to provide to support their claims?
Students will have to provide the data from their experiments to support their claims (measurements of the products formed in a certain amount of time/possibly calculating rate). This will be in the form of data tables, graphs, and images of the reaction completion.
For their online research into enzyme catalyzed reactions, they will need to provide references for their information. The references will need to be from reputable sources.

- What activities will be required of all students? What activities will be optional or self-determined?
Every student will be required to participate in most phases of this PBL unit. Many of the tasks will be group tasks where students divide their work to complete it efficiently. If the teacher notices a lack of engagement by members within a group, specific tasks may be assigned by the teacher for that student.
The type of reaction and data method collection of the enzyme reaction lab will be self-determined and then approved by the teacher.

- How will these activities create student ownership?
Students will gain ownership by determining their enzyme reaction lab procedure (with the teacher checking for safety). They will work in groups to determine their initial and revised procedure. They will also gain ownership because they will be able to present the results from their experiment using whiteboards (where they can create images, graphs, and written descriptions of their reactions). Students will gain ownership through the selection of the mode of presenting their final product.

- How will these activities foster engagement and active involvement?
Students will be actively involved and engaged in researching the importance and examples of biomass to biofuels reactions. They will also be engaged and involved in presenting their research.
Students will be engaged and involved by completing their procedure and gathering data during their enzyme catalyzed reaction.

- How will these activities engage students in higher order thinking?
Students will engage in higher order thinking skills when they discuss and revise their enzyme reactions. Not only will they be devising their own experimental procedures, they will be listening to the procedures of other groups to determine the possible issues related to their experimental plans.
The final product will require students to use higher order thinking to determine how to persuade people to promote research. By asking a student to persuade someone, they are required to evaluate the information they have been learning.

- How will these activities help students learn biofuels content?
The entry event (Aftermath Video Clips) creates a situation that motivates students to learn about how biofuels could help solve the problem of a finite petroleum resource. At the core of this unit is an enzyme catalyzation experiment where students develop procedures test variables when organic molecules are broken down to simpler molecules. This is a core component of the conversion of biomass into a more useable form.

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- How will you use just-in-time instruction (provide a specific example) and how will you know it's needed?

I believe that once students start to complete their enzyme experiments they will have a difficult time measuring the outcomes of their experiments. They may notice a qualitative change in their reaction, but not know how to measure the changes. I may have to give a lesson on calculating reaction rate. This could include a worksheet with example experimental data where students answer a series of questions showing they understand how to calculate rate. Alternatively, the teacher may be able to use students who understand calculating rates may become the reaction rate specialists who peer tutor struggling students.

- How much time will you allot for each required activity (provide a timeline), including time needed to debrief and reflect, and time needed to revise based on feedback?

	Monday	Tuesday	Wednesday	Thursday	Friday
Week #1	**Pre-test:** Biomass/Biofuels, Enzymes. **Entry Event Video**: National Geographic, Aftermath. Guided questions between each video. Whiteboard activity to connect biomass to biofuels into help solve this problem. **Assessment**: What question/ s do you have about using biomass as a fuel?-Exit Slip	**Debrief:** Show image or actual corn stalk. Ask questions to get students to connect the stalk to depletion of petroleum resources. **Engage**: Hands as Enzymes to breakdown toothpicks. Students complete multiple trials to determine which conditions allow for the maximum number of toothpicks to be converted during 10 seconds. **Assessment:** Use data to support conclusions from your trials for converting toothpicks (biomass) into two pieces (biofuels) with enzymes?.	**Group reflection and Conclusions from yesterday**: Toothpickase lab whiteboarding to connect the model reaction to biomass to biofuels. Gallery walk of toothpick lab results. **Assessment**: Gallery Walk Posters and Comments made on others posters.	Students will research, analyze, and share important reactions in the conversion of biomass to biofuels. Students also find two possible contacts to ask questions about biomass and biofuels. **Reflection:** What questions to do have about biomass converting to biofuels? **Assessment:** Friday's 2-3 minute presentation about the reactions that convert biomass to biofuels.	**Debrief**: What did we learn during yesterday's research? Class discussion. **Task**: Students continue to research, analyze, and share important reactions in the conversion of biomass to biofuels. **Assessment:** Present their findings on reactions in 2-3 minutes to show what they have found and concepts they do and don't understand.
Week #2	**Debrief**: Corn Stalk and Stover images with questions to reinforce connection to biomass and biofuels. Connect to biomass available for reactions. **Task**: Students design experiments into enzymes. Students will be given different, substrates, enzymes, lab equipment, and detection equipment. Students may "mess around" with the equipment to create a plan. They then share their plan **Assessment**: Students create an investigative plan..	Students complete experiment that was designed and approved on Monday. Groups then share their results in a gallery walk and presentation. Students revise their experiment to test another variable. **Assessment**: Students create a revised investigative plan.	Students complete experiment that was designed and approved on Tuesday. Groups then share their results in a gallery walk and presentation. Students create list of rules of thumb for effective conversion of biomass to biofuels using enzymes. **Assessment**: Group list of rules of thumb.	Students generate a group lab report (Google Doc, Prezi, PPT, etc) that describe their experiments and optimal conditions for their enzyme reactions. **Assessment**: Group Lab Report and Within Group Assessment of 21st Century Skills.	Students make contact with the biofuels expert to answer questions they have about the role enzymes play in converting biomass to biofuels. **Assessment**: Letters to expert, notes from interview with expert, or some other summary of expert contact.

Week #3	**Culminating Investigative Question**: How can biological methods be effectively used to convert biomass to biofuel to meet our energy needs? **Task:** Students will develop a way to present to an audience their thoughts and answers about the question and why they think it is important for enzymes to be used in the conversion of biomass to biofuels. Possible Prompt: A biochemist is seeking public support for their enzyme research. They need media materials to help their cause. Develop a way to show others students your grade level how and why biological methods can be effectively used to convert biomass to biofuel to meet our energy needs. **Assessment:** Observing how students worked in groups. Students write one way their group can improve tomorrow.	**Debriefing:** Going over obstacles and reminding students how to improve from yesterday. **Work Time**: Working on media material production in groups. **Assessment**: Draft of media piece due tomorrow.	**Debriefing**: Any questions you have over biomass/biofuels for their media piece? **Task**: Students write what they want reviews to focus on. Gallery walk of draft of presentation media piece. Students then revise their presentations. **Assessment:** Tomorrow's presentation	Final Presentations Post Test	**Extra Day**: Depending on where more scaffolding may be needed, this day has been included as a day of reflection or an extention activity (possibly contact with another expert in the field of biomass and biofuesl).

- How will students be involved in decision-making regarding project details and demonstrations of their learning? Provide specific examples of areas in which students will be provided with voice and choice.
Students will be able to choose which variable they explore in their toothpick enzyme lab. Students will be given choices in terms of which reactions they complete in their experimentation. Students will be given choices in which mode they prefer to present their final product. This will allow student voice to be present. Whether students create a poster, audio recording, visual presentation, and video or some other presentation form, their voice will be present in the way they demonstrate their learning.

- How will you prepare students to take on project responsibilities?
This unit will be well into the school year. Therefore, 21st century skills will have been practiced and reinforced prior to the unit. This will be done through post-holes such as the moon-survival group activity or the broken circles group activity.

- How will you assure that students are learning important content?
The teacher will ensure that students are learning important content by asking questions during debriefing and at the end of each class. The teacher will also circulate the class while they are completing online research and their enzyme reaction labs. White circulating the teacher will ask questions to determine how well students understand the work they are completing. The rubric for the lab report and the rubric for the presentation will also ensure that students are including important content into work. Finally, the experiment and final product will go through at least one iteration. This ensures that students who did not demonstrate understanding of important content in the first trial will be able to demonstrate learning the second trial. If the second time does not show content understanding by students, additional homework may be assigned or conversations after class may be necessary.