

## Experimental Design and Planning: Claim, Evidence, Reasoning

Work with your group to come up with a research plan, including a question, biomass/treatment choices, initial claim, and argument to support the claim. Be prepared to communicate your plan with your instructor and class.

Research Question: What question are you hoping to answer with this experiment?

Biomass choice:

Cutting/grinding treatment:

Initial claim: Based upon your current knowledge and available evidence, what do you expect to happen in this experiment?

Evidence for claim: What specific knowledge, observations, or other information do you have to support your initial claim?

Justification: Explain how this evidence supports your claim.

## Revising your Initial Claim based upon New Evidence and Drawing Conclusions

You began this investigation with a research question, an initial claim, and a justification based upon your current knowledge and available evidence. After completing this investigation and reviewing the results, you should have quite a bit more evidence for evaluating and revising your initial claim.

Review your initial claim, evidence, and justification. What new evidence and information do you have from this investigation that can help you revise your claim and make a stronger argument? Use the table below to organize new information and evidence that relates to your research question and claim. Use additional pages if needed.

Lab Data (Glucose and Ethanol Changes)	Other Ideas (Prior Knowledge, Research, Class Discussion, Readings, etc.)

**Revised Claim** (based upon new evidence):

**Justification** (explain how new evidence supports your revised claim):

Be prepared to communicate the results, revised claim, and justification to the class. Questions, criticisms, and new evidence that you hear from your classmates and teacher can help you to further improve your claim and justification. Likewise, the results from your experiment can be helpful for other groups to revise their claims and better understand the process of converting cellulosic biomass to ethanol. As you discuss results as a class, take notes and record new evidence that you can use in your final lab report.

Scientists and engineers at the Great Lakes Bioenergy Research Center (GLBRC) use the same process to share and gather information as they investigate methods to make cellulosic ethanol. In frequent meetings and conferences they present new findings, discuss and critique scientific arguments and work together to answer questions and solve complex problems.

## Build a Scientific Argument: Claim – Evidence – Reasoning

Develop a reasoned argument that supports or refutes your initial claim. It is essential that you pinpoint specific evidence (numbers, times, concentrations, changes, etc.) and state how it directly relates to your claim. Evidence can be drawn from multiple sources, including the results from other lab groups. Use the previous activities as a guide to develop your argument.

Your response should also include the graphs that were created as a group. This portion of the lab should be completed individually. The guidelines below can help to create an effective scientific argument.

<b>*Claim *Evidence *Reasoning *Written Argument Guidelines</b>				
<b>Criteria</b>	<b>Excellent</b>	<b>Proficient</b>	<b>Basic</b>	<b>Emerging</b>
<b>Initial Claim</b>	<ul style="list-style-type: none"> <li>Initial claim uses concise scientific language to specifically address prompt.</li> <li>Main idea establishes a clear focus in an interesting and appealing manner.</li> </ul>	<ul style="list-style-type: none"> <li>Initial claim clearly demonstrates an understanding of the prompt.</li> <li>Main idea establishes clear focus for the paragraph.</li> </ul>	<ul style="list-style-type: none"> <li>Initial claim demonstrates a basic understanding of the prompt.</li> <li>Main idea shows some purpose and establishes basic focus for the paragraph.</li> </ul>	<ul style="list-style-type: none"> <li>Initial claim demonstrates a poor understanding of the prompt.</li> <li>Main idea shows little purpose and establishes poor focus for the paragraph.</li> </ul>
<b>Evidence</b>	<ul style="list-style-type: none"> <li>More than three pieces of evidence are expertly chosen to concisely and accurately support or refute the initial claim.</li> <li>Evidence and vocabulary demonstrate an excellent understanding of scientific principles.</li> </ul>	<ul style="list-style-type: none"> <li>Two pieces of evidence are specific and use scientific vocabulary to accurately and effectively support your claim.</li> <li>Evidence demonstrates a good understanding of scientific principles.</li> </ul>	<ul style="list-style-type: none"> <li>Two pieces of evidence are present and use some scientific vocabulary to support or refute the initial claim.</li> <li>Evidence demonstrates basic understanding of scientific principles.</li> </ul>	<ul style="list-style-type: none"> <li>There is poor or no evidence to support or refute the initial claim.</li> <li>Scientific vocabulary is missing or used improperly.</li> <li>Evidence demonstrates a poor understanding of scientific principles.</li> </ul>
<b>Reasoning/ Justification</b>	<ul style="list-style-type: none"> <li>Reasoning completely explains the application of the evidence to support or refute the initial claim.</li> <li>Transitions are used to create natural and effective flow of ideas between sentences.</li> </ul>	<ul style="list-style-type: none"> <li>Reasoning elaborates evidence, connecting back to support or refute the initial claim.</li> <li>Use of appropriate transitions between reasoning and next piece of evidence.</li> </ul>	<ul style="list-style-type: none"> <li>Some reasoning elaborates evidence, connecting it back to support or refute the initial claim.</li> <li>Moderately effective use of transitions between reasoning and evidence.</li> </ul>	<ul style="list-style-type: none"> <li>Reasoning absent or does not elaborate evidence or connect back to support or refute the initial claim.</li> <li>No transitions</li> </ul>
<b>Future Claims</b>	<ul style="list-style-type: none"> <li>The written argumentation ends with insights and questions that lead to future claims that can be investigated.</li> <li>Reasoning for the development of the future claims is included.</li> </ul>	<ul style="list-style-type: none"> <li>The written argumentation ends with insights and questions that lead to future claims that can be investigated.</li> </ul>	<ul style="list-style-type: none"> <li>The written argumentation ends with questions and a discussion of what went wrong in the learning sequence.</li> </ul>	<ul style="list-style-type: none"> <li>The written argumentation ends without any hint of uncertainty or further questions.</li> </ul>
<b>Conventions</b>	<ul style="list-style-type: none"> <li>Accurate spelling and word choice.</li> <li>Excellent use of varied sentence structure, abbreviations and symbols.</li> </ul>	<ul style="list-style-type: none"> <li>Accurate spelling</li> <li>Appropriate use of sentence structure, abbreviations and symbols.</li> </ul>	<ul style="list-style-type: none"> <li>Some spelling errors</li> <li>Some mistakes in sentence structure, abbreviations and symbols.</li> </ul>	<ul style="list-style-type: none"> <li>Many spelling errors</li> <li>Many mistakes in sentence structure, abbreviations and symbols.</li> </ul>