Literacy Design Collaborative

# Squirmy Science: Design Module for Ecology Unit

★ TASK ★ LADDER

by Claire Hampel, Peter DeWitt, Kelly M. Gaier Evans, and David Chase

*Adapted from "Battelle Design Module Template" by Kelly M. Gaier Evans and Peter DeWitt*

This module has been developed from the Battelle Design Module Template. The Squirmy Science module, which addresses life science standards, is for middle school students who are new to the design process. The class is taught within the context of a STEM school that has an eight-week science course. This eight-week course focuses on ecology and biology concepts including food chains, ecosystems, limiting factors, and characteristics of living things. The goals of this module are as follows:

- A clear understanding of the design process basics
- Working as a team to develop a model
- Considering the limitations to determine the best model
- Doing research to inform a design concept
- Testing a model to determine success
- Writing a full report of design with multiple design components
- A full understanding of ecosystems, food chains, and mealworms

Production is the essence of STEM education. Purposeful production is the definition of design. The Battelle Design Module Template is based on the process Battelle Memorial Institute engineers go through in designing and prototyping solutions to the world's problems and opportunities. This process has led to the Xerox machine, the CD, and countless other innovations! This module template is meant to be applied in a "real-world" manner—optimally driven by authentic partnerships with your community. Your community partner can help identify a need and parameters for the students' design, as well as then serving as an authentic audience for your students' work. There is a world of opportunities out there that is waiting for our students' design ability. Use this LDC module template to help the students scaffold and capture their design process with excellence.

Note: The Design Process requires that students already have the ability to test solutions in a controlled

manner (i.e., carry out a controlled experiment). It is advisable, therefore, that your students be relatively fluent in experimentation prior to completing this module. If your students do not yet have a sound foundation in experimentation, please see the Battelle Controlled Experiment Module Template. These modules are part of a three-part Battelle LDC Science Collection: Data Analysis, Controlled Experimentation, and Design. The series represents a continuum of skills that build upon each other.

| GRADES | DISCIPLINE | COURSE | PACING |
| --- | --- | --- | --- |
| **6 - 8** | **Science** | **Life Science: Get a Backbone** | **11 hr** |

# Section 1: What Task?

## Teaching Task

### Task Template BETA A - Argumentation

How can we most effectively create an ecosystem for mealworms? After reading the Request for Proposal (RFP), conducting background research on mealworms and mealworm ecosystems, and designing and testing a prototype, write a design report in which you describe your design and argue its effectiveness in meeting the requirements of the RFP and providing a superior ecosystem for mealworms. Support your response with evidence from your research. Include charts, tables, and/or illustrations to help convey your message to your readers. Identify any gaps or unanswered questions.

## Standards

### *Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects*

RST.6-8.1

Cite specific textual evidence to support analysis of science and technical texts.

WHST.6-8.4 **Focus**

Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

WHST.6-8.7 **Focus**

Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

WHST.6-8.9

Draw evidence from informational texts to support analysis, reflection, and research.

RST.6-8.2 **Focus**

Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.

WHST.6-8.1 **Focus**

Write arguments focused on discipline-specific content.

### *Next Generation Science Standards*

MS-LS2-1

Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

MS-LS2-4 **Focus**

Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

### *Next Generation Science Standards (NGSS Comprehensive)*

MS-PS1.SEP.1. **Focus**

Developing and Using Models - Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems.

## *Texts*

- **SquirmyScienceLDCProjectRFP.pdf**
- **Text List for Squirmy Science.docx**

## *Student Work Rubric - Argumentation Task - Grades 6-8*

| | Emerging | Approaches Expectations | Meets Expectations | Advanced |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| **Controlling Idea** | Makes an unclear or unfocused claim. | Makes a **general** claim **that addresses the prompt**, with an **uneven focus**. | Establishes and maintains a clear claim that addresses all aspects of the prompt. | Establishes and maintains a clear, specific, and credible claim that addresses all aspects of the prompt. |
| **Selection & Citation of Evidence** | Includes minimal details from sources. Sources are used without citation. | Includes **details, examples, and/or quotations** from sources that are **relevant to the claim**. **Inconsistently** cites sources. | Includes details, examples, and/or quotations from sources that are relevant to the claim and supporting ideas.<br>Consistently cites sources with minor formatting errors. | Includes well-chosen details, examples, and/or quotations from sources that support the claim and supporting ideas. Consistently cites sources using appropriate format. |
| **Development / Explanation of Sources** | Explanation of ideas and source material is irrelevant, incomplete, or inaccurate. | Explanation of ideas and source material is **minimal** or **contains minor errors**. | Accurately explains ideas and source material and how they support the argument. | Thoroughly and accurately explains ideas and source material, using reasoning to support and develop the argument. |
| **Organization** | Lacks an evident structure. Makes unclear connections among claim, reasons, and evidence. | **Groups ideas and uses some transitions** to connect ideas, with **some lapses in coherence or organization**. | Groups and sequences ideas to develop the controlling idea. Uses transitions to clarify the relationships among claim(s), reasons, and evidence. | Groups and sequences ideas logically to develop the controlling idea and create cohesion. Uses varied transitions to clarify the relationships among claim(s), reasons, and evidence. |
| **Conventions** | Major errors in standard English conventions interfere with the clarity of the writing.<br>Language or tone is inappropriate. | **Errors** in standard English conventions **sometimes interfere** with the clarity of the writing.<br>Uses language and tone that are sometimes inappropriate for the audience and purpose. | Consistently applies standard English conventions; minor errors, while noticeable, do not interfere with the clarity of the writing.<br>Uses language and tone appropriate to the audience and purpose. | Consistently applies standard English conventions, with few errors. Demonstrates varied syntax and precise word choice.<br>Consistently uses language and tone appropriate to the audience and purpose. |
| **Content Understanding (Generic)** | Attempts to include disciplinary content in explanation or argument but understanding of content is weak; content is irrelevant, inappropriate, or inaccurate. | Briefly notes disciplinary content relevant to the prompt; shows basic or uneven understanding of content; minor errors in explanation. | Accurately presents disciplinary content relevant to the prompt with sufficient explanations that demonstrate understanding. | Integrates relevant and accurate disciplinary content with thorough explanations that demonstrate in-depth understanding. |

## Background for Students

We have been studying food webs and looking at how changes in an ecosystem affect the living organisms in an environment. You will now be taking that knowledge and putting it to the test! In teams of three, you will research, plan, build, test, and evaluate an ecosystem for mealworms to live in for a week. As you develop your design, consider the needs of space, moisture, food, and air within the limits of the provided resources. Your goal is to see not only if they will live but also if they gain weight over the five days. Remember, your worms should be gaining weight as they move to their next life stage. Get your thinking caps on as you keep costs down while supporting life efficiently.

## Extension

Not provided

# Section 2: What Skills?

## Preparing for the Task

**TASK ENGAGEMENT**: Ability to connect the task and new content to existing knowledge, skills, experiences, interests, and concerns.

## Interpreting a Request for Proposals (RFP)

**UNDERSTANDING THE LIST OF REQUIREMENTS**: Ability to read, understand, analyze, and interpret a list of design requirements into a description or graphic representation of what a design solution must be able to do.

**UNDERSTANDING THE STATEMENT OF WORK IN LIGHT OF THE TIMELINE**: Ability to scale the scope of a project to fit the time available.

**SEEKING CLARIFICATION ON RFP**: Ability to identify gaps in understanding about either the design requirements or the statement of work and to then articulate those gaps in understanding as questions that can be answered by the organization or individual that has submitted an RFP.

## Creating Possible Solutions (Concept Design)

**BACKGROUND RESEARCH**: Ability to find designs that have been previously developed by others - and to glean useful information from the approaches they took.

**BRAINSTORMING POSSIBLE SOLUTIONS**: Ability to engage in a collaborative, creative process to brainstorm many possible solutions to an RFP.

**ANALYZING POSSIBLE SOLUTIONS (PROS/CONS)**: Ability to engage in theoretical, technical analysis of brainstormed, possible solutions in order to identify pros/cons of each solution - in reference to an RFP's list of requirements and scope.

## Preparing and Presenting a Proposal

**COMMUNICATING POSSIBLE SOLUTIONS**: Ability to condense possible solutions into a simple paper or presentation that presents one or more options and potential pros and cons of that (those) solutions.

**CONSTRUCTIVE FEEDBACK**: Ability to give and receive specific, constructive feedback on a design proposal in order to inform decisions of course for the rest of the design process.

## Detailed Design

**CLARIFYING SIZE, FORM, FUNCTION**: Ability to clearly design a solution and articulate that solution: "it looks like this . . ."

**TESTING CRITICAL DESIGN COMPONENTS**: Ability to test critical subsystems for feasibility.

**FINALIZING DESIGN**: Ability to incorporate critical component test results in order to adjust the design of subsystems (and overall design) as necessary in order to ensure final design solution adequately addresses the list of requirements contained in an RFP.

**CREATING A DATA TABLE**: Ability to determine how to write consistent and accurate data into an organized table during a scientific test.

## Design Report

**TITLE PAGE**: Ability to [illegible] with [illegible] identifying information

**TITLE PAGE**: Ability to make a title page with appropriate identifying information.

**EXECUTIVE SUMMARY**: Ability to write a brief, comprehensive, and accurate summary of an issue/need and designed solution to that need.

**GRAPHIC OF OVERALL DESIGN**: Ability to generate a graphical representation (photograph, drawing, CAD rendering, etc.) of an overall design solution in order to orient the reader to the components of the solution.

**DETAILED DESIGN INFORMATION**: Ability to communicate (with words and graphics) the details of a design solution and how it is built/executed.

**DEFENSE OF DESIGN**: Ability to clearly articulate (using evidence) how the design solution meets the original design requirements as laid out in the RFP.

**APPENDIX**: Ability to organize and communicate all technical reports, data from sub-system test reports, specific experimental protocols, etc. into an easy-to-navigate appendix to be used by the reader as needed.

# Section 3: What Instruction?

| PACING | SKILL AND DEFINITION | PRODUCT AND PROMPT | SCORING GUIDE | INSTRUCTIONAL STRATEGIES |
|---|---|---|---|---|
| ***Preparing for the Task*** | | | | |
| *25 mins* | **TASK ENGAGEMENT**: Ability to connect the task and new content to existing knowledge, skills, experiences, interests, and concerns. | **MEALWORM QUESTIONS AND OBSERVATIONS LIST** Write 10 observations about the mealworm.<br><br>Write 10 questions about mealworms. | Work that meets expectations includes:<br>• 10 qualitative observations about the mealworm<br>• 10 questions about the mealworm. | 1. Place mealworms on tables so that as students come in they will see the worms.<br>2. Place magnifying glasses on the tables.<br>3. Have them write down 10 observations of the bug in their notes.<br>4. Share out their observations with the class and write a group list on the board or giant Post-it.<br>5. Give students time to write a list of at least 10 questions about the mealworm they have in their notes.<br>6. Share out their questions and record the questions of the class on the board or a giant Post-it. |
| | Standards:<br><br>Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.<br>**SL.7.1** : Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly. | | | |
| *15 mins* | **TASK ENGAGEMENT**: Ability to connect the task and new content to existing knowledge, skills, experiences, interests, and concerns. | **LISTING ENGINEERED PRODUCTS AROUND US** List products that you see in the room that have been engineered and explain the importance of engineering in our world. | Work that meets expectations includes:<br>• Five things in the room that have been engineered. | 1. Project the slideshow in the room for students to see.<br>2. Have students write down some ideas for what is engineered in the room.<br>3. Share out their ideas of what has been engineered.<br>4. Advance to slide 2 where a pictorial of fields engineers work in can be found.<br>5. Explain that engineering is everywhere and that is why we are going to practice the engineering process with a project on mealworms. Explain that engineering is essential to solving problems, developing technology, and building new ideas.<br>6. Students will write on a Post-it why they think engineering is important as an exit ticket. |
| | Additional Attachments:<br><br>**LDC Engineering Slides.pptx** | | | |
| ***Interpreting a Request for Proposals (RFP)*** | | | | |
| *35 mins* | **UNDERSTANDING THE LIST OF REQUIREMENTS**: Ability to read, understand, analyze, and interpret a list of design requirements into a description or | **VISUAL OF PROJECT PROPOSAL** Read and understand the requirements of the proposal.<br><br>Know your group members and assign | The proposal summary/picture will be evaluated with the following criteria:<br><br>Correctly identifies the task, constraints, materials, products, | 1. After the task engagement from the previous day, students will read through the first page of the project proposal as a class. (I suggest just projecting through the due dates and showing them the other parts at another time to prevent them from being overwhelmed.)<br>2. Students will be placed into their groups of three by the teacher who will prepare the group lists |

| | | | | |
|---|---|---|---|---|
| | graphic representation of what a design solution must be able to do. | roles.<br><br>With your group, write/draw a brief summary of the proposal. | team role, and final due date. | ahead of time, making heterogeneous groups.<br>3. As a team, students will write or draw a picture to symbolize the task, constraints, materials, and products of the proposal in order for the teacher to check for understanding.<br>4. Teams will share out their pictures or read their summary to help clarify the task for all students and have time for questions to be answered. |
| | Additional Attachments:<br><br>**ScoringRubricSquirmyScience 2015.12.21.docx**<br>**FinalReportRubricSquirmyScience (1).docx**<br>**SquirmyScienceLDCProjectRFP.pdf** | | | |
| *10 mins* | **UNDERSTANDING THE STATEMENT OF WORK IN LIGHT OF THE TIMELINE**: Ability to scale the scope of a project to fit the time available. | **CREATING A TIMELINE**<br>Based on the requirements of the project, think about the necessary timeline for completing the project on time. Discuss the timeline with your peers and make decisions about due dates for important parts of the project. | Project calendar that includes all the due dates. | 1. Students will get out their agenda books/online calendars.<br>2. Students will be asked about the timeline of the project. Have a discussion with students about how long each element should take, looking at the requirements of each product that has to be turned in.<br>3. Set due dates, giving students some choice (maybe choosing from two dates) when they think they would prefer to turn in a certain aspect of the project—making them feel a part of the project and giving them some control over the due dates.<br>4. Have students write out the final decisions made by the class for due dates.<br>5. Post the class due dates on the class website or on a poster in the room to help reinforce due dates.<br>6. Talk to students about real-life consequences of engineers not completing things on time.<br>7. Explain consequences for not doing their work and the effect of that on their group members.<br>8. Walk around/initial to check that all students wrote down the due dates. |
| *10 mins* | **SEEKING CLARIFICATION ON RFP**: Ability to identify gaps in understanding about either the design requirements or the statement of work and to then articulate those gaps in understanding as questions that can be answered by the organization or individual that has submitted an RFP. | **ENTRANCE TICKET**<br>After having a day to think, write at least one question or an aspect of the project that needs clarification on a Post-it note. | Post-it note should include at least one quality clarifying question about the project. | 1. Set out Post-it notes on tables.<br>2. Write down the prompt on the board or on a slide.<br>3. Have students bring up their question to place on a specific spot in the room.<br>4. Read out the questions and answer them to ensure clarification of the question.<br>5. Give time for additional questions as needed. |
| ***Creating Possible Solutions (Concept Design)*** | | | | |
| *1 hr and 10 mins* | **BACKGROUND RESEARCH**: Ability to find designs that have been previously | **RESEARCHING MEALWORMS**<br>Read online articles and resources that will answer | Student work meets expectations if:<br><br>● The notes sheet is | 1. Review the research questions that need to be answered in the background research paper on the project proposal sheet. |

| | | | |
|---|---|---|---|
| developed by others - and to glean useful information from the approaches they took. | research questions for the project.<br><br>Write detailed notes to answer all the research questions in the graphic organizer provided. | complete and accurate<br>• The research paper explains concepts in each section with details, full answers, and sources listed. | A. Ecology: Paragraph 1<br>○ What is ecology?<br>○ What is an ecosystem?<br>○ What food chain could you create in your container for the mealworms?<br>○ What are the abiotic and biotic factors in the ecosystem you are designing?<br>○ What would happen if one thing in the ecosystem changed?<br><br>B. Mealworms: Paragraph 2<br>○ What is a mealworm?<br>○ How does it fit into the invertebrate family?<br>○ What is their life cycle?<br>○ Describe the anatomy of a mealworm.<br><br>C. Mealworms in their environment: Paragraph 3<br>○ Where in the world can mealworms be found?<br>○ How do they obtain energy?<br>○ Where do they fit in a forest food web? (Describe who their predators are.)<br>○ What special traits do mealworms have that help them survive?<br><br>2. Hand out/share with students the graphic organizer notes sheet and explain what information should go in each column.<br><br>3. Have students move into their project groups so that they can collaborate.<br><br>4. Instruct students that each one of them is responsible for completing a notes sheet graphic organizer but that when writing the research paper they can each choose a paragraph they want to write.<br><br>5. Give students class time or homework time to complete this research report.<br><br>Note: Students are expected to find articles on their own. Students built this skill (finding and evaluating credible sources) earlier in the year. |

Standards:

**MS-LS4-4** : Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.

**MS-LS2-2** : Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

**WHST.6-8.9** : Draw evidence from informational texts to support analysis, reflection, and research.

**WHST.6-8.8** : Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.

**WHST.6-8.7** : Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

**RST.6-8.10** : By the end of grade 8, read and comprehend science/technical texts in the grades 6—8 text complexity band independently and proficiently.

**RST.6-8.8** : Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.

Additional Attachments:

**Group research sample Mealworm Research Paper - Google Docs.pdf**

| | | | | |
|---|---|---|---|---|
| | **Student group research - Report of Mealworms - Google Docs.pdf**<br>**Sample student Background Research Notes Sheet - Google Docs.pdf**<br>**Student sample Background Research Notes Sheet - Google Docs.pdf**<br>**SquirmyScienceLDCProjectRFP.pdf**<br>**SquirmyScienceLDCProjectRFP.pdf**<br>**ScoringRubricSquirmyScience.docx**<br>**BackgroundResearchNotesSheet.docx** | | | |
| *30 mins* | **BRAINSTORMING POSSIBLE SOLUTIONS**: Ability to engage in a collaborative, creative process to brainstorm many possible solutions to an RFP. | **BRAINSTORM PAGE**<br>Write down an entire page of possible solutions for the design of your ecosystem, listening effectively to each of your group members. | The page of possible solutions meets expectations if it includes all ideas, even if not especially realistic, applying the practice of saying "yes, and" instead of "yeah, but." | 1. Explain to students the rules of this demonstration about how to brainstorm.<br><br>Prompt: Your team is planning a party. Have one person start out with an idea for your hypothetical party.<br><br>Round 1: **YEAH, BUT...** After the first person has an idea for the party, their team members can only say, "yeah, but..." in response to their idea. The original party planner continues to give ideas for the party while the other two members state reasons their idea won't work starting with the words, "Yeah, but..."<br><br>2. After three minutes stop the round and explain round 2.<br><br>Round 2: **YES, AND**: Another team member starts with an idea for the party. Team members can only start sentences with, "Yes, and...." in response to their party idea. Everyone continues to build off of that one idea, all adding to the party.<br><br>3. Call students back together after three minutes and draw some conclusions:<br><br>● Ask how it felt to have your ideas shot down.<br>● Ask what felt different in the group when people started to say yes.<br><br>More thoughts you can share: In a brainstorming session, people have to say yes. Ideas need a yes environment in order to grow. Just as in improvisation, brainstorming sessions need a "Yes, and..." rather than "Yes, but..." set up. "Yes, but" is a fancy term for idea deflection.<br><br>What is Yes, and? **Yes** is the acceptance of the idea. **And** is the building upon that idea. All brainstorming needs a spirit of yes to work. No, you won't keep all the ideas you or your employees come up with, but you will be surprised where "Yes, and" can take you.<br><br>4. Have students think about the squirmy science project and write an entire page of ideas using the principle of "Yes, and."<br><br>5. After 12-15 minutes, have students circle their top five ideas on their paper. |
| | Standards:<br><br>**SL.6.1** : Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. | | | |

| | | | | |
|---|---|---|---|---|
| *30 mins* | **ANALYZING POSSIBLE SOLUTIONS (PROS/CONS)**: Ability to engage in theoretical, technical analysis of brainstormed, possible solutions in order to identify pros/cons of each solution - in reference to an RFP's list of requirements and scope. | **SQUIRMY SCIENCE DECISION MATRIX**<br>Analyze your top designs by ranking the criteria for each in a decision matrix. | Student work will include the following:<br>• Complete the worksheet attached.<br>• Complete decision matrix for students' top design ideas. | 1. Briefly talk to students about what engineers have to think about when designing a product. Then ask students what are the qualities of a good product in this engineering design.<br>2. Have students get into their groups and explain the worksheet directions, modeling an example on the board.<br>3. Give students time to fill out the decision matrix for their top five choices from their brainstorming list.<br>4. Sign each worksheet to show they were completed. |
| | Standards:<br>**ETS1.A:1.** : The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1) | | | |
| | Additional Attachments:<br>**decision matrix student work.pdf**<br>**ScoringRubricSquirmyScience.docx**<br>**SquirmyScienceDecisionMatrix.docx** | | | |
| ***Preparing and Presenting a Proposal*** | | | | |
| *35 mins* | **COMMUNICATING POSSIBLE SOLUTIONS**: Ability to condense possible solutions into a simple paper or presentation that presents one or more options and potential pros and cons of that (those) solutions. | **PROJECT PROPOSAL WORKSHEET**<br>Fill out a template for your top choice in preparation for a conference with the teacher. | To meet expectations, the proposal worksheet should:<br>• Be detailed, showing thoroughness of thought, cost analysis skills, and innovation in their top design choice<br>• Include a justification that references and cites student research. | 1. Have students get in their groups and hand out the design proposal sheet.<br>2. Explain that throughout the next couple of days their group will be called back to propose their work to you. However, today they are going to finalize their proposal and evaluate each others' proposals (see next mini-task, Sharing Constructive Feedback on Project Proposals).<br>3. Walk through the parts of the worksheet, answering questions as you go.<br>4. Students should have a pretty clear idea of their design from the previous activities, so as soon as they are ready they can begin filling out the proposal sheet. |
| | Additional Attachments:<br>**Proposal Sheet student work samples.pdf**<br>**DesignProposalSheetSquirmyScience.docx** | | | |
| *35 mins* | **CONSTRUCTIVE FEEDBACK**: Ability to give and receive specific, constructive feedback on a design proposal in order to inform decisions of | **SHARING CONSTRUCTIVE FEEDBACK ON PROJECT PROPOSALS**<br>First, read your peers' proposal handout. Next, write at least two | Students meet expectations if they:<br>• Provide feedback on peers' designs by writing at least two constructive | **Teacher note:** Students should have some experience with providing peers with written feedback prior to teaching this mini-task. Also, this mini-lesson assumes students have started planning for a long-term project and completed a project proposal. Some possible project proposal templates are included under Student Resources. For additional background |

| | | | | |
|---|---|---|---|---|
| | course for the rest of the design process. | constructive comments about your peers' design on sticky notes. | comments on sticky notes<br>● Produce constructive comments that are substantial, related to the assignment objectives, and provide a question or idea. | lesson ideas, see the **Decision Making Practice mini-task** linked below under Teacher Resources.<br><br>**Modeling and Guided Practice:**<br><br>1. Ensure all partnerships and groups have completed their project proposal and have it on hand.<br><br>2. Explain that throughout the next couple of days their group will be called back to propose their work to the teacher. However, today they are going to **evaluate** each other's proposals in order to get ideas on how to improve their plans.<br><br>3. Create a t-chart on the board and ask students, *"What is the difference between a **comment** and a **constructive comment**."* Depending on student responses and interests, it could be helpful to draw an analogy to social media comments. You might say: *I heard some students talking about the upcoming school dance. One of them posted some photos of ideas for a possible school dance theme and shared it with the school dance planning committee using social media. One student wrote a response to the picture saying, "I disagree that we should have a pirate theme" (**a comment).** Another student wrote, "I like the pirate theme, but I heard that the neighboring middle school had a similar theme for their dance a few weeks ago and some of our students may have attended. Given that one of our goals for this dance is innovation, would it be possible to consider a Treasure Island theme instead?" (**a constructive comment**).*<br><br>4. Call on students to share examples of the difference between the two. Explain that today students will practice writing at least **two** constructive comments (i.e., ideas that are helpful and give a potential question or idea to the other group). Depending on your students' background knowledge and what is shared during the discussion, you might say: **Comments** are often about a writer's likes or dislikes, or are commands to another writer—delete this word, or add more information about ____. However, strong peer editors usually go beyond just writing their opinions and give specific feedback to their peers after thinking about the specific task and goals of the assignment. Typically, **constructive comments** are considered helpful because they are related to the project goals (i.e., I wonder if we should push back the date of the dance given that we will need to design Treasure Island-themed decorations).<br><br>5. If students need additional modeling, offer some examples and sentence starters:<br><br>**What constructive feedback looks like:**<br><br>● *I like____; however,____.*<br>● *It seems helpful how you ____; I wonder what ____.*<br>● *It is interesting how you _____. Have you considered adding/removing/changing _____ in* |

| | | | | |
|---|---|---|---|---|
| | | | | *order to _____?*<br><br>**What constructive feedback does NOT look like:**<br><br>(One of the following in isolation.)<br><br>● *Don't____.*<br>● *Remove ____.*<br>● *Great job!*<br><br>6. You may also consider creating a "mock" project proposal, and go through the process of writing constructive comments on sticky notes for this proposal. Either way, it is important to share some sort of criteria—for example, a rubric.<br><br>**Student Practice:**<br><br>1. Switch the teams' proposals and have them write on sticky notes to make at least two comments for the other group.<br><br>2. When they are finished, they can pass the paper back to the group and discuss the comments of their peer edit.<br><br>**Closing:**<br><br>1. Ask groups/partnerships to share one piece of helpful feedback they received.<br><br>2. Give students time either in class or as homework to revise their project proposals to incorporate the feedback they received. |
| | Standards:<br><br>**SL.7.1.C** : Pose questions that elicit elaboration and respond to others' questions and comments with relevant observations and ideas that bring the discussion back on topic as needed.<br>**WHST.6-8.5** : With some guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on how well purpose and audience have been addressed. | | | |
| | Additional Attachments:<br><br>**Sample Design Proposal Sheet .docx**<br>**Sample Design Proposal Sheet Version 2**<br>**Decision_Matrix**<br>**Decision Matrix Practice Mini-Task**<br>**Sample Design Proposal Sheet with Example.docx** | | | |
| *1 hr* | **CONSTRUCTIVE FEEDBACK**: Ability to give and receive specific, constructive feedback on a design proposal in order to inform decisions of course for the rest of the design process. | **TEACHER SIGNATURE OF PROPOSAL**<br>Meet with teacher to gain constructive feedback on your team's design.<br><br>Modify your design based on teacher feedback. | A presentation which meets expectations to move forward will include:<br><br>● A list of materials being used<br>● Project costs within the $25 budget<br>● Justification for | 1. As students are doing other work for class, call back student groups one at a time and have them present their design proposal to you.<br><br>2. Evaluate their design by talking through the materials they are using, their costs, and the effectiveness of their design.<br><br>3. Sign off on all groups that have thought through their design and are ready to build. Tell groups that |

| | | | | |
|---|---|---|---|---|
| | | | why the design should be effective. | aren't ready to go back and consider your comments.<br><br>**It should take no more than 10 minutes per group or about an hour total depending on the number of groups you have. |
| | Additional Attachments:<br><br>**DesignProposalSheetSquirmyScience.docx** | | | |
| ***Detailed Design*** | | | | |
| *35 mins* | **CLARIFYING SIZE, FORM, FUNCTION**: Ability to clearly design a solution and articulate that solution: "it looks like this . . ." | **DETAILED DESIGN DRAWING**<br>Draw a neat, precise, detailed diagram of your team's final design.<br><br>Describe your team's design in three to four sentences. | See attached rubric.<br><br>Drawings that meet expectations include:<br><br>● A neat, precise, and detailed drawing of their final product that demonstrates a full understanding of the team's building design<br>● A brief description that includes the size/dimensions of the design and the function of each of the materials. | 1. Have students get into their groups to first write a brief description of why they chose the design they did as a team. This just has to be a short three to four sentences including anything they changed based on our meeting. The description should include the size of the design and the function of the various materials.<br><br>2. Show students some sample pictures of diagrammed drawings as examples of what they will be creating.<br><br>3. Next, pass out paper or students can work on computers for their individual drawings showing the form of their design.<br><br>4. Instruct students to keep their drawings to turn in with their final design report. |
| | Standards:<br><br>**ETS1.A:1.** : The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1) | | | |
| | Additional Attachments:<br><br>**Detailed Design Drawing student work.pdf**<br>**ScoringRubricSquirmyScience 2015.12.21.docx**<br>**closed-ecosystem.gif** | | | |
| *20 mins* | **TESTING CRITICAL DESIGN COMPONENTS**: Ability to test critical subsystems for feasibility. | **MEASURING MATERIALS SELECTED**<br>Measure out materials and evaluate the amounts for your habitat.<br><br>Place one mealworm on your bedding material of choice to observe activity.<br><br>Take notes on your measurements and what you observe. | Notes should be detailed and include any problems students foresee and any changes that are discussed. | 1. Set out all the materials for the habitat design.<br><br>2. Talk to students about the purpose of micro-testing before they build. Engineers test out their subsystems to ensure that no materials or time are wasted. Small tests will be the last chance to change the design before building the prototype.<br><br>3. Have groups measure out the materials necessary for their design, as listed in their proposal sheet and diagram. (All materials can be gathered except the number of mealworms they want.)<br><br>4. Once they have all the materials selected, students will talk as a group as to whether or not they see any issues with the amounts they have. |

| | | | | |
|---|---|---|---|---|
| | | | | 5. Next, groups will be given one mealworm to place on the bedding of their design.<br><br>6. Students will observe the mealworm for any foreseeable problems with their design and discuss any changes that need to be addressed. Instruct students to take detailed notes of any problems they foresee and any changes that are discussed. |
| | Standards:<br><br>**ETS1.B:1.** : A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) | | | |
| *10 mins* | **FINALIZING DESIGN**: Ability to incorporate critical component test results in order to adjust the design of subsystems (and overall design) as necessary in order to ensure final design solution adequately addresses the list of requirements contained in an RFP. | **FINAL DESIGN PROPOSAL**<br>Change the design proposal sheet to reflect the final design amounts for building. Include your notes on why specific changes were made. | The design proposal sheet meets expectations if it is updated to reflect any changes made for the final design. The proposal sheet should also include detailed notes on why changes were made from the original design to the final design. | 1. After seeing all the materials laid out and testing the mealworms' reaction to the bedding material, teams will fill out a new proposal sheet. |
| | Additional Attachments:<br><br>**DesignProposalSheetSquirmyScience.docx** | | | |
| *1 hr* | **FINALIZING DESIGN**: Ability to incorporate critical component test results in order to adjust the design of subsystems (and overall design) as necessary in order to ensure final design solution adequately addresses the list of requirements contained in an RFP. | **ECOSYSTEM FOR MEALWORMS**<br>Using your final design proposal, carefully measure out each of your materials (as practiced last week). Build your mealworm ecosystem, taking notes and pictures to document the process. Be sure to also take a picture of your final design. | Ecosystems which meet expectations:<br><br>• Address the requirements contained in the RFP (completed within budget; include essential elements of moisture, bedding, air/temperature, and space)<br>• Follow the final design proposal. | 1. Set out all the materials for the habitat design.<br>2. Instruct students that as each item goes on sale, students will be able to purchase their materials. Water and mealworms will be sold last.<br>3. Have groups measure out the materials necessary for their design (as practiced last week), as listed in their proposal sheet and diagram.<br>4. Once groups have measured out their materials, they may begin building their designs as proposed. Instruct students to document their building process, taking notes and pictures of various building stages.<br>5. After prototype has been built, students may purchase their mealworms and place them into their ecosystem.<br>6. Note: Once their ecosystem is built, students will make observations and record their first set of data. Please reference the “making a data table” mini-task. |
| *55 mins* | **CREATING A DATA TABLE**: Ability to determine how to write consistent and accurate data into an organized table during a scientific test. | **MAKING A DATA TABLE**<br>Create a data table that the group will use to record observations of the habitat.<br><br>Daily: Make observations and record data in data table. | The data table template meets expectations if it includes detailed observations in table format for each day of the experiment. | 1. Get students into their teams and share or hand out the data table template.<br><br>2. Ask the students what should be monitored and recorded during the week to determine the success of our experiment?<br><br>3. Fill in the categories as a class so that everyone is recording the same data. |

| | | | | |
|---|---|---|---|---|
| | | | | 4. Ask for a group to volunteer to share their ecosystem observations with the full class. Use the volunteer groups' ecosystem to demonstrate how students will record data in their table. Instruct all groups to make observations and record.*<br><br>5. Circulate the room while students are working asking students to explain how they collected their data.<br><br>6. Have students keep their sheet since it will be the appendix of the final report.<br><br>*ONGOING: This full mini-task will take about 15 minutes on the first day, but then students will continue to collect data throughout the week. If you have students build their ecosystems on a Monday, they may collect data Monday-Friday. Each day will require about 10 minutes for students to find their ecosystems, make observations, and record their data. |
| | Additional Attachments:<br><br>**SquirmyScienceDataTable.docx** | | | |
| ***Design Report*** | | | | |
| *15 mins* | **TITLE PAGE**: Ability to make a title page with appropriate identifying information. | **CREATING A TITLE PAGE**<br>Create a title page that is appropriate in formatting and content for your design group. | A completed title page with:<br><br>● 12 pt font<br>● Times New Roman font<br>● Running header<br>● Names of group members<br>● Title of paper<br>● School name. | 1. Give students a sample APA title page and ask them what they think needs to be on a proper title page.<br>2. Write on the board the list they come up with.<br>3. Have them open a document on their computers and create their groups' title pages or write them on paper.<br>4. Trade their title pages with another group for a quick check of their title page. |
| | Additional Attachments:<br><br>**OWL title page requirements** | | | |
| *40 mins* | **EXECUTIVE SUMMARY**: Ability to write a brief, comprehensive, and accurate summary of an issue/need and designed solution to that need. | **WRITING YOUR EXECUTIVE SUMMARY**<br>Describe your project and findings to someone outside of your group in 30 seconds. | The executive summary meets expectations if it is a brief (two paragraphs), comprehensive, and accurate summary of the project assigned and the design solution created by assigned student group. | 1. Review with students the rubric for the final design report. Read through all of the sections.<br><br>2. Tell students that we are going to practice for writing the executive summary by talking about it.<br><br>3. Reiterate that students only have 30 seconds to explain their entire project. Have them write down five words on a Post-it note that will prompt them to fit in all parts of the project in 30 seconds. (If they need help, some words to write down could be initial, change, tested, results, learned.)<br><br>4. Pair them with one other person who is not in their design group.<br><br>5. Have them tell their partner a summary of their project in just 30 seconds. |

| | | | | |
|---|---|---|---|---|
| | | | | 6. Then have them switch and have the other person try to summarize in 30 seconds.<br><br>7. Have students return to their seats and write down the key elements of an executive summary for your class (refer to rubric).<br><br>8. Assign writing the executive summary with the group and give work time if possible. |
| | Standards:<br><br>**SL.7.2** : Analyze the main ideas and supporting details presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how the ideas clarify a topic, text, or issue under study. | | | |
| | Additional Attachments:<br><br>**FinalReportRubricSquirmyScience (1).docx** | | | |
| *10 mins* | **GRAPHIC OF OVERALL DESIGN**: Ability to generate a graphical representation (photograph, drawing, CAD rendering, etc.) of an overall design solution in order to orient the reader to the components of the solution. | **SELECT FINAL DRAWINGS**<br>Select the group member's drawing that best represents the final design of your habitat. | None. | 1. Have all students get out their initial design drawings and have them discuss which one they want to include in the final report. |
| *10 mins* | **DETAILED DESIGN INFORMATION**: Ability to communicate (with words and graphics) the details of a design solution and how it is built/executed. | **TYPING UP/INSERTING DRAWING DESCRIPTION**<br>Type up or edit your initial design description and format into the final design report. | The brief description is two to three sentences in length and describes in detail the design solution and the materials used. | 1. Give students time to edit their initial design description and type it up to insert into report on the page after the graphic.<br><br>2. Check on student progress up to this point. They should have the title page, executive summary, graphic, and description completed. |
| | Standards:<br><br>**WHST.6-8.2** : Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. | | | |
| *35 mins* | **DEFENSE OF DESIGN**: Ability to clearly articulate (using evidence) how the design solution meets the original design requirements as laid out in the RFP. | **DEFENSE OF DESIGN**<br>Write two to three paragraphs on how your design solution meets the design requirements. Use at least three sources from the background research to support your design decisions. | Defense of design meets expectations if it includes:<br><br>• Two to three paragraphs on how the design solution met the design requirements<br>• At least three sources from the background research to support design decisions. | 1. Explain the defense of design by reading through the rubric criteria.<br><br>2. Create a t-chart on the board with the word "claim" on one side and the word "support" on the other. Write up an example claim: "We chose to put in the apple slice because it would keep the moisture in the habitat and meal worms need moisture." Support: "...mealworms need to get their water from something solid, like a vegetable. Put slices of carrot, celery, potato, or green pepper (or any other fruit or vegetable) on top of their bedding" (Abigale's Edibles).<br><br>3. Have students work with their team to write another claim and support specific to their design. |

| | | | | |
|---|---|---|---|---|
| | | | | 4. Share out with the class their examples and write on the board for other groups to use if applicable.<br><br>5. Ask students how they might reference back to their graphic and their data table in the defense of design. Give students a few minutes to work as a team to incorporate either their graphic or their data table. Ask students to share out and add to the examples on the board.<br><br>6. Give students work time to use more of their research to write the defense of design as a team.<br><br>** If your students don't know how to do in-text citations you will need more instruction here. |
| | Standards:<br><br>**WHST.6-8.9** : Draw evidence from informational texts to support analysis, reflection, and research. | | | |
| *15 mins* | **APPENDIX**: Ability to organize and communicate all technical reports, data from sub-system test reports, specific experimental protocols, etc. into an easy-to-navigate appendix to be used by the reader as needed. | **DATA TABLE**<br>Type up your data table and format into the design report. | Appendix meets expectations if it includes a data table with detailed observations in table format for each day of the experiment. | 1. Show students how to create a table on Google Docs and format the page to nicely fit all the data.<br><br>2. Instruct students to type up their data and insert into final report document. |
| | Standards:<br><br>**MS-ETS1.SEP.3.1.** : Analyze and interpret data to determine similarities and differences in findings. (MS-ETS1-3) | | | |

## *Instructional Resources*

### *Teacher Resource*

**VIDEO: LDC Design: Full Module Deep Dive**

# Section 4: What Results?

## Student Work Samples

### Approaches Expectations

- Sample 1 squirmy science.pdf
- Sample 2 squirmy science.pdf

### Meets Expectations

- Sample 3 squirmy science.pdf

## Teacher Reflection

**Did students perform better or worse than you expected?**

Students did better than I had expected. They really understood the design process through this task. This also brought to life the concept of limiting factors for students. They were very motivated by the task and really enjoyed working on it due to the live creatures.

**Were there parts of the rubric that all students seemed to do well on?**

Students did well on sections of the rubric that were modeled in class. We had limited class time so the things I spent more time on, they did better on. While this is not surprising, I think there is a line between modeling and copying from the teacher. I think they were challenged to write the conclusion and to consider future testing.

**Were there parts of the rubric that all students struggled with?**

The part of the rubric that students struggled with was incorporating research appropriately and using data to support their conclusions. These are two areas we need to work on with students as they progress toward their work in high school and beyond.

**If you were to re-teach this module, which parts of your instructional ladder would you definitely keep and what parts would you consider replacing or modifying?**

I really liked the introduction day, asking questions about the mealworms. It was memorable and thought-provoking for students. I would also keep the in-class build day, project proposal sheet, and the gathering data work. All areas were effective, but the challenge was really in time. I would also modify the rubric to be more specific in what they needed to incorporate.

**Anything else that comes to mind that you would change for next time?**

I would say this is a great project for younger students or students who have never written scientifically before. The content is more basic and therefore is easier for them to write about and comprehend. This led to better practice of writing scientific reports and helped my students push their writing abilities.

If a teacher was just wanting to try some of this module then I might suggest doing just the research notes and writing the group background paper. Students always need help doing effective research that will inform

decisions.

Also to save on materials and time, I might suggest having all teams propose a solution and just one being created to test. This would speed things up as well! Happy Squirming.

## *All Attachments*

- SquirmyScienceLDCProjectRFP.pdf : https://s.ldc.org/u/1bbnshb8xv0aaiu8twtqqctea
- Text List for Squirmy Science.docx : https://s.ldc.org/u/di8p60of2p1iykggizk92evb
- Sample 1 squirmy science.pdf : https://s.ldc.org/u/8vlydstr75uv37yyl5g61tin
- Sample 2 squirmy science.pdf : https://s.ldc.org/u/1hvgcqypjafruve4fprf1mn1a
- Sample 3 squirmy science.pdf : https://s.ldc.org/u/4dctagf2zgopg9v8bscc29a9y
- VIDEO: LDC Design: Full Module Deep Dive : https://s.ldc.org/u/4aebejiee85n1gk7oijqhnq9s