

Destination 2017: Education for Sustainability Lesson Plan

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Campus: West

Discipline: Mathematics

Week 1

1. Course Prefix and Name (select a course you wish to incorporate sustainability, ex: *ENC 1101*):
 - a. MAC 1105

2. Needs Assessment
 - a. What is the CIM [course outcome](#) that you plan on teaching during your sustainability-focused lesson?
 - i. Solve algebraic statements
 - ii. Read in a mathematical context

 - b. What is a particular lesson, activity, or unit you already use that you wish to incorporate sustainability? Or, if you will be creating a new lesson, which concepts might align with sustainability?
 - i. I will use an adjusted homework assignment to include problems that introduce sustainability topics and calculations.
 - ii. I will create a new special assignment that is more like a learning module which includes slides, YouTube videos, and problem solving that addresses certain sustainability topics.

 - c. What [sustainability topic](#) might it cover?
 - i. Population growth
 - ii. Carrying capacity
 - iii. Biodiversity (habitats, overfishing)
 - iv. Resource consumption (overuse, waste)
 - v. Climate change

For more resources see,

- Sample Valencia lesson plans ([English](#), [New Student Experience](#), [Mathematics](#)),
- [Tips on integrating sustainability into existing courses](#)
- [Arizona State University's archive of sustainability lesson plans](#)

Week 2

3. Student Learning Outcomes

What is your end learning goal with the lesson? What should the [students be able to do/understand/care about](#)?

- a. Solve an algebraic equation, including exponential and logarithmic, that illustrates approximations to the sustainability topics of this lesson (population growth, carrying capacity, biodiversity, resource consumption, and climate change).
- b. Translate a sustainability topic situation being considered into a mathematical statement (algebraic equation) to be solved, utilizing domain and range conditions where necessary.
- c. Translate a solved algebraic equation into English, and interpret the solution with respect to the sustainability topic situation being considered.
- d. Demonstrate an understanding of the sustainability topics addressed.

Week 3

4. Lesson Title:

- a. "World-Based Math Problems for Sustainability"

5. Lesson Summary:

- a. This lesson includes screencasts and resource material to introduce to you some of the key topics of sustainability, along with explanations and examples of how to connect mathematics to sustainability issues. After having reviewed the sustainability resources, you will be asked to take a short online quiz to make sure you have some understanding of sustainability. Then, there will be a set of math problems to solve related to the sustainability topics. The instructions will be clear as to what is expected, and how your solutions will be graded. Finally, there will be an exit quiz to assess your understanding of how mathematics can be used to answer sustainability questions and help address sustainability issues. As a final assessment, a report will be written that demonstrates the use of mathematics to study and analyze a sustainability scenario, and demonstrates the communication of the analysis and problem solving to a wider audience.

6. Lesson Overview/Background:

- a. How will your lesson connect to the [3 pillars of sustainability](#): environmental, social, and economic issues?
 - i. The screencasts and resource materials will address these pillars in terms of background information, and in terms of mathematical problems, idealized if necessary, that relate to the sustainability topics that impact these pillars.
- b. How will your lesson address at least one of the [5 key concepts](#)?
 - i. This lesson has the potential to address the key concepts of scale, long term development, and tradeoffs. Scale can be addressed by using equations to predict outcomes for input parameters that take on varying degrees of geographic scale. Long term development can be addressed similarly to scale, but from a time perspective.

Tradeoffs can be addressed by using systems of equations and inequalities to exhibit the impacts of tradeoffs in relation to system variables.

7. Assessment

- a. Identify the [type\(s\) of assessment](#) (*experiential, inquiry-based, project-based, place-based*) strategies you will use to assess content mastery ([summative](#)) and write out the instructions that will be given to students.
 - i. A project-based summative assessment will be used to assess content mastery, although part of the assessment will be inquiry-based. The project-based aspect will be the writing of a report to deliver information, conclusions, and recommendations regarding a sustainability situation introduced in the instructions. The inquiry-based aspect will be the mathematical problem solving required to generate the report.
 - ii. Instructions for the above-referenced summative assessment are as follows:
 1. Read the story that introduces the sustainability situation and explains the problem(s) to be solved.
 2. Solve the mathematical problem(s) that need to be solved as was done during the problem solving formative assessment.
 3. Review the report template and examples, and familiarize yourself with the writing guidelines provided.
 4. Write a report that can serve as a deliverable to a client which contains the following:
 - a. A summary of the problem(s) introduced in the story.
 - b. The introduction of the mathematical solutions and the detail supporting those solutions.
 - c. An interpretation of the mathematical solutions that addresses the story.
 - d. A conclusion reached from the work done.
 - e. A set of recommendations that address the extra questions asked at the end of the story.
 5. Submit the report on Blackboard as a PDF file.
 6. The report will be graded based on five categories: neatness, completeness, correctness, understandability, and presentation.
- b. Identify the strategy or strategies you will use to assess student learning and provide ongoing feedback ([formative](#)) and write out the instructions that will be given to students.
 - i. Formative assessments will include quizzes and mathematical problem solving, and will address the pillars of sustainability and the key concepts related to sustainability.
 1. There will be a pre-problem solving quiz to assess the understanding of the sustainability issues and topics being covered by the lesson. This quiz will consist of 15 questions, 3 for each of the 5 sustainability topics being addressed.
 2. There will be a mathematical problem solving assignment to assess the ability to translate sustainability problems into mathematical equations and inequalities to solve, and then to take the answers and interpret them with respect to the original stated problem. The problem set will consist of 15 problems to solve, 3 for each of the 5 sustainability topics being addressed.
 3. There will be a post-problem solving quiz to assess the understanding of how mathematics can be used to address sustainability issues. This quiz will consist of 15 questions.

- ii. Instructions for the above-referenced formative assessments are as follows:
 - 1. Pre-Quiz:
 - a. Before taking this pre-quiz, make sure you read, listen to, and study the resource materials provided in this lesson's learning module on Blackboard.
 - b. Using a browser, navigate to <http://prequiz.mysurvey.com>.
 - c. Read the instructions for taking the quiz on the first page.
 - d. Click on 'Begin.'
 - e. Once you have finished answering the questions, click on 'Submit.'
 - 2. Math Problems:
 - a. Make sure the general instructions are read and understood.
 - b. Solve each word problem presented, making sure that the solution is written in parts, as follows:
 - i. Translate the word problem into a mathematical problem, identifying the variables used, the kind of mathematical model used to formulate the problem, and any domain or boundary conditions imposed on the independent and dependent variables. For the domain and boundary conditions, explain the meaning of those conditions with respect to the sustainability topics addressed by the problem.
 - ii. Solve the mathematical problem resulting from (i), showing all steps clearly.
 - iii. Translate the mathematical answer from (ii) into English, making sure to link the mathematical answer to the questions posed in the original sustainability word problem.
 - 3. Post-Quiz:
 - a. Using a browser, navigate to <http://postquiz.mysurvey.com>.
 - b. Read the instructions for taking the quiz on the first page.
 - c. Click on 'Begin.'
 - d. Once you have finished answering the questions, click on 'Submit.'

8. Lesson Activities

- a. What will students need to know or do prior to the lesson activity or activities (readings, items to be prepared, prior knowledge)?
 - i. Students will need to study the appropriate sections of mathematics being used in this lesson, as well as watch the referenced background material.
- b. Describe the activity or activities students will be doing.
 - i. Write out the instructions that will be given to students.
 - 1. **Activities:** The activities of this lesson include the reading and viewing of background sustainability resources, studying examples of how to apply mathematics to sustainability questions, performing the formative and summative assessments, and engaging with fellow students via discussion forums and screencasts.
 - 2. **Instructions:** The instructions for the assessments are part of the assessments, as outlined above. The instructions for the discussion forums are included in the

forum. The instructions for the screencasts are part of the screencast tool.

- ii. How will you keep students engaged throughout this activity.
 1. **Discussions:** This mode of engagement will be different depending on whether the class is face-to-face or online. For face-to-face classes, there will be a certain amount of time devoted for students to have an open discussion about what was learned about the various sustainability topics through solving the math problems. For online classes, an asynchronous discussion forum will be used to share what was learned about the various sustainability topics through solving the math problems. In both cases, the Professor will participate as necessary to keep the discussion going by asking probing questions.
 2. **Screencasts:** Students will be given the opportunity to create screencasts or YouTube videos to present what they have learned about sustainability through their use of Mathematics.

9. Materials and Resources

For the questions below, include links to resources you plan to use with a summary of how you plan to use the resource.

a. What content do you already have?

None to date.

b. What new materials will you need to create?

i. Screencasts will be created using ActivePresenter

(<https://atomisystems.com/activepresenter>), and published on YouTube. Screencasts will be used to present background information on sustainability and how the issues can be studied using mathematics.

ii. Slides will be created with PowerPoint and published on SlideShare

(<https://www.slideshare.net/>). Slides will be used to present static material that can be referred to easily to remind students about facts of sustainability and the associated mathematics.

iii. Math problems will be created using MyMathLab, which is an online mathematics learning and assessment environment. The questions will be created to associate with background information.

Week 4

10. Reflection

- a. Explain how your outcome(s), learning activities, and assessments are aligned and connected.
 - i. The learning activities are designed to address the mathematical outcomes, along with the exposure to the sustainability topics.
 - ii. Reading material and viewing material are chosen to address the sustainability topics covered in the lesson, which gives students the opportunity to create thoughtful links between sustainability and mathematical problem solving.
 - iii. The assessments are designed to connect sustainability topics to both mathematical problem solving and communications to a wider audience. The assessments also

measure to what extent the learning outcomes are being achieved, both individually and in aggregate.

- b. How will you [evaluate the effectiveness of your lesson](#)?
 - i. In addition to the assessments providing a measure of quantitative effectiveness, the Discussion Forums and Screencasts that students participate in will provide a sense of qualitative effectiveness.