

Destination 2018: Sustainability Lesson Plan

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The goal of this lesson plan is to help you decide why and where you will infuse sustainability to improve student learning. Remember that sustainability is not an "add-on" content area; rather, sustainability can be integrated into already existing lessons as in-class examples of concepts and as a context for activities and problem sets that promote critical thinking.

Week 1: Needs Assessment

This week you will write a needs assessment for your lesson, learn about SDG goals, and identify 3 goals that could align with your course and topic.

Needs Assessment

1. Write your Needs Assessment:

(examples)

My students need to improve their ability to apply chemistry to problems that affect everyday life. Although I have used sustainability to improve the "real-life" impact of CHM 1020 lessons to my students, I feel the topic should be infused more regularly in order to help students think more critically of what is means to be considered sustainable versus green chemistry.

2. Explain why you think infusing sustainability will help this need:

(examples)

The concept of sustainability, aka considering the needs of future generations while meeting those of this generation, is often conflicted with the idea of green chemistry (reducing health and environmental impact through chemical decisions, e.g. creating materials that reduce carbon footprint). Much of my class focuses on how chemistry works more than why the decisions to apply certain chemical reactions or use specific chemicals over another reaction or chemical.

3. State where (course or area) you are infusing sustainability and the topic:

(examples)

CHM 1020, Chemistry in Everyday Life. Sustainability would be infused in Chemistry of the Environment/Pollution, Health, Agriculture, etc.

Research SDGs

Visit the [Sustainable Development Knowledge Platform](#) to research the Sustainable Development Goals.

4. Choose at least 3 of the SDGs of interest that could align with your topic and share why:
(*examples*)

12. Responsible Consumption and Production. Production of chemical byproducts and material chemistry/design can be manipulated during the designer/planning stage before the execution and distribution stages. "Doing more and better with less" can help reduce pollution, improve affordability, and increase accessibility of many chemical products and/or inventions over time. I can translate this to my students on a grand scale and on a microscale/personal level based on sustainable consumption and lifestyles.

13. Climate Action. I introduce greenhouse gases and the chemical process of creating SO_x and NO_x gases, oxyradicals, photodegradation, etc. Linking problems like the ozone layer to chemical equations, and then translating that to climate impact will be beneficial to my students.

14. Life Below Water. I can connect activities such as temperature conversions, volume calculations, and ideal gas law to the concept of water rise as the average temperature of the world increases. Furthermore, Rachel Carson's Silent Spring is a starting point for environmental awareness in my class, and so this may be a useful conduit to move from the impact of Silent Spring to the relationship between environmental and economic sustainability.

Week 1 Reflection

5. Now that you have completed this week's portion of the template, reflect on the following:

- I'm excited about getting a stronger background for sustainability and learning new ways to direct my students' attention towards a more sustainable lifestyle.
- I have questions about finding lesson plans/articles that address sustainability, but are at the right level for my students.

Week 2: Learning Outcomes/Research

This week you will write the student learning outcome for your lesson, explore lesson plan examples, look at a variety of classroom assessment techniques, and consider how you could incorporate the 3 Pillars of sustainability with a learning activity.

Student Learning Outcome(s)

The Student Learning Outcome is a statement of what the student will learn or be able to do because of this lesson. For more information on how to write a measurable learning outcome, review the following resources:

How to [Write Measurable Learning Outcomes](#) | Bloom's Taxonomy Resources - [Bloom's Taxonomy Action Verbs](#), [Bloom's Interactive Graphic](#), [Bloom's Taxonomy of Learning Domains](#)

6. Write your Learning Outcome:
(*examples*)

Students will be able to evaluate social, environmental, and chemical actions through the lens of sustainability.

Students will be able to apply chemistry to problems that affect everyday life.

Sustainability Lesson Plan Samples

Explore the following resources for lesson plan ideas:

- [Sustainability teaching activities across the disciplines](#) (Repository developed by Carleton College)
- Lesson plans organized according to conceptual Sustainability Systems: [Water](#), [Energy](#), [Food](#), [Waste](#), [Landscape & Ecosystem](#), [Supply Chain](#), and [Quality of Life](#) (Developed by ASU faculty)
- [AASHE Curriculum Resources Hub](#) (requires login)

7. Of the lesson plans you've explored, pick 3 and share why you selected those:
(*examples*)

Food Waste Composting Workshop/Lesson Plan (<https://hub.aashe.org/browse/casestudy/18918/Promoting-Sustainability-Science-on-Campus-Renewable-Energy-Workshops-Hosted-at-Kean-University-in-New-Jersey>) was selected as it can be a novel opportunity to bring active learning/laboratory experience to a traditionally non-laboratory based course.

Introduction to Energy and Sustainability. (<https://sustainability.asu.edu/sustainableschools/learn-more/energy/>) was selected as it reviews energy savings and costs for transportation (chance for math inclusion to the course) as well as solar energy/alternative energy options for to be considered for our local community.

Food Systems and Sustainability (<https://sustainability.asu.edu/sustainableschools/learn-more/food/>) can be adapted to enhance my current lesson on food chemistry and calories. The lesson starts with a preview of how does food get to the table, but this one is more detailed than my current think-pair-share lesson plan.

Classroom Assessment Techniques

Explore the following resource for Classroom Assessment Techniques:

- [101 Strategies to Demonstrate the Essential Competencies](#) – a college of classroom assessment techniques aligned to the essential competencies of a Valencia educator prepared by Valencia faculty Donna Colwell and Kevin Colwell

- [50 CATs by Angelo and Cross](#)
- [Classroom Assessment Techniques](#) by Northwest Evaluation Association

8. Of the CATs you've explored, pick 3 and share why you selected those:
([examples](#))

1. *Background Knowledge Probe/Tell me everything you know: to assess what is already known so that I can better gauge to what level I can arrange the actual lesson.*
2. *Pro/Con grid for students to assess the pros and cons of organic farming, traditional farming, and sustainable farming.*
3. *Serial Testimony, for students to reflect and share their own food pathways and way to imagine adding in sustainability.*

3 Pillars Activity Idea

Review the 3 Pillars Worksheet.

9. Describe an activity that incorporates the 3 pillars:
([examples](#))

An activity would be to discuss the impact of a meat-based diet versus a vegetable-based diet using the three pillars. I've used a similar type activity to engage students on, for example, to outline the life cycle of cattle raised as a food source, but I appreciated the conundrum I added in the example in Week 2's workshop, regarding organic orange from South America vs. traditional orange from Florida. I liked the complexity of the debate and think my students will benefit from a similar discussion.

Week 2 Reflection

10. Now that you have completed this week's portion of the template, reflect on the following:

- a. I'm excited about...the new resources you have shared with us.
- b. I have questions about...None right now, but I'm sure they will pop up as I start to implement the lesson plan/learning outcome.

Week 3: Putting it All Together

The goal for this week is to create an activity that incorporates the SDG, CAT, and connection to the 3 Pillars of sustainability.

SDG Selection

11. Choose the SDG that aligns best with your Needs Assessment/Student Learning outcome and explain why:
([examples](#))

Responsible Consumption and Production aka doing more and better with less. This SDG will be useful in creating content that guide students in understanding how to apply chemistry to problems that affect everyday life. I can use the platform of responsible consumption and production to create complex scenarios that will build students complex thinking skills and also to help them see the connection of chemistry to problems in everyday life.

CAT Selection

12. Choose the CAT that aligns best with your Needs Assessment/Student Learning out come and explain why:
([examples](#))

The Pro/Con grid best aligns with the chosen Needs/Assessment as students will have to consider and evaluate facts and background information to best fill out a pro/con grid for the scenarios presented to them during lectures/class activities. This will enhance their critical thinking skills and also be a tool for me to assess what level they are at for comprehension of the material and mastery of the skill.

3 Pillars Activity

13. Describe how you will incorporate the 3 Pillars into your activity:
([examples](#))

The Three Pillars activity can be used for knowledge building and for debate. I will ask students to consider the economic, environmental, and social impacts of having a meat vs vegetarian based diet, and then ask them to prepare short statements to defend their position, weaken the opposing position in a mock debate at the end of the activity.

Activity Draft

14. Create a draft of the activity using the SDG, CAT, and 3 Pillars:
([examples](#))

What is a sustainable diet?

Part 1. Prelecture Activity:

Over the next week, you will investigate the sustainability of meat vs. vegetable-based diets. While you do your research, consider the economic, environmental, and social impacts of eating a predominantly meat-based diet versus a predominantly vegetable-based diet. You should also consider the chemicals and other materials needed to support different type of agricultural and commercial enterprises.

After much of your research is complete, create a Pro/Con grid organized by the three factors mentioned above (economic, environmental, social), and make a new grid for each diet type. You may include a neutral column if you think something may be negligible or neutral.

An example grid may have headings like the one below:

Meat-Based Diet	Pro	(Neutral)	Con
Economic			
Cost to consumers			
Cost to companies			
Etc...			
Social			
Workers/Laborers			
Environmental			
Chemicals used			
Chemicals produced			

The pro-con grids will be due on Canvas the evening before our lecture.

Please bring at least one printed copy of your grids with you to class.

During lecture activities.

Part 2: You will be arranged into groups of four. You will have 5 minutes to exchange grids with one of your partners and review the grids you receive in return. While reading their grids, consider where your arguments/grids align and where your Pro/Con grids differ. After you have read each others' grids, you will have 4 more minutes to discuss the grids with the other two partners in your group (1 min per person). As a group, you will select 2 people who were best able to argue that a meat-based diet is the most sustainable diet; conversely, the other 2 people should have best argued in favor of the vegetable-based diet.

Part 3:

[I will then present this scenario] "In the near future, the country of Hungaria, with a population of 12 million people and 11,000 sq miles, is fearful of the potential food scarcity due to their lack of sustainable practices. The reigning government body has elected to enforce an optimized sustainable diet for all of their citizens, but have yet to select a set of dietary practices and guidelines for its citizens. The reigning body has been assembled to hear arguments as to which is the most sustainable diet choice for their country and await your opening statement."

[All of those assigned to the vegetable group will go to one side of the class, and those assigned to the meat group will go to the other side.]

For the next 10 minutes, work as a group to prepare an opening statement to the governing body that defends your chosen diet and highlight its benefits in terms of the three pillars. This statement should also consider any negative impacts that your chosen diet may have. While preparing your group's main points to present to the governing body, your group should consider what exactly are you proposing as the best sustainable diet choice, what factors need to be considered during the implementation of your plan, and what are potential drawbacks to your plan.

By the end of your preparation time, a student should be selected to present your group's 1-2 minutes opening statement to Hungaria's governing body.

15. Explain how the activity aligns with your Needs Assessment/Student Learning Outcome
([examples](#))

This three-part activity allows students to perform their own research and start to critically assess the information they gathered. The first part of the activity is done outside-of-class, with a deadline prior to the in-class activity so that students should be prepared for the actual activity. The initial part is also more guided in that I asked students to consider the chemical impact of each diet type. The open-ended Pro/Con grid allows students freedom in qualitatively assessing the information they collected. The progression of the student's work from individual observation to group analysis to recommendations closely align with stages of the scientific method. Once more, connections can be made between chemistry and problems in everyday life.

Week 3 Reflection

16. Now that you have completed this week's portion of the template, reflect on the following:

- a. I'm excited about...implementing the lesson plan in the fall.
- b. I have questions about... the breadth of the lesson plan. I can already see that I need to trim it down to allow for time to cover all of the relevant course content.

Week 4: Lesson Plan Draft

This week you will finalize your activity and create directions for students.

*Based on some feedback to cut down to a more manageable aspect, I've decided to change to:

Needs Assessment: Students have difficulty connecting chemistry to everyday life. One topic we cover is the chemistry of food, where students struggle with calculating nutritional value and macronutrient content.

Student Learning Outcome(s): Students will be able to apply chemistry to problems that affect everyday life, such as nutrition.

Students will be able to calculate food energy content by macronutrient.

Students will be able to calculate percentages.

Students will be able to ascribe a meal plan as sufficient for nutritional health or insufficient for nutritional health according to USDA dietary guidelines.

17. Prepare a set of instructions on how to facilitate this activity.

(examples)

Answer the following questions:

What prior knowledge will students need to be successful with this activity?

This occurs towards the end of the semester during the food and nutrition block of Chemistry of Everyday Life. At this point, students have been exposed to the different macronutrient food categories: fat, protein, carbohydrate and the food pyramid, along with the chemistry of each macronutrient. They have also been exposed to dietary guidelines by the USDA and suggestions to implement or maintain healthy food practices while on a budget and/or busy college schedule. This activity will follow the lesson where students learned how to calculate calories per gram for each macronutrient: 9 kcal/ g fat; 4 kcal/g protein; and 4 kcal/g carbohydrate.

What needs to be setup prior to delivering the lesson?

In advance:

1. Prepare several meals with a variety of macronutrients.
2. Split up the options so each student has 4 meals.
3. Scramble meals up so that students can reorganize the days into an excellent example of a food diary based on the recommended guidelines, a sufficient food diary that may miss targets by ~10-15%, and a poor example that is too small in one or more macronutrient area.
4. Prepare worksheets for the calculations.

What resources and materials will you need?

choosemyplate.gov and health.gov/dietaryguidelines/2015

myfitnesspal.com: to make up mock meals, such as:

Krispy Kreme Glazed Donut		Calculate Calories	Calculate % of total calories	Nutrition Value ✓ = yes, X = no
Carbohydrate (g)	21			
Protein (g)	2			
Fat (g)	11			
Total Calories	191			

Wegmans Spicy Tuna Roll		Calculate Calories	Calculate % of total calories	Nutrition Value ✓ = yes, X = no
Carbohydrate (g)	32			
Protein (g)	15			
Fat (g)	7			
Total Calories	251			

Quinoa Salad		Calculate Calories	Calculate % of total calories	Nutrition Value ✓ = yes, X = no
Carbohydrate (g)	36			
Protein (g)	9			
Fat (g)	10			
Total Calories	270			

Starbucks Caramel Latte Tall		Calculate Calories	Calculate % of total calories	Nutrition Value ✓ = yes, X = no
Carbohydrate (g)	37			
Protein (g)	11			
Fat (g)	11			
Total Calories	291			

Avocado, tomato, and Cucumber salad		Calculate Calories	Calculate % of total calories	Nutrition Value ✓ = yes, X = no
Carbohydrate (g)	11			
Protein (g)	3			
Fat (g)	15			
Total Calories	191			

How do you plan to introduce the topic?

I plan to introduce the topic with the nutritional guidelines, and have students write down their recent meals. We will also discuss traditional and sustainable farming and ranching/foodways.

How will you keep students engaged?

Students will be asked to work individually to solve their 4 meals, and then they will combine with other group members to organize their meals into two separate menus, one that hits all targets, one that misses the target as defined by the nutritional guidelines. Groups will then be reorganized to make a third menu, one that they believe hits the nutritional target and is a sustainably-produced menu.

Step-by-step run of the activity

During activity session:

1. Review how to calculate the calorie content of food groups, and what would be considered poor, sufficient, and excellent food diaries. Review how to calculate % totals.
2. Handout worksheets and scrambled meals to paired up students
3. Ask students to evaluate their meals nutritionally.
4. Have students spend ~4-5 minutes calculating and deciding on what meals would be considered poor, sufficient, and excellent.
5. After 5 minutes, pair up the students and ask them to make 2 daily menus, one that fits the guidelines and one that does not, when they mix up all the meals they've calculated individually.
6. Next, that group will join with a second group that had different meals, to discuss how each group made their decisions/assessments on poor, sufficient, excellent.
7. After the discussion, groups will pool their meals to create a healthy and sustainably-sourced menu.
8. At end of activity, review the calculations and preface the next lesson on vitamins and micronutrients.

Now that you have addressed the questions above, include directions in the draft of your activity

Part 1: Carbohydrates 45-60%; Protein: 10-35%, Fat: 20-35%

You have four meals in front of you and you are to determine which meals meets the recommended ratio of carbohydrate to protein to fat and which meals are not meeting the recommended dietary guidelines by percent macronutrient per meal.

Recall: 4 Cal per gram of Carbohydrate
4 Cal per gram of Protein
9 Cal per gram of Fat

Example, Pear and String Cheese Snack:
7g protein
17g carbohydrate
3.5g fat

First, multiply the grams by the Cal/gram factor:

1. 17 g carbohydrate * 4 kcal/g = 68 kcal = 68 Cal
2. 7 g protein x 4kcal/gram = 28 kcal = 28 Cal
3. 3.5 g fat x 9 kcal/g = 31.5 kcal = 31.5 Cal

Second: Add up Carb, Protein, and Fat Calories to get total Calories

$$68 \text{ kcal} + 28 \text{ kcal} + 31.5 \text{ Cal} = 127.5 \text{ kcal} = 127.5 \text{ Calories}$$

Third, divide the calories of a macronutrient by total calories to get the % macronutrient.

$$28 \text{ Cal}/127.5 \text{ Cal} * 100 = 21.96\% \text{ Carbohydrate}$$

$$68 \text{ Cal}/127.5 \text{ Cal} * 100 = 53.33\% \text{ Protein}$$

$$31.5 \text{ Cal}/127.5 \text{ Cal} * 100 = 24.71\% \text{ Fat}$$

Part 2:

With your partner, organize all of your meals into two meal plans. Work together to build two menus: One menu should include the meals that when added together, meet the daily nutritional guidelines for total %carbohydrates, protein, and fats. The second menu should be built using the meals that when added together would fall short of the recommended nutritional targets for the day.

Part 3:

With one other group, review your meals and your decision making process. Next, you will pool your meals and create a daily menu that is nutritionally sound and you believe has been sustainably-sourced and purchased. When crafting this menu, consider what we've learned about sustainable farming and ranching, how the food made it to market, and how the food made it to the table. Reflect on the meals through the three pillars of sustainability: economic, environmental, and social.

Week 4 Reflection

18. Now that you have completed this week's portion of the template, reflect on the following:

- a. I'm excited about... already implementing some of the strategies learned in Destination in my summer course.
- b. I have questions(thoughts) about...crafting an entirely new course offering based on sustainable chemistry.