

Sustainable Science: Contextualizing Chemistry for Middle School Teachers

Course Syllabus

July 6-July 27, 2022

Updated 3/3/22

Sustainable Science:

This course will provide educators an introduction to Green Chemistry and provide the skills and knowledge to integrate sustainability through chemistry in their classrooms. By investigating how industry is applying sustainable science participants will contextualize key science topics, such as ecosystem dynamics, matter and its interactions, and earth and human activity.

Class Meeting Information

This is a virtual learning course with work expected to be completed from February 14th - March 7th, 2022.

Synchronous Virtual Class Times:

July 6, July 13 and July 20 from 9am-10am MST

Zoom Call Information will be sent via email.

Instructor Information

Name: Erin Mayer

Cell Phone: 303-642-1877

Email: erin.mayer@bvsd.org

Erin Mayer has the amazing privilege of facilitating the learning of scientist explorers at Casey Middle School in Boulder, Colorado. She has been working alongside young learners for over 20 years to create safe and open learning environments filled with opportunities for learners to lead their learning as they connect with and develop deep and enduring understandings of the natural world. As a Beyond Benign lead teacher, Erin is an advocate for sustainable practices, including green chemistry practices, that provide students opportunities to define a problem and then create solutions to solve the problem that are sustainable and environmentally conscious. In other words, practices that inspire students to invent, design, and innovate. This directly aligns with her overarching goal for student learners; to build the confidence and capacity in student learners to apply their scientific understandings to address problems that they see and become empowered to develop and create sustainable and applicable solutions.

Prerequisites: High School or Middle School Science Teaching Experience

Course Description:

This course will provide educators an introduction to Green Chemistry and provide the skills and knowledge to integrate sustainability through chemistry in their classrooms. By investigating how industry is utilizing green chemistry principles and practices, participants will contextualize

key science topics, such as ecosystem dynamics, matter and its interactions, and earth and human activity.

Laboratory activities being used in K-12 classrooms that pose risks to both human health and the environment will be analyzed, and green chemistry replacement labs and hazard awareness techniques that are safer and more cost effective will be featured. Participants will evaluate laboratories based on green chemistry principles such as safer solvents, real-time analysis and pollution prevention. They will identify lab activities that are of concern to the health and safety of the environment and humans and recognize safer alternatives.

Course Objectives

After completing this course, the student will be able to:

- Explain the key criteria of green chemistry
- Examine the effects of chemical products and processes on human health and the environment
- Formulate safer alternatives to traditional K-12 labs
- Apply chemical hazard awareness tools to reduce risk in the classroom and lab
- Apply green chemistry and sustainable science principles to student-centered STEM labs
- Give examples of how these 12 principles are being used in industry to make the world more sustainable.
- Implement green chemistry principles and practices in their classrooms

Required readings:

All required readings will be given to students in the form of PDF or web-linked documents. No book purchases are required although throughout the course students will be given recommendations for further reading if they wish to purchase these. The Green Chemistry community has made the majority of these resources available for free for educators and this class will encourage teachers to use those resources.

Types of Communication

Students will be expected to attend the virtual meet-ups on July 6, July 13 and July 20 from 9:00am- 10:00am MST. Over the course of the three weeks, students will submit assignments on Canvas to complete the course by July 27, 2022. Students may reach out electronically or call if there is an urgent matter.

Use of resources

We expect you to make use of materials in an ethical manner. Always cite your sources of information, and if you find you want to leverage someone's ideas, templates, etc., we expect you to credit the appropriate parties. Sadly, it's pretty easy to spot when a student hasn't done so. Thanks in advance for being responsible!

Expectations of Students:

We expect you to:

- Attend virtual classes fully prepared to discuss all assigned material – share responsibility for the quality of the experience.
- Contribute to the class discussion in a way that enhances the learning process.
- Conduct yourself in class as you would in a professional situation (i.e., be courteous, offer constructive criticism, compliment on a job well done, and give thoughtful feedback).
- Provide ongoing feedback with regard to the extent in which this class is meeting your expectations and objectives.
- Assignment Due Dates:
 - Assignment 1: July 13, 2022
 - Assignment 2: July 20, 2022
 - Assignments 3 & 4: July 27, 2022

Please reach out as soon as possible if you have any emergencies or need more time to complete the course. We may or may not be able to accommodate this request.

Expectations of the Instructor:

You can expect us to:

- Review course content, materials and assignments prior to the start of the class
- Share syllabus prior to the start of the course
- Respond to individual email within 24 hours.
 - Erin Mayer's email address: erin.mayer@bvsd.org
- Give you individual feedback on assignments.
- Enjoy teaching you and learning from you!

Evaluation and Grading

In this course you will be evaluated in the following way:

Virtual Class Participation	20%	July 6, July 13 & July 20, 2022
Assignment 1 (Green Chemistry Reflection)	10%	Due: July 13, 2022
Assignment 2 (Lab Exploration Reflection)	20%	Due: July 20, 2022
Assignment 3 (Lab Analysis Safety/Toxicity)	20%	Due: July 27, 2022
Assignment 4 (Virtual Lab Video Presentation)	30%	Due: July 27, 2022

Total: 100%

Grading Scale

- A = 90% – 100%
- B = 80% – 89%
- C = 70% – 79%
- D = 60% – 69%

Course Outline

Instruction Time Total: 16 hours

Introduction to Green Chemistry	<p>Introduction to Green Chemistry –July 6- July 13, 2022</p> <p>Introduction to Green Chemistry readings and videos are designed to prepare participants with the knowledge needed to think critically for the lab portion of the course.</p>
Instructional time	4 hours
Learning resources	<p>Watch the 2 videos of Dr. John Warner and Dr. Paul Anastas explaining the importance of green chemistry education and the history of the 12 principles of green chemistry:</p> <ol style="list-style-type: none">1. http://www.youtube.com/watch?feature=player_embedded&v=VRJLmKAhdyw#at=63 (10 minutes)2. http://www.beyondbenign.org/greenchemistry/greenchem.html (Intellectual Ecology 30 minutes) <p>Read the following articles:</p> <ol style="list-style-type: none">1. Strategies: https://www.greenbiz.com/article/5-strategies-accelerate-green-chemistry2. Benefits: https://www.environmentalleader.com/2016/03/6-benefits-of-becoming-a-sustainable-business/ - Environmental Leader, March 6, 2016, <i>6 Benefits of Becoming a Sustainable Business</i>3. Growth Mindset - Green Chemistry: https://www.google.com/url?q=https://www.degruyter.com/document/doi/10.1515/9783110445923-008/html&sa=D&source=docs&ust=1636119335408000&usg=AOvVaw2cRnDjDkNVr4gxsc1UOC8B4. 12 Principles Explained: https://www.acs.org/content/acs/en/greenchemistry/principles/12-principles-of-green-chemistry.html
Objectives	<p>Students will:</p> <ul style="list-style-type: none">● Understand the reasons why Green Chemistry is critical to the future sustainability of the world.● Consider the importance of green chemistry education and how they can become a part of that change.● Explain the key criteria of green chemistry● Examine the effects of chemical products and processes on human health and the environment● Reflect on how green chemistry can drive instructional practices in the classroom and how using these practices connect to growth mindset
Assignments	<p>Short writing assignment (Due July 13, 2022):</p> <p>Based upon the videos and readings, write a 1 pager that states how your students might benefit from knowing about green chemistry. The aim of this</p>

	exercise is to give you a concise framework for sharing with students, parents, colleagues and administrators why you are integrating green chemistry into your teaching practice.
Method of instruction	Virtual introductions Video viewing Readings

Green Chemistry Lab Practice	Lesson 2 –July 13-July 20, 2022 Students will learn about the risk equation and understand fundamentally how Green Chemistry reduces hazards and therefore is inherently safer lab practice. Students will learn about green chemistry replacements for core chemistry concepts such as endothermic/exothermic reactions, types of reactions and equilibrium. Students will also tune in to a virtual Beyond Benign Lead Teacher Lesson Share-out where they will hear from teachers from across the US share their best practices for integrating green chemistry with their students.
Instructional time	3 hours
Learning resources	<p>1. Reading/Exploration - Replacement Labs: https://www.beyondbenign.org/cur-high-school/ https://www.beyondbenign.org/curriculum_topic/hs-chemical-reactions/ https://www.beyondbenign.org/curriculum_topic/hs-reaction-rates-equilibrium/</p> <p>2. View other lead teacher videos (links will be provided)</p> <p>3. Virtual Panel Participation – Zoom Link will be provided</p>
Objectives	Students will: <ul style="list-style-type: none"> • Understand the criteria in the risk equation and general toxicology • Apply chemical hazard awareness tools to reduce risk in the classroom and lab • Review replacement labs developed specifically to replace labs they currently use in the classroom • Workshop how they can alter their current lab activities and methods of instruction to be safer and more sustainable • Learn about local and national sustainable green chemistry initiatives
Assignments	All assignments below are due July 20, 2022: <ul style="list-style-type: none"> • Watch lead teacher presentation(s) and explore their resources to brainstorm how they have transformed their labs or have had their students work with them to transform their labs to be more sustainable • Group forum discussions on edits made to their lab(s) and why this would significantly improve their lab(s) • Reflection on how their edits to their labs are more green and will impact student exposure to green chemistry

Method of instruction	Lab practice Virtual group workshop Virtual panel
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Industry connections in the classroom	Lesson 3 – July 20-July 27, 2022 Students will explore industry connections to green chemistry. They will also engage in a workshop with one another to brainstorm how they can implement skills learned from exploring green chemistry to modify one lab to be safer, more green, and provide opportunities for students to engage with green chemistry and sustainable ideas.
Instructional time	3 hours
Learning resources	The following lesson plans: 1. High School Steelcase Modules: https://www.beyondbenign.org/curriculum_topic/hs-materials-science/ a. Ecovative (Mushroom materials) b. Sharklet (Shark skin inspired film) c. Cogent (Cradle to Cradle polyester fabric) 2. Middle School Modules: a. Sustainable STEM b. Inventing Green
Objectives	Students will: <ul style="list-style-type: none"> ● Learn about sustainable and green chemistry technologies. ● Collaborate with others to identify specific changes that could be made to current labs they conduct to make them more green ● Discuss with others how students can get involved in the lab analysis process by analyzing chemical safety/toxicity
Assignments	All assignments will below are due July 27, 2022: <ul style="list-style-type: none"> ● Group forum discussions on green chemistry technologies industry nationwide and locally ● Group discussions on initial steps to analyze current lab practices and how to modify these labs to be more green ● Individual reflections on ways to incorporate real-world technologies for increasing chemistry relevance for their own classrooms
Method of instruction	Virtual reading and exploration Virtual pair sharing Virtual group discussion

Green chemistry lab development	Lesson 4 - July 20-July 27, 2022 Apply your knowledge and implement the concepts into developing your own green chemistry lesson plan and video explanation
Instructional time	4 hours
Learning resources	Beyond Benign Lab featured spotlight on American Association of Chemistry Teachers March 2020: https://teachchemistry.org/periodical/issues/march-2020/designing-a-greener-le-ch-telier-s-principle-lab Archived 2018 Tools for Integrating Green Chemistry in Your Classroom Virtual Conference https://www.chemedx.org/event/announcing-unique-virtual-conference-tools-integrating-green-chemistry-your-classroom
Objectives	Students will: <ul style="list-style-type: none"> ● Review additional resources from American Chemical Society's partnerships to integrate green chemistry
Assignments	Develop a Green Chemistry Inspired Lab (Due July 27, 2022): <ul style="list-style-type: none"> ● Develop a lesson plan that integrates new green chemistry knowledge learned from the in-person lab day that fits into your curriculum. Integrate green chemistry principles and practices using the Beyond Benign lesson plan template provided or use one that is required by your school. Please make sure to include standards in your lesson plan. Develop a Green Chemistry Inspired Lab and create a video explaining: <ul style="list-style-type: none"> ● How they modified their lab to be more green ● How students will engage with the green chemistry principles or lab modification analysis/process ● Future steps they have for lab modifications and class discussions around green chemistry
Method of instruction	Readings Reflection