



Professional Development Institute

Flex Course Syllabus

Unleashing the Power of the NGSS and STEM (3-5)

PDI Course Number: 4T02

UCSD Course Number: EDUC40122

If you would like information about receiving post-baccalaureate (graduate) credit for completing this course, [please click here](#).

Course Timeline

Participants have one year to complete the course. Participants must spend a minimum of three weeks in this course.

Course Description

Have you been trying to find a way to incorporate the Next Generation Science Standards (NGSS) into your STEM classroom using a more hands-on approach to learning? This online course takes teachers of grades 3-5 through a step-by-step explanation of the standards and includes examples and suggestions of how to incorporate them into their science lessons. The course also guides teachers through how to interpret the science and engineering practices, crosscutting concepts, and disciplinary core ideas contained within the NGSS. Teachers will be introduced to various instructional models for learning, including the 5Es of inquiry, the 4E x 2 model, and Universal Design for Learning. Teachers will learn how to create an active learner-centered classroom so that various STEM strategies can be used to connect the design and implementation of NGSS-based science lessons, labs, and stations. Teachers will be introduced to an overview of assessment and how it applies to the Next Generation Science Standards, as well as a brief overview of how to blend technology and flip a science classroom to make it more student-centered. By the end of this course, teachers will have a solid understanding of the NGSS Standards and how to create engaging lessons to put them into practice and action in the classroom.

Educational Outcomes

1. Teachers will understand the basic principles of guided inquiry-based instruction.
2. Teachers will learn about the guided inquiry process, including how to apply this structure to science lessons.
3. Teachers will learn how to embrace higher-order thinking skills and Bloom's Taxonomy as a means of pursuing scientific phenomena within the realm of the Next Generation Science Standards (NGSS).
4. Teachers will learn about the Rigor Relevance Framework and Growth Mindset as a way to incorporate the NGSS standards within the STEM classroom.
5. Teachers will learn about the characteristics of effective STEM lessons and specific strategies for incorporating them into their science classroom.
6. Teachers will understand the structure of the NGSS which encourages three-dimensional thinking between the science and engineering practices (SEPs), crosscutting concepts (CCCs), and disciplinary core ideas (DCIs).
7. Teachers will understand the common characteristics of learner-centered instruction and will learn some specific teaching strategies which can be incorporated into the teaching of science.
8. Teachers will be introduced to each step of the 5E instructional model of inquiry and will understand how to use this model by viewing a specific example.
9. Teachers will understand each step of the 4E x 2 instructional model of inquiry which can be used to frame specific science lessons and activities, based upon the appropriate NGSS standards.
10. Teachers will be introduced to the guiding principles of Universal Design for Learning, and how this instructional framework is a perfect segue into teaching the NGSS.
11. Teachers will learn how to translate the NGSS standards into curriculum and instruction.
12. Teachers will be introduced to backward design as a great strategy for incorporating the NGSS into their STEM classrooms.
13. Teachers will gain a deep understanding of the science and engineering practices, and what is required for implementing same at the 3-5 grade level.
14. Teachers will gain a deep understanding of the crosscutting concepts, and what is required for implementing same at the 3-5 grade level.
15. Teachers will gain a deep understanding of the disciplinary core idea of physical science, and what is required for implementing same at the 3-5 grade level.
16. Teachers will gain a deep understanding of the disciplinary core idea of life science, and what is required for implementing same at the 3-5 grade level.
17. Teachers will gain a deep understanding of the disciplinary core idea of earth and space science, and what is required for implementing same at the 3-5 grade level.
18. Teachers will gain a deep understanding of the disciplinary core idea of engineering, technology, and applications of science, and what is required for implementing same at the 3-5 grade level.
19. Teachers will understand the importance of engineering and the role it plays in both the scientific and engineering practices and the disciplinary core ideas of the NGSS.
20. Teachers will have a basic understanding of the engineering design process.
21. Teachers will understand the components of active learning and will learn specific strategies for incorporating it into their STEM classrooms.

22. Teachers will understand the important role that technology plays in the NGSS and will be exposed to numerous strategies and resources for incorporating same into their STEM classrooms.
23. Teachers will understand what science stations are and the guidelines for implementing them in a student-centered inquiry-based science classroom.
24. Teachers will learn about the different types of assessment and the role each of them plays in student performance.

Instructional Media

- Online Discussions
- Online Engagement
- Online Collaboration
- Instructor Feedback
- Instructor Interaction
- Online Resources and Websites
- Supplemental Instructional Materials
- Printable Classroom Resources

Evaluation

- Test #1 (5% of final grade)
- Test #2 (5% of final grade)
- Test #3 (5% of final grade)
- Test #4 (5% of final grade)
- Test #5 (5% of final grade)
- Autobiography and Goals for the Course (10% of final grade)
- Article/Video Reflection (15% of final grade)
- Course Collaboration/Share Ideas with the Class (10% of final grade)
- Cumulative Assignment/Project: Plan and Assess Science Activities Using the 5E's (20% of final grade)
- Reading/Learning Log (20% of final grade)

Topical Outline

Unit One

- Guided Inquiry-Based Learning
- Work Smarter, Not Harder
- What is STEM?
- NGSS: An Overview
- **Assignment #1**
Write an autobiography including information about yourself, your grade level and what you specifically hope to learn about implementing the Next Generation Science

Standards into your 3-5 STEM classroom. Your autobiography should be a minimum of three paragraphs.

- **Test #1**

Unit Two

- Learner-Centered Teaching Strategies
- Instructional Models for Learning
- Universal Design for Learning
- **Assignment #2**

As an educator, it is important to be aware of the research, studies, and professional work done in the field. In the course, you will find an article and video that are relevant to the specific course content. Read the article and then write an essay with your thoughts.

- **Test #2**

Unit Three

- Translating Standards to Curriculum and Instruction
- Dimension 1: Science and Engineering Practices
- Dimension 2: Crosscutting Concepts
- **Assignment #3**

Online Discussion Board Participation/Engagement: Please post a tip, strategy, or idea that specifically relates to effectively implementing the Next Generation Science Standards into your 3-5 STEM classroom. Your assignment should be a minimum of three paragraphs and detailed enough for another teacher to easily follow. This is a great opportunity to share and collaborate with other teachers at your grade level around the country. Take time to review and respond to other postings that are relevant to your classroom population in order to gain effective ideas to use immediately in your classroom

- **Test #3**

Unit Four

- Dimension 3: Disciplinary Core Ideas — Physical Sciences
- Dimension 3: Disciplinary Core Ideas — Life Sciences
- **Test #4**

Unit Five

- Dimension 3: Disciplinary Core Ideas — Earth and Space Sciences
- Dimension 3: Disciplinary Core Ideas — Engineering, Technology, and Applications of Science
- **Test #5**

Unit Six

- Active Learning in the Science Classroom
- Blending Technology into the Science Classroom
- Science Stations
- Assessing the Science Classroom
- **Assignment #4**

Review the Next Generation Science Standards for your grade level. Choose one of the performance expectations for each of (1) physical science; (2) life science; and (3) earth and space science and create a detailed hands-on science activity lesson plan lab, experiment, or station that students can actively participate in using the 5E's to accompany it. You can refer to the format which was presented in Unit Two to help you. Be sure to include the standard to which the activity applies and that the learning objective(s) is shared in easy to understanding "child speak." Then, create some type of assessment for one of the activities. The chosen assessment must address the requisite content standards for your grade level and be related to the above-described activity.

- **Assignment #5**

The culminating practicum is a three-step process. (1) In the first assignment, you were asked what goals you had and what you hoped to learn from the course. Think back to your original goals for this course. Write a minimum two-paragraph reflection specifically describing how what you learned can be used to help you reach those goal(s). (2) Next, write a minimum three-paragraph plan that specifically describes the ways in which you intend to implement a particular strategy you learned in this course into your own teaching situation. (3) Last, write a minimum two-paragraph reflection describing a student you have or have had in the past. Then, discuss how the strategies you learned in this course will specifically benefit that student as you put your plan into action.

Bibliography

Althoff, S., K. Linde, J. Mason, N. Nagel, & K O'Reilly (2007). "Learning Objectives: Posting and Communicating Daily Learning Objectives to Increase Student Achievement and Motivation." Retrieved from <http://files.eric.ed.gov/fulltext/ED496125.pdf>

Authentic Education (n.d.). "What is Understanding by Design[®]?" Retrieved from <https://www.authenticeducation.org/ubd/ubd.lasso>

Bagaiti, A., S.Y. Yoon, D. Evangelou & I. Ngambeki (2010). "Engineering Curricula in Early Education: Describing the Landscape of Open Resources." *Early Childhood Research & Practice*, 12(2). Retrieved from <http://ecrp.uiuc.edu/v12n2/bagaiti.html>

Beaty, Andrea (2013). *Rosie Revere, Engineer*. New York, NY: Abrams Books for Young Readers.

- Biesty, Stephen (2013). *Cross-Sections Castle*. New York, NY: DK Publishing.
- Branley, Franklyn M. (2002). *The Sun: Our Nearest Star*. New York, NY: HarperCollins Publishers Inc.
- Child, Emma (2015). *Giraffes: Fun Facts and Amazing Photos of Animals in Nature*. CreateSpace Independent Publishing Platform.
- Cobb, Vicki (2002). *I Get Wet*. New York, NY: HarperCollins.
- Cole, Joanna (1997). *The Magic School Bus and the Electric Field Trip*. New York, NY: Scholastic Inc.
- Cole, Joanna (1999). *The Magic School Bus Explores the Senses*. New York, NY: Scholastic Inc.
- Crelin, Bob (2009). *Faces of the Moon*. Watertown, MA: Charlesbridge.
- Feynman, Richard, in *The Feynman Lectures on Physics* (1964). Vol. 1, 4-1. "What is Energy?" Retrieved from http://www.feynmanlectures.caltech.edu/I_04.html
- Gibbons, Gail (1995). *Planet Earth/ Inside Out*. New York, NY: William Morrow & Company, Inc.
- Gross, P., D. Buttrey, U. Goodenough, N. Koertge, L. Lerner, M. Schwartz, & R. Schwartz (2013). "Final Evaluation of the Next Generation Science Standards." *Thomas B. Fordham Institute*. Retrieved from <https://edexcellence.net/publications/final-evaluation-of-NGSS.html>
- Kleiner, Mariela (2008). *Meet Einstein*. Palo Alto, CA: Meet Books LLC.
- Krajcik, J. (2016). "Three-Dimensional Instruction: Using a new type of teaching in the science classroom." Retrieved from http://static.nsta.org/files/tst1508_50.pdf
- Lauber, Patricia (1990). *An Octopus is Amazing*. New York: NY: HarperCollins Children's Books.
- Locker, Thomas (1997). *Water Dance*. Boston, MA: Houghton Mifflin Harcourt Publishing Company.
- Martella, R.C., Nelson, J.R., & Marchand-Martella, N.E. (2003). *Managing disruptive behaviors in the schools*. Boston, MA: Allyn & Bacon.
- McTighe, J. & R.S. Thomas (2003). "Backward Design for Forward Action." Retrieved from <http://jaymctighe.com/wordpress/wp-content/uploads/2011/04/Backward-Design-for-Forward-Action.pdf>
- Murphy, A. (2011). "STEM Education — It's Elementary." Retrieved from <http://www.usnews.com/news/articles/2011/08/29/stem-education--its-elementary>

Nagy, W.E. & Scott, J.A. (2000). "Vocabulary Processes." In M.L. Kamil, P. Mosenthal, P.D. Pearson, & R. Barr (Eds.) *Handbook of reading research* (Vol. 3, pp. 269-284). Mahwah, NJ: Erlbaum.

National Academy of Sciences (1996). "National Science Education Standards." Retrieved from <http://www.nap.edu/catalog/4962/national-science-education-standards>

National Academy of Sciences (2002). "Scientific Research in Education." Retrieved from <https://www.nap.edu/read/10236/chapter/5>

National Assessment of Educational Progress (2016). "The Nation's Report Card." Retrieved from http://www.nationsreportcard.gov/science_2015/#?grade=4

National Center on Universal Design for Learning (2012). "UDL Guidelines — Version 2.0: Principle III. Provide Multiple Means of Engagement." Retrieved from <http://www.udlcenter.org/aboutudl/udlguidelines/principle3>

National Commission on Excellence in Education (1983). "A Nation at Risk." Retrieved from <http://www2.ed.gov/pubs/NatAtRisk/risk.html>

National Research Council (2001). "Knowing What Students Know: The Science and Design of Education Assessment." Retrieved from <http://www.nap.edu/read/10019/chapter/1>

National Research Council (2007). *Taking Science to School: Learning and Teaching Science in Grades K-8*. Committee on Science Learning, Kindergarten Through Eighth Grade. R.A. Duschl, H.A. Schweingruber, and A.W. Shouse (Eds.). Board on Science Education, Center for Education. Division of Behavioral and Social Sciences and Education. Washington, D.C.: The National Academies Press.

National Research Council (NRC, 2011). *Successful K-12 STEM Education: Identifying Effective Approaches in Science, Technology, Engineering, and Mathematics*. Committee on Highly Successful Science Program for K-12 Science Education. Board on Science Education and Board on Testing and Assessment, Division of Behavioral and Social Sciences and Education. Washington DC: The National Academies Press.

National Research Council (NRC, 2012a). *Education for life and work: Developing transferable knowledge and skills in the 21st century*. Washington, D.C.: The National Academies Press. Retrieved from <https://www.nap.edu/catalog/13398/education-for-life-and-work-developing-transferable-knowledge-and-skills>

National Research Council (NRC, 2012b). *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*. Committee on a Conceptual Framework for New K-12 Science Education Standards. Board on Science Education, Division of Behavioral and Social Sciences and Education. Washington, D.C.: The National Academies Press.

NGSS Lead States (2013). *Next Generation Science Standards: For States, By States*. Washington, D.C.: The National Academies Press.

National Science Teachers Association (n.d.). “Science and Engineering Practices.” Retrieved from <http://ngss.nsta.org/Practices.aspx?id=2>

Orion, N. & A. Hofstein (1994). “Factors that influence learning during a scientific field trip in a natural environment.” Retrieved from <http://onlinelibrary.wiley.com/doi/10.1002/tea.3660311005/abstract>

Osborne, Will & Mary Pope Osborne (2000). *Knights and Castles (A Magic Tree House book)*. New York, NY: Random House Children’s Books.

Peet, Bill (1970). *The Wump World*. New York, NY: Houghton Mifflin Company.

Program for International Student Assessment (2012). “PISA 2012 Results.” Retrieved from <https://nces.ed.gov/surveys/pisa/>

Ranney, W. (2005). “How old is the Grand Canyon?” Retrieved from <http://geology.com/articles/age-of-the-grand-canyon.shtml>

Rendina, D. (2015). “Defining Makerspaces: What the Research Says.” Retrieved from <http://renovatedlearning.com/2015/04/02/defining-makerspaces-part-1/>

Storad, Conrad (2012). *Earth’s Changing Surface*. North Mankato, MN: Rourke Publishing LLC.

U.S. Department of Education (n.d.). “Science, Technology, Engineering and Math: Education for Global Leadership.” Retrieved from <http://www.ed.gov/stem>

Walker, Niki (2007). *Harnessing Power from the Sun*. New York, NY: Crabtree Publishing.

Ward, H., J. Roden, C. Hewlett, & J. Foreman (2005). *Teaching Science in the Primary Classroom: A Practical Guide*. Thousand Oaks, CA: Paul Chapman Publishing.

Wiggins, G. & J. McTighe (2005). *Understanding by Design*. Danvers, MA: Association for Supervision and Curriculum Development.

Zoehfeld, K.W. (1995). *What’s Alive?* New York, NY: HarperCollins.