

# ENGINEERS AS TEACHERS

*Helping scientists and engineers communicate science to the public*

## Objectives

Iridescent's "Engineers as Teachers" program aims to help scientists and engineers communicate their skills, collaborate constructively with peers, and to inspire underserved children to become scientists and engineers.

Through this course students will collaborate with one another and learn to:

- Tell an engaging story based on key aspects of a research field
- Utilize clear, visually appealing multi-media tools and powerful communication techniques
- Develop meaningful lesson plans, learning objectives
- Check for participant understanding and assess participant mastery of concepts
- Engage large, diverse public audiences in understanding basic science

## Selected reading

1. McComas, W. F. and L. Abraham, Asking More Effective Questions, Rossier School of Education, University of Southern California.
2. How People Learn. Washington, DC, National Academy Press.(1999)
3. Wiggins, G. P., & McTighe, J. (2005). Understanding by Design (2 ed.): Association for Supervision & Curriculum Development.
4. Minner, D. D., Levy, A. J., & Century, J. (2009). Inquiry-Based Science Instruction. What Is It and Does It Matter? Results from a Research Synthesis Years 1984 to 2002. Journal of Research in Science Teaching.
5. Wilson, C. D., Taylor, J. A., Kowalski, S. M., & Carlson, J. (2009). The Relative Effects and Equity of Inquiry-Based and Commonplace Science Teaching on Students' Knowledge, Reasoning, and Argumentation. Journal of Research in Science Teaching.
6. Mayer, R. E. and R. Moreno (2009). A Cognitive Theory of Multimedia Learning: Implications for Design Principles. Multimedia learning. New York, Cambridge University Press.
7. Shunk, D. M., Pintrich, P.R., & Meece, J.L. . (2008). Motivation in education: Theory, research, and applications. Upper Saddle River, NJ: Pearson Merrill/Prentice Hall.

## Training Schedule

Week	In-class activities	Assignment Due	Notes
1	<ul style="list-style-type: none"> <li>• Introduction to mission, philosophy, syllabus, Basecamp and topics.</li> <li>• Students choose a topic/story from existing ones and identify 4 lesson ideas that would together tell their story.</li> </ul>		
2	<ul style="list-style-type: none"> <li>• Basic lesson planning using a lesson plan template.</li> <li>• Practice using a concept map</li> </ul>	Reading Reflection: "Asking More Effective Questions"	
3	<ul style="list-style-type: none"> <li>• <b>Guest lecture on using multi-media tools to create engaging lessons</b></li> <li>• Developing pre and post assessment questions</li> <li>• <i>Presenting Lesson Plan 1</i></li> </ul>	<ul style="list-style-type: none"> <li>• Read "Understanding by Design"</li> <li>• Lesson Plan 2</li> </ul>	
Demo Family Science Session			
4	<ul style="list-style-type: none"> <li>• Motivating your participants</li> <li>• Designing lesson experiments that allow participants to redesign</li> <li>• <i>Presenting Lesson Plan 2</i></li> </ul>	<ul style="list-style-type: none"> <li>• Reading Reflection "Motivation"</li> <li>• Lesson Plan 2</li> </ul>	
5	<ul style="list-style-type: none"> <li>• <b>Guest lecture on body language and engaging large audiences</b></li> <li>• <i>Presenting Lesson Plan 3</i></li> </ul>	<ul style="list-style-type: none"> <li>• Lesson Plan 3</li> <li>• Pre-post Assessment</li> </ul>	
6	<ul style="list-style-type: none"> <li>• <b>Guest lecture on photo and video documentation</b></li> <li>• What to expect at school sites</li> <li>• <i>Presenting Lesson Plan 4</i></li> </ul>	<ul style="list-style-type: none"> <li>• Lesson Plan 4</li> <li>• Reading Reflection "How People Learn"</li> </ul>	Teaching 1st Family Science Session
7	<ul style="list-style-type: none"> <li>• Reworking lesson experiments to ensure participants can redesign</li> <li>• <i>Presenting revised Lesson Plan 2</i></li> </ul>	Rewriting the direct instruction script in each of the 4 lesson plans to incorporate higher-order questions.	Teaching 2nd Family Science Session

Week	In-class activities	Assignment Due	Notes
8	<ul style="list-style-type: none"> <li>Evaluating participant work (Midterm Report)</li> <li><i>Presenting revised Lesson Plan 3 or 4</i></li> </ul>	<ul style="list-style-type: none"> <li>Read “Inquiry-based Science Instruction”</li> <li>Self-reflection</li> </ul>	Teaching 3rd Family Science Session
9	<ul style="list-style-type: none"> <li>Advanced lesson planning and story creation</li> <li><i>Presenting Lesson 1 of new topic</i></li> </ul>	<ul style="list-style-type: none"> <li>Mid-term report</li> <li>Lesson Plan 1 of new topic</li> </ul>	Teaching 4th Family Science Session
10	<ul style="list-style-type: none"> <li>Advanced experiment design</li> <li><i>Presenting Lesson Plan 2 of new topic</i></li> </ul>	<ul style="list-style-type: none"> <li>Lesson Plan 2 of new topic</li> <li>Rewriting the direct instruction script in each lesson plan to incorporate higher-order questions.</li> </ul>	
11	<ul style="list-style-type: none"> <li>Revisiting higher-order questioning</li> <li><i>Presenting Pre and post assessments</i></li> </ul>	<ul style="list-style-type: none"> <li>Pre-post assessment</li> <li>Read “ Cognitive Theory of Multimedia Learning”</li> </ul>	
12	<ul style="list-style-type: none"> <li>Reflection and evaluation of participant work</li> <li><i>Presenting Lesson Plan 3 of new topic</i></li> </ul>	<ul style="list-style-type: none"> <li>Lesson Plan 3 of new topic</li> <li>Reworking experiments in each lesson to ensure participants can redesign</li> </ul>	Teaching 1st session of new topic
13	<i>Presenting Lesson Plan 4 of new topic</i>	<ul style="list-style-type: none"> <li>Read “Relative Effects of Inquiry-based Teaching”</li> <li>Lesson Plan 4 of new topic</li> </ul>	Teaching 2nd session of new topic
14	<ul style="list-style-type: none"> <li>Share evidence of learning and misconceptions</li> <li>Overview of Final Presentation requirements</li> </ul>		Teaching 3rd session of new topic
15	<i>Practice Final Presentation</i>		Teaching 4th session of new topic
16	Final Presentation		

### Grade Breakdown

*Holds will be placed on grades for students who have not returned all borrowed materials.*

*Missing a teaching session will result in an immediate no-pass or an F.*

Class attendance and punctuality: 20%  
Weekly Assignments/Mentor Meetings: 20%  
Assessment and use of participant work: 20%  
Lesson Plan Presentations (practice and final): 20%  
Midterm, Final Presentation and Final Report: 20%

#### Weekly Assignments

- In addition to weekly lesson plans, students are required to write 3 written reflections for “Asking More Effective Questions”, “Motivation” and “How People Learn”.
- Students are also required to write 2 “Self-Reflections” based on their external evaluation form and/or video of the session or practice lesson.
- Students are required to get necessary documentation completed at sessions (pre and post tests, exit slips, instructor evaluation form, parent sign-in sheet, videos, pictures)

#### Mentor Meetings

- Students are required to meet with Engineering Alum Mentors (students who have already completed the training) twice during each set of sessions i.e. four times over the course of the semester.
- During meetings, students may discuss any achievements or challenges but must also ensure that their lesson plan's experiment is challenging, aligns with the lesson's learning objective and allows participants to redesign key aspects.

#### Assessment and use of participants' work

- Create rigorous assessments that check for higher level student understanding
- Grade pre and post assessments and exit slips
- Analyze assessment data
- Adapt teaching / lesson plans based on data collection

#### Lesson Plan Presentations

- Lesson Plans are due by 12:00 noon the day listed
- Relevance to the story
- Clear, accurate analogies
- Appropriate vocabulary,
- Complete script for lessons
- Clear directions for experiments
- Accompanied by engaging visuals or multi-media
- Within the time limit

#### Midterm Report

Write an abstract (200 words) that describes your experience. Address the story you chose to teach, what you did, what worked, and what didn't. Identify the relevance of each experiment in helping your participants understand the story. Describe your assessment techniques and results. What improvements will you make to the story and its execution in the future? Include three graphs (for the pre and post assessment data and for two exit slips).

#### Final Presentation

- 10-15 minute presentation discussing participant data
- Graphs and charts on participant learning
- Clear power point presentation, well designed and visually appealing (includes pictures and videos)
- Talk flows between presenters,
- WELL REHEARSED

#### Final Report

- Written 2000 word article that will be submitted to the National Science Teachers Association journals.
- Follow NSTA's guidelines

## Important Checklists and Documents

### Reading Reflections

Write a 1-2 page journal-style reflection on the weekly reading. This reflection is to improve YOUR teaching skills, so the more comprehensive and thoughtful, the more your teaching will improve.

Within the reflection, touch upon each of the following questions:

- What is the main idea/concept of the reading?
- What do you think is the most difficult/easy part of this idea/concept?
- How do you think you could use your understanding of this main idea/concept in your teaching? Give SPECIFIC examples.

### Self-Reflections

Write a 1 page journal-style reflection on your lesson video and observation form. Remember, this reflection is to improve YOUR teaching skills, so the more analytical, the more engaging your teaching will be and the more your students will learn. Within the journal, touch upon each of the following questions:

- What did I do well?
- What do I need to work on?
- What are some specific ways I can improve? (you can get these ideas by searching the internet, asking a teacher, or using the appropriate section on your evaluation form.)

### Preparation for each session checklist

- All materials (for ~30 participants) - you are responsible for getting materials from us or for buying materials we don't have. KEEP ALL RECEIPTS FOR REIMBURSEMENT.
- Copies of pre and post assessments and exit slips
- Copies of concept maps
- Poster or description of directions
- Clean up items (towels, paper towels, cleaner if necessary)
- Flip Camera
- HOLDS WILL BE PLACED ON GRADES IF MATERIALS BORROWED ARE NOT RETURNED

### Necessary Documents

- Lesson Plan template, Concept Map template, Midterm and Final Report Directions can be found on Basecamp ([www.Iridescent.basecamphq.com](http://www.Iridescent.basecamphq.com)) under "Engineers and Mentors" , "Training Documents"
- Please post all videos, lesson plans, and other material relating to your story underneath the story project.
- Weekly announcements will be posted under "Engineers and Mentors", "Engineers as Teachers Training Announcements"