

ENGINEERS AS TEACHERS

2014 SYLLABUS

Helping scientists and engineers communicate scientific concepts to the public

Course Overview

Iridescent is a science education nonprofit, that helps engineers and scientists communicate their work to underprivileged communities through open-ended engineering design challenges. Iridescent's approach is to build infrastructures that last beyond any one-time program, and to provide resources over many years for children to deepen their curiosity, creativity and persistence.

Through the "*Engineers as Teachers*" (*EasT*) course, scientists and engineers learn how to develop and teach a Family Science Course for children and their families at local elementary schools. The Family Science Course consists of 5 sessions held once a week for two hours. The content of the Family Science sessions should highlight applications of basic physics and/or engineering concepts and emphasize the engineering design process. The content is designed to show participants the exciting action at the forefronts of science, technology and engineering.

Learning Objectives

EasT students will become familiar with the engineering design process and will be able to use creativity and intuition when approaching a design problem. *EasT* students will also learn pedagogical techniques to disseminate physics and engineering principles using divergent teaching practices, conversation, and active participation. At the end of the semester they will be able to:

- Develop authentic engineering design challenges that illustrate fundamental physics and/or engineering concepts of their research, project or other area of expertise and interest
- Able to present an engaging story that relates those key concepts of an engineering research field to the every day life of a child
- Develop solid, meaningful lesson plans to teach complex science and engineering concepts to children (age 3-10) and their families
- Utilize clear, visually appealing multimedia tools and powerful communication techniques to educate the families on complex topics without the use of jargon

Lesson Plan Development

During the course *EasT* students will develop quality lesson plans while their instructor and peers provide meaningful feedback to ensure the group is well-prepared to teach a Family Science Course. The peer review process will be used to assess the quality of each engineer's teaching, science explanations and engineering design challenges. Lesson plans will additionally be evaluated by an Iridescent Instructor who will offer pedagogical suggestions, answer science questions, and help ensure *EasT* students have a firm grasp of the concepts that they will be teaching and how to best teach them.

Class website / Assignments

The course will use Basecamp, a web-based project management and collaboration tool used by Iridescent. Students will be given access to the system and course announcements will be posted regularly to Basecamp. Basecamp will be the primary website for all working documents, reflections, feedback and finalized lesson plans.

Homework/readings/assignments will be assigned each week that will be due on Monday at 11:59 PM the following week. Unless mentioned otherwise by the instructor, all homework needs to be uploaded to Basecamp or emailed directly to the Instructor.

Reading Reflections

EasT students will be assigned relevant pedagogical articles to read during the course of the semester. For each article *EasT* students will be required to write a 2-paragraph reflection giving five specific examples of how they will apply the findings from the article in their teaching.

Grade Breakdown

Please note: Attendance to all family science sessions and class meetings is MANDATORY. Missing a Family Science session will result in an automatic failing grade.

Class & FS sessions attendance and punctuality	20%
Reflections / Readings / Assignments	20%
Lesson Plan Development	20%
Engineering Design Challenges	20%
Family Science teaching & self-reflections	20%

Attendance Policy

- Students are required to attend all class sessions, and all assigned Family Science Course sessions
- Tardiness or absence will reduce the final grade.
- Please contact the Iridescent instructor immediately if there is an uncontrollable absence or tardiness.
- Missing a Family Science Course will result in an automatic failure. Make sure to pick a team that can teach on the days that each team member is available on.

Self-Reflections/Evaluations

After each Family Science session, *EasT* students write a 1-page journal-style reflection on their teaching experience. Th reflection is designed to improve teaching skills and *EasT* students are encouraged to be self-analytical in their reflections. Within the journal, *EasT* students discuss: What went well; What needs to be improved; What are some specific ways in which to improve; Was last weeks' reflection incorporated into the teaching?

Office Hours

Office hours are by appointment only. Please contact the instructor directly to schedule office hours at least 48 hours in advance.

EasT Deliverables Checklist

- Weekly Homework: Readings & Responses, assignments
- Develop 2 Open Ended Engineering Design Challenges
- Develop 2 Lesson Plans
- Teach 2 Family Science Courses
- Volunteer for 3 Family Science Courses
- Create 2 design challenge videos

Weekly Outline

WEEK 1 - EMPOWERING “YOU” TO RELATE, EXCITE AND INSPIRE OTHERS

Activities:

- Icebreakers
- Walk around the campus neighborhood — Introduces *EasT* students to the neighborhood, local community, families and their background
- Silent Build Open Design Challenge - This activity helps *EasT* students observe group dynamics, other learners and be introduced to open ended design challenges (OEEDC) and the elements required for a [good OEEDC](#)
- [Upgoer 5 Challenge](#) - The goal of this exercise is to help *EasT* students communicate the science behind the Silent Build Design Challenge using just the most commonly used 1000 words in the English Language (i.e no scientific jargon)
- Brainstorming – Through this activity, the *EasT* students identify one overarching story-topic and 5 subtopics that they will teach to the Family Science Course participants. *EasT* students are also introduced to [Prezi](#) as a means of documenting their design process and the [5 steps to creating an OEEDC](#).

Assignments – due next Monday at 11:59 PM — for each *EasT* student

- Create Basecamp account
- Take pre-course *EasT* Survey
- Write 1-paragraph reflection on today’s lecture – what did you learn?
- Read “*Surely you’re joking, Mr Feynman*” and write a paragraph about an object and/or experience from your childhood, in the spirit of Feynman’s lectures. What do you remember about the excitement, curiosity and persistence it sparked in you? Post your response on Basecamp or send it to your instructor
- Create a Prezi account for your group and start building your concept map based on the overarching topic and 5 subtopics that resulted from the brainstorming session in class. Complete Stage 2 of the OEEDC creation process i.e. research one subtopic per team member and add the following about your subtopic on your Prezi
 - o **A clear story** - how do your topics relate? how can children relate to your topics? What is the “real-world application”?
 - o **Examples** (pictures, movies, videos, etc.) that illustrate your topic/ concepts
 - o **Scientific articles** (at least 3 articles about each subtopic)
 - o **Cross-over with technology** - show technological applications of each subtopic; Remember that you will have to design an ENGINEERING challenge based on each topic
 - o **Questions that are driving your research**

WEEK 2 – WHEN HAVE YOU LEARNED BEST?

Activities:

- Icebreakers
- Group discussion – What is knowledge? How is knowledge acquired?
- Engineering charades – This activity helps *EasT* students observe and experience “active learning”
- How would you teach someone to ride a bike in 5 steps – This activity helps *EasT* students observe how different people view and solve a common problem in different ways ([Styles of Learning](#))
- When have you learned best? – *EasT* students describe a time/situation when they learned best and another time when their learning failed. They characterize both situation by 2 adjectives each. These adjectives are used during Family Science Courses to assess their teaching
- Four group learning stations: *EasT* students build a geometric shape that will not break when thrown to the floor. This activity illustrates the 4 styles of learning (teacher centered, student centered conversational divergent, student centered visual, student centered kinesthetic: [Styles of Learning](#))
- OEEDC creation brainstorming Step 3
 - o *EasT* students explain their subtopic and the research
 - o *EasT* students narrow their subtopic to 3 concepts that they teach
 - o *EasT* students start brainstorming ideas for possible design challenges that illustrate those 3 concepts.

Assignments – due next Monday at 11:59 PM – for each *EasT* student

- Write 1-paragraph reflection on today’s lecture – what did you learn?
- Read “*Pedagogies of Engagement*” from Smith K., Sheppard S., Johnson D., Johnson R. Write a reflection on what an engaging classroom looks like and whether or not you believe that group learning is a better approach to learning science and engineering.

WEEK 3 – TINKER, TINKER!

Activities:

- Attention grabbers – *EasT* students learn strategies to get the attention of the group, such as, “Simon says”, “If you can hear me clap once...”, or “Clap to the rhythm”
- Practice Teaching - *EasT* students break into small groups and teach each other their chosen topics
- Brainstorming design challenges - *EasT* students work in pairs and brainstorm 2 possible design challenges for their subtopic
- Class discussion – *EasT* students discuss what makes a good design challenge.
- Tinkering - *EasT* students spend time creating a good design challenge that meets Iridescent’s [good OEEDC](#) design constraints.

Assignments – due next Monday at 11:59 PM – for each *EasT* student

- Write 1-paragraph reflection on today’s lecture – what did you learn?
- Read “*Listen to your kids*” from Thomas Harvey and write a reflection on why it is essential to remain in touch with the child within *you*. Finish your design and send your instructor the following:
 - o Subtopic associated with design
 - o 3 concepts the design is illustrating
 - o Design challenge description (1 paragraph)
 - o Build 1 possible design that satisfies the challenge
 - o Pictures/video of your design
 - o List of materials used
 - o Short paragraph that explains why it is a good/bad design based on the OEEDC rubric

WEEK 4 – TELL ME A STORY

Activities:

- OEEDC presentations to the class – *EasT* students present their design challenges to the class and peers guess what concepts they were trying to illustrate and assess whether they have all elements of a good design
- Lesson Plan Discussion – *EasT* students discuss elements of a good lesson plan
- Story Telling – *EasT* students develop the story they want to introduce to the families and share it with the larger group
- Tinkering – *EasT* students develop mini designs and demo’s they will use

Assignments – due next Monday at 11:59 PM – for each *EasT* student

- Write 1-paragraph reflection on today’s lecture – what did you learn?
- Make your lesson plan # 1 and #2 that meets Iridescent’s lesson plan template. Please include demos (and demo materials), pictures, videos, and materials in your lesson plans.
- Create a separate “bullet point” outline for your lesson plan as you should be ready to teach your lesson in class next week. Do NOT make a script.
- Watch the following video’s of Jonathan Kozol, a former educator who has become an activist and voice for minorities living in low socioeconomic standing neighborhoods (specifically South Bronx and East Harlem). Write a paragraph about your own ideas and thoughts about the subjects of the video’s.
 - <http://www.youtube.com/watch?v=SgkZKTPEspg>
 - <http://www.youtube.com/watch?v=R09EfxHuIXA&feature=related>
 - <http://www.youtube.com/watch?v=YDMEFUWnxKs&feature=related>
 - <http://www.youtube.com/watch?v=TQsoU6CyGQw&feature=related>
 - <http://www.youtube.com/watch?v=7jYfzwneh6U&feature=related>
 - http://www.youtube.com/watch?v=g_H5dOD1XgQ&feature=related

WEEK 5 – LET’S TEACH!

Activities:

- First lesson teaching - *EasT* students practice their first full lesson with their peers who assess based on the “effective / ineffective learning” that was defined in week 2
- Feedback on lesson plan #1 and #2 – *EasT* students are given feedback that pushes the lessons to highlight “constructive teaching”
- Tinkering – *EasT* students develop the 2nd design for their group

Assignments – due next Monday at 11:59 PM – for each *EasT* student

- Write 1-paragraph reflection on today’s lecture – reflect on changes, new ideas, and designs that you have thought of or modified over the past 2 weeks
- Finalize your lesson plan #1 and #2 based on the feedback received in class.
- Finalize your second design
- Watch the following TED talk and comment on this style of learning. Do you agree with this approach? Why? http://www.ted.com/talks/dan_meyer_math_curriculum_makeover.html

WEEK 6 – EMBEDDED ASSESSMENT, THE STUDENT PORTFOLIO

Activities:

- Family Science assessment – *EasT* students are introduced to assessment of student learning and student designs and portfolios as a means of embedded assessment
- *EasT* students develop specific questions to assess learning
- *EasT* students also work on lesson plan #3 and #4

Assignments – due next Monday at 11:59 PM – for each *EasT* student

- Finalize your lesson plan #1 and #2 based on the feedback received in class.
- Research and write a short description of the school you will be teaching at commenting on: school size, leadership, interesting points/features, teacher-student ratios, comments posted, school mission, test scores, percentage of free-lunch, etc
- Finalize Family Science assessment sheet for lesson #1, #2, #3 and #4

WEEK 7 – BRINGING IT ALL TOGETHER

Activities:

- Presenting all designs - *EasT* students present their five designs for each week and practice teach their introductory lesson with a translator.

WEEK 8 - 12 – TEACHING THE FAMILY SCIENCE COURSE!

Assignments – due next Monday at 11:59 PM – for each *EasT* student

After each Family Science session, write a 1-page journal-style reflection on your teaching experience and observation feedback, analyzing: What went well; What needs to be improved; What are some specific ways in which to improve; Was last weeks’ reflection incorporated into the teaching?