Infusing Undergraduate Research in Natural Sciences_Biological Sciences_BSC 1011
LARGE LECTURE

I. Infusing Undergraduate Research in Natural Sciences_Biological Sciences_BSC 1011

a. Genet, K.S.,Anoka-Ramsey. 2021. The Cure for Introductory, large enrollment, and online courses. Scholarship and Practice of Undergraduate Research 4(3):13-21
Explains the use of citizen science projects as CURE courses. Several programs are producing large amounts of data (images and videos) on the presence, behavior or movements of animals in different parts of the world. This data collected by scientists or citizens can be used as an educational tool to introduce the research process to students at any educational level. This paper introduces the Wildcam Gorongoza in Africa but could be applied to any other citizens science project that utilizes images/videos of animals.

b. Shuster, M.I., J. Curtiss, T.F.Wright, C.Champion, M.Sharifi. 2019. Implementing and Evaluation a Course-Based Undergraduate Research Experience (CURE) at a Hispanic -Serving Institution. Interdisciplinary Journal of Problem-Based Learning. 13(2)
Article provides an assessment tool specifically designed for CURE courses to assess student persistence, scientific self-efficacy, scientific identity and valuing scientific community objectives.

c. Butz, A. R., and Branchaw, J. L. (2020). Entering Research Learning Assessment (ERLA): Validity evidence for an instrument to measure undergraduate and graduate research trainee development. CBE—Life Sciences Education, 19(2), ar18.
Survey assessment tool of undergraduate and graduate student development in research mentored activities with research laboratories.

d. Brownell, S.E., D.S.Hekmat-Scafe, V.Singla, P.C.Seawell, J.E.C.Iman, S.L.Eddy, T. Stearns and M.S.Cyert. 2015. A high-Enrollment Course-based undergraduate research experience improves student conceptions of Scientific Thinking and Ability of Interpret Data. CBE Life Sciences Education 14-1:14.
A curriculum was developed to train students to engage in a scientific inquiry by providing an open ended set of written prompts, on a specific topic in molecular biology. Students indicated that experimental repetition, data analysis and collaboration as essential in science and course exams revealed that students performed better on critical thinking exam questions.

e. Branchaw, J., Butz, Amanda, A. Smith 2020. Entering Research: A Curriculum to Support Undergraduate and Graduate Research Trainees. 2nd edition. Volume 2. W.H. Freeman/Macmillan Learning, New York. ISBN-13:978-1-319-26368-3.
Available for Free download at http://cimerproject.org
This scientific mentoring curriculum was developed by way of 95 active learning modules that cover several aspects of the scientific research process and empower students to succeed in research. The modules or activities are available for free download and are accompanied by detailed facilitator instructions and implementation recommendations on inclusion.

f. Kimberly D. Tanner 2013. **Structure Matters: Twenty-One Teaching Strategies to Promote Student Engagement and Cultivate Classroom Equity.** CBE—Life Sciences Education Vol. 12, 322–331, Fall 2013
Extremely helpful detailed strategies that maybe be adapted to any classroom to promote student engagement and equity.

II. Research-Based Course Activities

a. FAU Biosphere Project – Students will have access to an extensive set of images (50,000) of animals that visit gopher tortoise burrows at FAU, including the burrowing owls.
Implementation: students will work in groups of five students during specific class times and outside of class to develop projects that would represent 25% of their class grades.

In Class Activity 1 - Instructor will introduce the scientific method and the FAU Biosphere data bank.

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Student Learning objectives (Knowledge):

- students will learn about the scientific method
- students will learn about the and scientific process (from observation through publication)

Activity from book Entering Research (Branchaw et al 2020).

1. Science or Pseudoscience?
2. Scientific literacy test
3. The Nature of Science

Implementation:

Individual and Group work: Students to complete sheets #1 and #2 individually and then discuss in groups of 5 students (15 min). Students then complete sheet #3 individually (5min) and then discuss with the group (10min).

Instructor (facilitator) to ask for one person from each group to answer one of the questions out loud (volunteer basis and not all groups will speak because I will have 70 groups). Instructor fills in missing information, corrects information and clarifies the scientific method (good idea to have one slide of the scientific method)

Homework 1 - Instructor asks students to develop questions that can be answered by the type of data that is provided in the FAU Biosphere data bank.

In Class Activity 2 – Instructor discusses whether questions proposed can be answered by data provided to students. Introduces literature searches and annotated bibliography. *Homework 2* – students have to revise their research questions and conduct a literature search and annotated bibliography on their research question and submit for instructor approval.

In class Activity 3 - Instructor will introduce students to characteristics of a good hypothesis and will facilitate an active learning activity in class for students to develop a hypothesis in class based on their research questions.

Students Learning Objective (Formulate Hypothesis):

- students will learn to identify the characteristics of a good hypothesis
- students will learn how to develop a good hypothesis

Activity: Research Writing 1: Background information and Hypothesis or research question (Branchaw et al, 2020)

Implementation:

- *Individual work*: students will complete the activity sheet individually as homework and bring it to class (30 min to 1 hour)
- *Lecture:* in class short lecture by instructor on characteristics of a good hypothesis (15 min)
- *Group Work:* students will discuss their proposed hypothesis in groups of 5 students and have a chance to hone in the hypothesis (30 min)

- instructor/facilitator asks for one volunteer per group to address a good hypothesis from their group and explain its characteristics. What makes it a good hypothesis?

Considerations: Keep the same composition of groups between classes or allow groups to change so students can get to know more people in class (pros and cons)? When it is time to assign groups to conduct group project, do I allow students to self group or randomly assign students to groups? (pros = students can select people that live close to them or have similar schedule; cons= shy students who do not know other students will be left without a group)

Homework 3: Students will conduct a peer evaluation of another student's hypothesis using a rubric

In class Activity 4 – Students will learn to develop an experimental design, collect scientific grade data, and data analysis. *Homework 4:* students will develop the experimental design and expected outcomes and bring to class for peer review.

In class Activity 5 – Peer review of experimental design and expected outcomes. *Homework 5:* students submit final description of experimental design and expected outcomes for instructor approval.

In class Activity 6 – Students will begin to collect and analyze data . *Homework 6:* students will submit data collected and initial graphs, figures or tables for evaluation by instructor.

In class Activity 7 – Students will learn how to develop a scientific powerpoint presentation to be delivered in class *Homework 7:* students will develop and submit powerpoint presentation for instructor approval.

III. Assessing Undergraduate Research and Inquiry Activities

Use a bulleted list to describe how the research-based course activities will be assessed in your course.
In class Activity 1.

In class activity 1 -Assessment: Could be another science literacy test with more challenging questions or use the same test with pre and post and no discussion of the test (Think about it)

In class activity 2 – Assessment – Instructor review of homework with rubric (TBA)

In class activity 3 - Assessment: Worksheet can be collected after class to assess student's learning. Individual assessment.

In class activity 4 - Assessment: peer review in class

In class activity 5 - Assessment: Review by instructor with rubric

In class activity 6 - Assessment: Review by instructor with rubric

In class activity 7 - Assessment: Review by instructor of quality of research project and presentation with rubrics

Program assessment - End of semester survey using qualtrix survey by Shuster et al. 2019 and Butz et al 2020.

IV. Additional Resources

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a. **Faculty Resources**

ii. **Society for the Advancement of Biology Education Research – SABER**
http://saberbio.wildapricot.org

iii. **Center for the Improvement of Mentored Experiences in Research - CIMER**
http://cimerproejct.com (Free downloadable curricula)

iv. **National Research Mentoring Network – NRMN** – http://nrmnet.net

V. **Contact Dr. Evelyn Frazier (efrazier@fau.edu) for additional information about this course/discipline area.**