

Education Session
Midwest Developmental Biology Meeting June 6, 2004
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Suggestions for the classroom:

1. Have students in small groups or singly present parts of the assignment.
2. For each topic hand out thoughtful questions or problems. Students must come to class with written notes that answer the questions or make notes on problem solutions. Discussion in class.
3. Use original research papers instead of textbook readings in part or totally. Provide guiding questions for students to answer.
4. Use a research paper or topic as a "case"; do in steps by small groups. Use news reports too & compare.
5. Have students choose research paper topics, reviews, or even text explanations; have a poster session.
6. When students come to class have them assemble in small groups; assign the questions on your handout for the topic. They should take minimal time since they are prepared. Each group writes out their answers on the board and then each group will present their answer for whole class discussion.
7. The first day of class start the students talking by coming up with questions about development or requests for topics to be included in the course sessions.
8. Always have all work stop ten minutes before the end of class for students to write a reflective piece on what they have learned, what they have questions about, what they want to know more about, or most of all what they saw today that connects to something they have read or we have talked about previously.
9. Have students write 1 page papers to explain the difficult topic you just finished as though they were teaching a fourteen year old (or 10 or whatever).
10. Use "just-in-time-teaching" (JiTT) so that they must respond to your online questions by 2 hours before class. You then go to class prepared to emphasize points that many did not understand or about general misconceptions or incomplete thoughts.
11. Have practice quiz/test and after students write for 5 to 10 minutes, have them discuss the answer with a neighbor and then share some examples orally and / or collect answers in order to write comments or use their answers to explain the issues. Do practice writing often and insist on them using their own words rather than copying anything from any source.
12. When you teach in ways that students do not expect, you must keep explaining "WHY" you are doing that. You need to show them how they are improving & how they are discussing problems like scientists.
13. Emphasize the need to come to class prepared in order to share, participate in discussion, ask questions, and to understand the complex issues in current developmental biology research. You must give them incentive, namely participation points, collaborative group or individual writing in class for points, and the ability to understand the exciting new research.
14. Have students "act" [skits] as cell parts or molecules/atoms to help them to understand some process.

Suggestions for the laboratory:

1. Have students in groups of 2 to 3 work on original research projects. You will probably have to have some restrictions for organisms, type of study, and use of instrumentation and supplies.
2. A modification of this might be to have student groups all work on one overall problem, but each group will be doing a specific part of that project. This might be related to the research of the instructor.
3. Use current research papers to write laboratories so that the students in the whole class or one small group will be able to extend this research, but have knowledge about where to begin.
4. Allow students to follow previously published research for one laboratory and then in groups to modify the protocols for the next 2 to 3 weeks in order to have an original extension project.
5. Have students keep organisms in the laboratory or student project space in order to describe developmental progress in detail for those organisms. For all laboratories students MUST keep records.
6. Have students use a digital camera on a microscope to take pictures of slides and present posters or a slide show to teach the others about their embryo at a certain stage or follow a certain structure over developmental time.

Current web sites as of May 2004:

<http://www.sdbonline.org/> LOTS of web sites: member labs & courses & *Developmental Biology*
<http://www.sciencemag.org/cgi/content/full/304/5670/521/DC1> from 4-31-04 *Science* article on scientific teaching - LOTS more web sites, etc.
<http://www.Colorado.edu/MCDB/MCDB1111> and <http://knowledgefactor.net/> are both sites from M.W. Klymkowsky at MCD Biology on introductory course, but lots of ideas
<http://bioliteracy.net> is from the same origin, but is an interactive site where you can add ideas
<http://www.biology.iupui.edu/biocourses/N100/> <http://www.biology.iupui.edu/biocourses/Biol540/>
<http://webphysics.iupui.edu/jitt.html> and <http://webphysics.iupui.edu/webscience/webscience.html> all come from K.A. Marrs and colleagues at IUPUI on biology courses taught using the JiTT noted above and see the Marrs and Novak article.
<http://www.pkal.org> Lots of ideas about places to learn about teaching and learning
<http://www.aacu.org/SENCER/> This is AAC&U project on civic engagements / has 4 model courses
<http://www.nap.edu/books/0309072778/html/> Site to see and if desired to download 2002 text about improving science teaching edited by Fox and Hackerman - see below.
<http://www.ijdb.ehu.es/> *International Journal of Developmental Biology* - Special issue 2003 on Education
<http://www.flaguide.org/> site on assessment techniques including SALG [HEADY course instrument]
<http://www.cellbioed.org/> Online journal *Cell Biology Education [CBE]*
<http://www.sundancepub.com> Click on Dr. Brenda Parks NSTA presentation - integrate science content & literacy
<http://www.biologists.com/web/index.html> *Journal Development*
<http://www.interscience.wiley.com/jpages/0265-9247/> *BioEssays*
<http://www.developmentalcell.com/> *Developmental Cell*
<http://books.nap.edu/books/0309085357/html/index.html> book on transform undergrad science - below
<http://www.aspb.org/education/> American Society of Plant Physiologists Education site
<http://server.dmc.marine.edu/> Darling Marine Center - courses for teaching DB

A few of the MANY helpful books & articles:

Ambrose III, H.W. et al. 2002 *A Handbook of Biological Investigation* Hunter Textbooks, Inc. Winston-Salem, NC
Board of NRC 2003 *BIO2010: Transforming Undergraduate Education for Future Research Biologists* NRC
Druger, M. et al. 2004 *Teaching Tips: Innovations in Undergraduate Science Instruction* NSTA Press Arlington, VA
Freedman, R.L.H. 1999 *Science and Writing Connections* Dale Seymour Publications, White Plains, NY
Handelsman, J. et al. 1997 *Biology Brought to Life: A Guide to Teaching Students to Think Like Scientists* Times Mirror Higher Education Group, Inc. Dubuque, IA
Handelsman, J. et al. 2004 Scientific teaching *Science* 304, 521-522 LOTS of info from online supplement
Journals Collection 2002 *Innovative Techniques for Large-Group Instruction* NSTA Press, Arlington, VA
Kitchen, E. et al. 2003 Teaching cell biology in the large-enrollment classroom: Methods... *CBE* Fall, 180-194
Marrs, K.A. & G. Novak 2004 Just-in-Time teaching in biology: Creating an active learner classroom using the internet *CBE* 3, 49-61
McLachlan, J.C. 2003 Using models to enhance the intellectual content of learning in developmental biology *Int. J. Dev. Biol.* 47, 225-229
NRC 1999 *How People Learn: Bridging Research and Practice* NAP, Washington, DC Also online
Siebert, E.D. et al. 1997 *Methods of effective Teaching and Course Management for University and College Science Teachers* Kendall/Hunt, NY
Siebert, E.D. and W.J. McIntosh 2001 *College Pathways to the Science Education Standards* NSTA Press Arlington, VA
Tobias, S. and J. Raphael 1997 *The Hidden Curriculum: Faculty-Made Tests in Science I & II* Plenum Press, San Francisco
Wood, W.B. and J.M. Gentile 2003 Teaching in a research context *Science* 302, 1510