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ConcepTests for Introductory Astronomy

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TYPICAL ASTRO 101:

- large (>100 students)
- Earth to Cosmos in one semester
- phenomenological not conceptual
- well-practiced lectures, heavy on AV, graphics
- multiple choice exams emphasizing recall
- competitive grading discourages student interaction

GETTING STUDENTS UNINVOLVED!

- numbing blizzard of rules and facts
- critical thinking not engaged
- science by authority not adventure
- social/collaborative nature of science lost
- no personal stake

CLASS IMPLEMENTATION
An Example of Peer Instruction

http://hea-www.harvard.edu/˜ pgreen/educ/PI.html

○ *First class:* gauge student background and prior knowledge. Prepare them for conceptual class mode.

○ Reading quizzes: encourages reading before class, and dispenses with the factoids.

CLASS IMPLEMENTATION
An Example of Peer Instruction

○ Lecture briefly in ∼standard format on one of the fundamental concepts to be covered.

○ Present a ConcepTest: a short multiple-choice question tests students' understanding.

○ After 1 minute, the students record an answer and are asked to turn to their neighbors to try and convince them of their answers.

○ 3 minutes for discussion and reconsideration, then each records a (new?) answer.

○ A quick tally decides whether to stay on this concept, or move on.

BENEFITS OF CONCEPTESTS

o Emphasize conceptual over rote learning.

o Emphasize student involvement in the learning - and scientific - process.

o Engage student ego and attention.

o Provide student self-gauging.

o Provide real-time student/instructor feedback.

o Anticipated misconceptions challenged, unanticipated misconceptions unearthed.

o Extensive documented success in Intro Physics!

ASTRONOMY CONCEPTEST DATABASE

<u>Source 1:</u> Instructor/Collaborators

Access Limitation
- increases the database
- prevents student access
- increases instructor participation
- facilitates evaluation, attribution, and modification

<u>C</u>urrently:
- 20 questions makes you a collaborator
- about 300 questions now on-line, organized by topic

http://hea-www.harvard.edu/˜pgreen/educ/ConcepTests.html

ASTRONOMY CONCEPTEST DATABASE

Source 2: Quiz Genie

- Instructor clicks on topics of interest from a searchable menu ($\sim$ 20 topics, 250 subtopics)

- Genie generates and displays multiple choice questions, answers highlighted.

- Questions recommended for ConcepTests are highlighted.

- Instructor selects desired questions.

- Genie returns an exam with headings.

Currently:

o $\sim$5,000 questions each cross-indexed by subtopic (246 total)

o Seeking Java programmer

http://hea-www.harvard.edu/~pgreen/
educ/ConcepTests.html

FORMAT of QuestionBank
alà Ohio State

```
                                                         asked of
                                                         1009
                                                         students
question                                                    |
ID                                                          |   74.5%
|                                                           |   right
| Number of answers                                         |    | 22.8%
|     |                                                     |    | wrong
|     |                                                     |    |  |
CAV   5


If the force of the sun's gravity were suddenly turned off  1009 745 228CAV
*)the earth would continue to move, but in a straight line   763 756    CAV
1)the earth would move directly away from the sun             87  86    CAV
2)the earth would stop moving                                 24  23    CAV
3)earth would spiral around sun at increasing distances       67  66    CAV
4)None of the other answers is correct                        65  65    CAV
>> NEWTN GRAV ACCEL
      |
      |
 List of relevant subtopic codes
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A HANDFUL OF REFERENCES
for Peer Instruction and ConcepTests

- Paul Green's Peer Instruction for Astronomy HomePage:
    http://hea-www.harvard.edu/ pgreen/educ/PI.html
  and Astronomy ConcepTest Database
    http://hea-www.harvard.edu/ pgreen/educ/ConcepTests.html

- Eric Mazur's Physics Peer Instruction HomePage:
    http://mazur-www.harvard.edu/Education/EducationMenu.html
  and its implementation
    http://physics11.harvard.edu/center.html

- Implementation at Eastern Michigan University:
    http://www.emich.edu/public/fcie/usingpeerinstruction.html

- ConcepTests for Chemistry and Implementation at Wisconsin:
    http://www.chem.wisc.edu/ concept/

PUBLICATIONS:

- Zeilik, M. et al. 1997, "Conceptual Astronomy: A novel model for teaching postsecondary science courses", Am. J. Phys., 65, 987

- P. M. Sadler 1992, "The initial knowledge state of high school astronomy students", Dissertation, Graduate School of Education, Harvard University

- Hake, R. 1998, "Interactive-engagement vs traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses," Am. J. Phys., 66, 64. See also http://carini.physics.indiana.edu/SDI