

Teaching Methods

The Game Show Challenge: Catalyst for Student Participation in Plant Propagation

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SUMMARY. The game-show format, used recurrently in an undergraduate-level, introductory plant propagation course, fostered a friendly, competitive incentive for students to master facts and concepts critical to understanding processes in plant physiology. Because student teams, rather than individuals, served as the contestants in each game, and because game points were never translated into grade points, participants and observers learned from and enjoyed

the exercises without anxiety. Propagation-specific clues and questions were prepared for "Wheel of Fortune," "Win, Lose, or Draw," and other games. These were followed up at the end of each semester with several play-off rounds of a plant propagation variant of "Jeopardy!", which served as an excellent means of course synthesis and review of key concepts. The format allowed for liberal use of humor as an effective pedagogical tool and resulted in the hands-on contributions of former students in construction of new game quizzes and puzzles for subsequent semesters.

When asked *why* they initially enrolled in horticulture, forestry, natural resources and environmental sciences (NRES), plant sciences, or related curricula, undergraduate students are most likely to mention their enjoyment of plants, their love of nature and the great outdoors, or their interest in preserving the environment. Plant propagation, an entry level course in the College of Agriculture, Consumer, and Environmental Sciences at the Univ. of Illinois, has two features that these same students are likely to view as much less enticing: 1) it is a **required** course for undergraduates in the horticulture science and horticulture production and management options and 2) it is centered on the **scientific basis** behind practical strategies in plant production industries.

Required courses, no matter what the subject matter, have a drawback in that there will always be some students who have a predetermined lack of interest and who enroll in the course only because they feel coerced to do so. Science-based courses are further

disadvantaged because many students, sometimes after their initial experience in an introductory chemistry or microbiology class, immediately equate the terms scientific hypothesis, math conversions, or lab experiments with unpleasant past experiences. Practically oriented underclassmen interested in plant production and service industries may have low tolerance for these topics.

Plant propagation is also a course that should, ideally, capture student interest while providing them with a strong, basic appreciation of how plant physiology, soil physics, and phytochemistry affect living plant responses. Genuine student learning and comprehension, by all accounts, is closely tied to the degree of student motivation (Malone and Lepper, 1987; McKeachie, 1986). Extensive education research has also indicated that active participatory learning can be more effective than passive learning via lecturing alone (Davis, 1993; McKeachie, 1986). To build an incentive-driven context for mastery of science principles in this setting, a team-centered game-show strategy was built into the required plant propagation laboratory and discussion course, which typically hosts 40 to 50 students per fall term. The format was specifically designed to introduce a science emphasis in ways that could be fun, as well as enlightening, and to present the information in a familiar context. Incorporating the games into the teaching program increased the levels of at least three factors contributing to student motivation: student involvement, variety, and rapport between students and instructors (Forsyth and McMillan, 1991; Sass, 1989). The games simultaneously review and emphasize key points, reinforce new vocabulary, and help students learn from teammates how to solve problems. The games intentionally stimulate friendly competition, but students know from the onset that actual grades or credit points are never part of the game score keeping.

The team approach

In the first scheduled lab session, students are instructed to form teams comprised of three to four members. They are asked to come up with a team name, which will be their tag for the entire semester. The team name must have a plant propagation theme and

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ideally give some indication of the personality and composition of the team. Student ingenuity is evident in many of the team tags created in past semesters: The Bad Seeds; Natural Bulb Killers; The Germinators; Seeds-R-Us; Hydroponic Hooplah; Bud Studs; The *Positive* Greenhouse Effect. Students are encouraged to use the team approach to tackle challenges in weekly laboratories, on problem sets, or in the games setting. The team setting provides a broader range of skills and backgrounds students can draw on for solving problems, and team members are made responsible for structuring and organizing some of their own learning experiences in laboratory sessions (McKeachie, 1986).

During "Graffiti Challenge" (a 5- to 10 min in-class activity used periodically throughout the semester), thought-provoking questions relevant to the most recent topics covered in class are scrawled on large sheets of buff paper placed at three or four different locations in the lecture room. Based on the material covered in preceding weeks, students are asked to suggest a scientific explanation for the queries. In some cases, hypothetical problems are posed relating to the previous lab session. In other cases, supplementary questions are posted with current newspaper articles ("Garlic Mustard Pest Invades Rangelands"; "1,288-Year-old Lotus Seed Sprouts Modern Growth: UCLA Scientists Seek Anti-aging Clues") or plant specimens (inbred and hybrid petunia lines; reverse-polar grafts; chimeral vegetative mutants) that illustrate or reinforce the scientific queries. Student teams assess the questions in random order, provide their own suggestions and explanations labeled with their team tag on a post-it note, and affix it to the graffiti sheet. Of course, each team may consider answers provided by other teams before answering some of these challenges. Answers are ranked, pooled, and discussed in class.

Growth regulator calculations, which are important for each student to master before setting up treatments in the laboratory, have always been a particularly challenging subject to explain in lectures. Concurrent with in-class coverage of growth regulator formulations, two or three graffiti sessions have been exclusively devoted to postings of growth regulator problems. Students have particularly ben-

efited from the peer teaching that occurs as lab teams tackle problemsolving together on the graffiti sheets. Since there are always alternative ways to approach math calculations, and individual students may be more comfortable with a different method than that used by the instructor, this exposure to other problemsolving methods has helped reduce math anxiety or the tendency for some students to give up before really trying to set up a calculation (Sarason, 1987). The math-oriented graffiti sessions give ample opportunity for students to think through problemsolving approaches before tackling them on exams. (Math-related graffiti sessions, with three to five calculations to be solved, typically extend well beyond the 5- to 10-min limit usually imposed for other graffiti sessions).

The questions discussed in depth during graffiti sessions frequently become candidates for future exam questions. The high level of discussion observed among team members and the quality of the resulting answers seem to indicate that this is a particularly effective teaching tool. Alternative ideas for this type of graffiti assessment in-class strategy were discussed in an open forum as part of an ASHS workshop Market-Driven Education: Strategies for Teaching Today's Students (Stack, 1994).

The following example questions from Graffiti Challenge illustrate how students may learn or apply information they have already learned in several different ways. As noted previously, mathematical calculations of growth regulator concentrations and conversions of units appear here as well as on quizzes, exams, and problem sets. A hypothetical question, such as "A friend planted some *Robinia* seeds he collected last month from his yard, but none of them germinated. What might be the problem?" initially seems simple but has many possible answers, encouraging brainstorming by all group members and illustrating the complex interaction of plant physiology and the environment. Students realize that they must appreciate the life cycle typical to the plant being considered, evaluate whether the seed was mature at time of collection, and consider what types of dormancy could be involved. Students must also apply this kind of reasoning to interpret the sample newspaper articles posted as

graffiti; e.g., the garlic mustard article cited previously. A chance to synthesize known facts and devise solutions to a new problem is provided by the question "Your boss wants you to hybridize two ferns. What conditions will be required and how might you accomplish this feat?" When presented with a segregating population of petunias, the question "If this progeny resulted from a self pollination of single parental plant, was the parent an inbred or hybrid? Why?" gives students an practical opportunity to apply learned principles when observing plants.

For this exercise, team names give students an immediate sense of identity—or a chance for anonymity. When answers are given under a team name rather than labeled by individual students, there is a degree of protection from embarrassment over a wrong answer or faulty reasoning. The same advantage is in force when students are asked to log results of lab experiments on the board for cross-comparison of data and calculations of trends within the entire class. Outlier results are immediately apparent, but reasons why can be suggested with humor, and individuals are not put on the spot. The teams provide a sense of camaraderie and give students ownership and identity as they contribute to the course.

Game show competitions

Team solidarity is strongest during the game show activities created for plant propagation class. The games are mostly adapted versions of television game shows. Students are motivated to compete with other students in game show activities, but entire teams (as a panel) serve as the contestant for each competition—individual students again are not put into the situation of being tongue-tied and not remembering the answer.

Early in the semester, when the fall weather is still warm enough, teams are selected randomly to participate in the "ECO-PARA-ENDO Steprace." Previous to this game, the class has learned all about different dormancy mechanisms that regulate seed germination and adaptation to an environmental regime: ecodormancy (seeds don't germinate due to lack of environmental triggers), paradormancy (seeds don't germinate until inhibitors or blocks in the seed coats, fruit, or

endosperm are broken down by weathering, digestion of the seed coat in an animal gut, transport of seed down a stream, etc.), or endodormancy (the seed embryo is incapable of responding until a timed, moist-chilling treatment is satisfied). The class moves outside and teams line up on equidistant markers. The instructor and two teaching assistants each coach individual teams, rapidly firing questions to the team member at the front of each line. Questions have only one of three answers—eco, para, or endo—and refer to the type of dormancy mechanism in the example. The lead student who answers quickly and correctly advances one space, and gets a chance at a bonus question. The student who answers incorrectly must return to the first marker, and begin the stepwise question-by-question advance again from the beginning marker. A team wins when three members have each advanced to the front marker. This is a good exercise for an outdoor session, because the questions are shouted loudly and in rapid succession to the teams, questions are delivered to all three teams simultaneously, which creates a cacophony, and team members and even the portion of the class not directly participating in the game tend to cheer on the participating teams and shout out correct (and incorrect!) answers. Improvement in the participating student's performance has been observed by lab instructors even within the short duration of the game. Frequently, students have been motivated to request copies of the game questions for independent study or for their own use in review sessions as a team.

A version of "Wheel of Fortune" is presented next. Student teams must decipher mutated versions of popular movie or TV titles or phrases (having just studied mutations that occur in clonally propagated plants). As in the popular game show, a series of blanks are displayed and team members are expected to guess a consonant or a vowel. The prize for a correct guess is not cash, of course, but receipt of a clue to help solve the puzzle and another chance to guess a letter. Points are tallied on the board only to foster friendly competition between teams and to allow students to follow their progress. After filling in a few of the letters

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and accumulating a few clues ("Incompatible crosses result in a fruit that is _____"; "Triploid melons have this property"; "Meg and Tom can't find anything to pollinate"; "Parthenocarpic grapes near Tacoma"), eventually a team will decipher the title

SEEDLESS IN SEATTLE

and new titles (e.g., Teenage Mutant Ninja Tubers, Sphagnum Force, Candid Chimera) and new sets of pertinent clues come in to play. In this game, clues play an important role in the repetition of vocabulary and concepts in a distinctly different and challenging way.

A game of "Win, Lose, or Draw" (a.k.a., "Pictionary") is played later in the semester. Similar to the previous game, the teams compete to guess mutated show titles with distinct propagation themes like "All's Quiescent on the Western Front," "Remains of the Daylily," "The Budded Holly Story," "The Podfather," "Internode with the Vampire," "Stolon Kisses," or "Cloneheads." Propagation structures and tactics must be sketched in cartoon-figure format on the board as other team members guess the clues until the title is deciphered. In the process, information relevant to the plant propagation strategy is reinforced.

In both of the previous games, high levels of participation even among the noncompeting students has been observed. Students in the back of the room may stand up on seats to see or hear clues better; laughter and often groans come from the observing students as they try to solve the puzzles before the contestants. The instructor has frequently needed to remind the class, "Audience, no help, please!" Since there is no coercion for noncompeting students to participate, their motivation is intrinsic because they find the games fun, challenging, or humorous.

Other games are included throughout the semester as time allows, including find-the-term puzzles or cryptograms that make otherwise daunting terms for specialized structures (e.g., cormels, bulbils, bulblets, pseudobulbs, stolons, etc.) a challenge to find and identify within a short span of game time.

The finale game show, played in brief sessions two or three times during the final weeks of class, is "Jeopardy!," which is an excellent way to review rapidly all of the diverse sub-

jects presented over the course of the semester (from seed dormancy mechanisms to hormonal interactions during regeneration to automation strategies in mass plant production). One of the acknowledged keys to the instant success of "Jeopardy!" on television was that the questions are more rigorous than other game shows—at first considered by industry experts to be far too difficult for the average viewer (Trebek and Barsocchini, 1990). Similarly, the level of questions designed for "Jeopardy!" review sessions in a plant propagation class are intentionally designed to be exacting and in-depth, usually requiring collective team deliberations to arrive at the correct answers. Interestingly, a similar format was recently cited by Gibson (1991) as an effective review technique for psychology concepts in class.

For "Jeopardy!," student teams each have some kind of noisemaker (a bell, horn, triangle, buzzer), and the first team to sound the noisemaker can provide a question corresponding to the answer forwarded by the instructor. Cryptic category titles like "The Polar Regions" (provide questions for these answers related to the physiological polarity of propagules), "J&M" (provide questionsrelated to the phase change—juvenile or mature—of plants), and "Raging Hormones" (provide questions.....related to interacting hormonal controls in plant response) are offered for selection. This is a stimulating and particularly fun exercise because it moves so quickly, and everyone in the class gains from the information reviewed to cap off the class.

Conclusions and overall assessment

While some of the games created for in-class use are unique, a core of games are constructed to resemble the familiar game shows popular in daytime television. An assemblage of props has been collected or created to foster this resemblance, including loud buzzers, bells, and whistles to announce answers in "Jeopardy!" and a large colored rotating wheel for use during "Wheel of Fortune" games. The familiarity of the games puts the exercise into a context that is, in almost all cases, quite familiar to all of the students and allows them participate in ways that draw on their direct experi-

ence (as television viewers) or memories (Hirsch, 1987).

The game show team approach has been well received and, with practice, the games run more smoothly each year. However, advance preparation of new questions can be a time-consuming, creative exercise. To run the games quickly and smoothly and avoid using up excessive classroom time, it requires the help of two to three people (instructor and lab teaching assistants) to keep score, pose questions, and act as judges when the student answer isn't exactly what is written on the cue card. Finally, the actual time that will be consumed for a particular game session is quite difficult to estimate, as the instructor can only guess how long it will take a team to win the game. In some cases, the game may terminate a few minutes before the bell, which is not a problem. But in other cases, the bell may ring before all clues have been solved, which is a dilemma for students who are interested in finishing the game, but need to rush to their next class.

Student comments on end-of-the-semester evaluations indicate that the format is an effective memory-jogger and it helps prompt learning without frustrations associated with graded activities. Student comments on evaluations have indicated that the games were not only entertaining but also educational. For example, one former student recently wrote "I remember taking exams and chuckling to myself as I thought back to the games. It would often be the difference between recalling the answer for the exam question or not." Another student wrote "graffiti sessions.....allowed us to obtain a multiple-sided view of the same problem," and "we got to work together and interact, and that doesn't happen that often in a lecture room." Student ratings for the course have been uniformly high. As perhaps the best testimony in favor of this approach, former students frequently drop in to labs and lectures in subsequent years when they know a game is scheduled and rally behind friends currently enrolled in the course. (This is

one reason that it is critical to create new, never recycled, game-show questions for each new semester.) Fortunately, former students have also been an excellent resource for new material and have frequently suggested new mutated titles from movies and television shows or music to be used in coming years.

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