

J. Chem. Ed., **2003**, *80*, 967.

Simple HTML Templates for Creating Science Oriented Jeopardy! Games for Active Learning

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Abstract (# of words = 148)

To enable more faculty to use another component of Active Learning in their multimedia equipped classrooms, we have developed a comprehensive Sciences Jeopardy! games web site. Jeopardy! is a unique way to help students master the content of their local course. For faculty, Jeopardy! is an engaging, alternative exercise that can enliven lectures or recitations. The freely accessible web site (<http://chemed.chem.pitt.edu/Jeopardy>) offers a number of complete Jeopardy! games for Organic Chemistry, General Chemistry, and Biochemistry (both in web accessible or zipped, downloadable formats). More importantly, instructions, design aids, blank Jeopardy! files, and content templates (both in ChemDraw and PowerPoint formats) are provided so that anyone can create their own customized Jeopardy! game with no prior coding or programming experience needed. For the more experienced web programmer, adaptation of the html template files is straightforward if one wishes to include molecular animations (e.g., Chime images), sound, or other web-accessible enhancements.

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Keywords: Collaborative/Cooperative Learning, Internet, Multimedia, Teaching/Learning Aids

Area: "WebWare"

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Introduction

To make a class more dynamic, games can be used instead of a traditional lecture format (1, 2). Games, in general, are well known in education, even if not widely exploited in science courses (3). A game is designed to be extremely engaging while simultaneously challenging students to utilize their knowledge in a novel way. Time limitations inherent in creating the game content prevent many interested teachers from using them. Also, students today are very media savvy, possessing a high threshold for “acceptable” multimedia presentations. These high expectations for quality presentations may also serve to limit the number of lecturers who use games in the classroom. We have taken the initiative to partially solve these problems by posting a number of complete games on the World Wide Web (WWW) (4) and, more importantly, by providing templates and aids that dramatically reduce the time necessary to create your own customized Jeopardy! game (5).

In order for students to make new knowledge their own, they need to use critical thinking skills with that data (6). The Jeopardy! game provides a unique opportunity for students to assemble this knowledge by demanding they recall facts, utilize concepts, or draw analogies, in order to pose the question for which they are given the answer (7, 8, 9, 10). In short, students demonstrate true mastery of information when they verbalize concepts and “question the answer.”

Why Use Jeopardy! in the Classroom

From the student perspective there are many advantages to using games such as Jeopardy! in the classroom. Rather than passive regurgitation of concepts, the game engages the student in an interesting deviation from the class norm. The Jeopardy! format challenges the students to use their chemical knowledge in a different fashion because they must pose the question once they see the answer. Strategically, it is beneficial to require students to both apply knowledge they have learned and demonstrate mastery of that information in diverse ways (11, 12). Jeopardy! also offers a unique insight to students, as it provides a non-graded, self-assessment on what they still need to learn. Advantages that may be less obvious to the student include helping them relax before exams since the

game can reinforce how much they know. It may also encourage them to form study groups on their own since they are using groups in the classroom during the Jeopardy! events. In our experience, using Jeopardy! is more effective than traditional reviews which many faculty hold just prior to exams, since the Jeopardy! format ensures maximal class participation, for each and every question, even in large lecture halls.

Instructors benefit from using Jeopardy! as well since it promotes faculty interest in their course via a new mechanism. The instructor can gain valuable feedback as to what students really know versus what they say they know or do not know. For example, [Organic Game #3](#), *Review of Gen Chem Concepts Necessary for Orgo (4)*, can be used on lecture day 1 or in the first recitation, as a pre-test to ascertain which General Chemistry concepts may need to be reinforced. While the conventional mode of delivery in the past has been transparencies and overhead projectors (13, 14), and more recently MS-PowerPoint (15), the WWW is now open to everyone. We have made our Science Jeopardy! games and tools available (4) on the WWW, which is easy to access. The nature of HTML coding and the standardization of browsers make it rather straightforward to customize a very professional-looking game to your unique needs. We have therefore posted a number of complete games, and the creative aids, in a free-access site on the internet at <http://chemed.chem.pitt.edu/Jeopardy>.

When to Use Jeopardy!

There are several ways to integrate Jeopardy! into a course. In today's university setting, multimedia-enhanced classrooms are the norm. This renders delivery of the game trivial by either accessing the games using the WWW or by downloading a version to your computer, depending on preference. One of the primary areas where the game can be extremely effective is as a review. For instance, at the first recitation or (even the first class meeting) selected concepts learned in General Chemistry, but key to Organic Chemistry and assumed as having been mastered, are quickly reviewed in an engaging format (see [Organic Game #3](#)). We have used this in the first recitation for two years now, and on both occasions the Jeopardy! "icebreaker" has been extremely well received as an intro to an oft-dreaded course. A Jeopardy! game can be used at the end of each chapter, just prior to an exam (covering several chapters), or at the end of the semester. Our templates, and postings of relevant games authored by others, allow for as high a frequency of use as one might want.

Students may also design their own games as extra credit projects, since having students create questions and answers has educational benefits (16). Examples of some student-designed game boards are included on the

current web site ([Organic Games #5-8](#)). In principle, Jeopardy! may also serve to replace a lecture. Instead, a teacher uses a Jeopardy! game to test comprehension of a reading assignment that "taught" the topic traditionally covered in lecture (e.g., alkane nomenclature). Repetition of key concepts is a powerful educational tool, and Jeopardy! is a unique way to review important subject matter with students (17).

How to Use Jeopardy!

There are many ways to use Jeopardy. If the lecturer was to record the frequency of the different answers of a multiple-choice variant of Jeopardy! (e.g., [Organic Game #3](#)), she or he could assess which particular topics or concepts the students are having difficulty with. Such a multiple-choice game couples that Jeopardy! variant nicely with Audience Response Systems (ARS) (18, 19).

There are no hard and fast rules for how to conduct Jeopardy! in the classroom, however we will briefly summarize our experiences and encourage you to adopt and adapt the game play to what works best for your situation. Suggested rules for various implementations of Jeopardy! can also be found on the web site (4); select the "Recommendations for Using this Site" which contains two sub-sections, "Browser Recommendations" and "Game Play Suggestions". Many Jeopardy! "answers" can be fit to more than one question; thus an expert is needed to judge the correctness of the question for a presented answer. See, for example, the displayed answer in Figure 1 ([Organic Game #4, Final Exam Review, Chaps 1-11, Jones, 2nd Ed](#)) for one Double Jeopardy! item. In Figure 1b, the column category containing information relevant to determining the correct question is displayed at the top left, and the point value is displayed at top right (these pieces of info are also displayed on the main game board).

Organic Chemistry					
Returns to Single Jeopardy Board or to Game Selection Page					
Double Jeopardy: Final Exam Review, Jones, Chaps 1-11 (2nd edition)					
Trivial Names	Class of Rxn	Trends	Reagents	Synthesis	Starting Materials
100	100	100	100	100	100
200	200	200	200	200	200
300	300	300	300	300	300
400	400	400	400	400	
500	500	500	500	500	500


Starting Materials	for 400 points
Leads to a high yield synthesis of	
	
Return to the Game Board	

Figure 1a

Figure 1b

Figure 1: Two screen captures of a Science Jeopardy! game. (a) The Double Jeopardy! Game Board, from Organic Game #4: Final Exam Review, Chaps 1-11, Jones, 2nd Ed. (b) The displayed “answer board” for the 400-point entry of the “Starting Materials” category.

The method of student response one chooses should correspond to the enrollment size of the class. In large classes sheets of paper or an ARS may be used, while in smaller classes simple hand signals may be effective for the multiple choice games, while a team captain can serve as spokesperson for non-MC questions (20). The time to complete a game varies based on the type of game (traditional, multiple choice), how it is used (for a review, post lecture summary, etc), and how much time you spend after each question discussing it. We have found that using three teams in a large recitation (~100 students) of 50-minute duration, one can get through 1 game board (e.g., Organic Game #3), or slightly more, when discussion is limited to about 1 in 5 answers. Deciding whether or not to use rewards or prizes is a matter of personal choice. Prizes could be extra credit points, chemistry related trinkets (often donated as left over publicity items from a company or event), or food/candy; our personal opinion is that these games are best when not used to earn course points since the sole occasion on which we did this led to excessive student discussions on “partial credit” and complaints that the teams were not fair, among other actions that detracted from the collegial, enjoyable learning environment that we were trying to create. Other professors using games in class have also communicated to us, anecdotally, that awarding points for game play increased tensions in unexpected ways.

What Is Available?

One can use Jeopardy! via the WWW (4) or download existing games from that site to a local computer and display them directly (the latter method is the one we prefer). The Single Jeopardy! game board contains 6 categories with 5 questions each (e.g., Figure 1a). Complete Jeopardy! games include Single Jeopardy, Double Jeopardy! (twice the points but also 6 categories with 5 questions each, and harder than the Single Jeopardy! board), and Final Jeopardy. Some of the Jeopardy! games currently ready for use are summarized in Tables 1 and 2. The web site also contains one Biochemistry oriented Jeopardy! game (a final exam review). There is also a Miscellaneous Category at the website. The Jeopardy! concept is used in an enormous number of teaching and learning environments so we have included a game used in a symposium at the Society of Research Administrators' (SRA) Annual Meeting. Because our Jeopardy! presentations use an html approach, one is not limited to simple text and images. Animations, sound, and Chime (21) images can all be used, though incorporation of these more sophisticated elements require some html coding to be done. Organic Game #6 includes some Chime examples (4).

Table 1: Organic Jeopardy! Games

Game#	Topic	Categories (Single and Double Jeopardy)
1	Alkane, Alkene, Alkyne & Alkyl Halide Nomenclature	Alkanes IUPAC, Alkenes IUPAC, Alkynes IUPAC, Alkanes Trivial, Alkenes Trivial, Alkynes Trivial, Potpourri, Everyday Molecules
2	Alkane, Alkene, Alkyne & Alkyl Halide Transformations	Reagents Alkenes, Reagents Alkynes, Reagents Halides, Reagents Miscellaneous, Name the Pathway, Trends, Starting Materials, Numeric Values, Acids/Bases, Classes of Reactions, Should Know
3	Review of Gen Chem Concepts Needed for Orgo	Bonds, Hybridization, Lewis Structure, Shape, Specific Values, Potpourri, Acids & Bases, Kinetics, Periodic Trends, Resonance
4	Final Exam Review, Chaps 1-11, Jones, 2nd Ed	Specific Values, Rx Reactions, Nucs and Bases, Names, Define, Just for Fun, Trivial Names, Synthesis, Starting Materials
5	Electrophilic and Nucleophilic Aromatic Substitutions (a student designed game)	Aromatic, EAS/NAS, Mixed Bag, Reactions, Reagents, Substituents,
6	Fun with Orgo II (a student designed game)	Drugs, Drunken Reactions, Old Dead White Guys, Killer Reactions, Three Letter Acronyms, Nucleophilic Aromatic Substitution
7	Carbohydrates (a student designed game)	Potpourri, Polysaccharides, Reaction ID, Reagents, Biochemistry, Naming
8	Carboxylic Acid Derivatives (a student designed game)	Amides, Anhydrides, Esters, Nitriles, Acyl Halides, Pot Luck

Table 2: General Chemistry Jeopardy! Games

Game #	Topic	Categories Single Jeopardy! Only
1	Final Exam Review	Electrochemistry, Kinetics, Equilibrium, Acids & Bases, Thermodynamics, Transition Metals
2	More Final Exam Review	Formulas & Stoichiometry, Ions & Formulas, Units & Measures, Intermolecular Forces, Reactions in H ₂ O, Gases & Gas Laws
3	Even More Final Exam Review	Thermochemistry, Atomic Structure, Periodic Table, Bonding, Liquids & Solids, Acids & Bases
4	Acids and Bases	Arrhenius, Bronsted, Lewis, Strengths, pH, Potpourri
5	History of Chemistry	Gases, Radiation, Atomic Theory, Quantum Theory, Radioactivity, Potpourri
6	Atoms and Ions	Radius, electron configuration, Oxidation State, Polyatomic Inos, Periodic Behavior, Potpourri
7	Review of Basics	Units, Sig Figs, Nomenclature, Quick Calcs, Electrolytes, Potpourri
8	Bonding	Bonding & Forces, Lewis Rules, Lewis Models, Hybridization, Formal Charge, Molecular Geometry
9	Solids, Liquids, and Solutions	Solids, Calculations, Physical Properties, Intermolecular Forces, Conc, Potpourri
10	Thermochemistry	Calculations, Calorimetry, Concepts & Units, Define Convert, ΔH

Available on our web site (4) is complete documentation about how to use an existing game or create your own. To create your own basic game, no html coding experience is needed; one only needs to use either the provided ChemDraw (22) or PowerPoint templates to create the gifs used in the provided html code. Also included on the web site are zipped versions of all games we have posted (to simplify downloading to your local computer), the ChemDraw or PowerPoint files used to create each game (in case you want to modify only a portion of an existing game), zipped Single Jeopardy! or Complete Jeopardy! blank game files, and various other templates to assist you in your game creation. New games can easily be added to our web site at any time, so we anticipate the listing of already prepared games will continuously grow.

Conclusion

We are happy to add your Science Jeopardy! game to this web site; this is an affective way of sharing your hard work. The solution keys remain a troubling aspect, though. Some educators feel that both students and instructors are too dependent on solution keys. In the Jeopardy! game format, a solution key is sometimes ineffective because answers may have more than one correct question. This issue necessitates our recommendation for an expert MC. We have included solution keys to some of the games on the existing web site. If someone wants the game, but not the solutions, to be available to their students, they can download the game and post it on their

own server. It is up to you whether you tell your students about our site or not (where all available answers are posted). In appreciation of time constraints faced by instructors everywhere, we have tried to make our HTML format of Jeopardy! user friendly and adoptable by everyone; we welcome any suggestions for improvement.

Acknowledgment

We would like to acknowledge Michele Monaco for drawing and typing many components of the games on the web site, Rebecca Claycamp for the SRA game, Michael Keck for several of the General Chemistry games (as published in the *J. Chem Ed.*), our colleagues Leonard Kogut, George Bandik, Erika Cederstrom, and Paula Grabowski as well as JG's Organic Chemistry II class, Spring 2002, for design consultation and/or question preparation, and John Nigro for careful proofreading of the manuscript and web site.

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