It Takes Two to Tango: Cliché-Riddled Strategies to Get Student to "Buy In" to Student Response Device (aka Clicker) Use[‡]

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Abstract

Getting students to "buy in" to the use of any new tool or technology is often a challenge. Many educators have already committed to using student response devices (aka "clickers"), but clickers require active participation by students to be effective. This paper illustrates the author's perspective from both sides of the interaction (student and professor) and highlights several methods (e.g. syllabus, policies, and interactive exercises including "bar trivia") used by him to motivate his students of small (12-25) or large (170-200) lecture sections to utilize the clickers in a fun and pedagogically useful way.

Manuscript

The literature contains many examples demonstrating the virtues of student response devices, also known as clickers, and their role in making the lecture classroom a more interactive learning environment. (Casanova 1971; Brown 1972; Littauer 1972; Mazur 1997; Shapiro 1997; Hake 1998; Crouch and Mazur 2001; Judson and Sawada 2002; Duncan 2005; Hatch et al 2005; Wieman and Perkins 2005; Casem 2006; Zhu 2007) Recently Judson and Sawada (2002) and Herreid (2006) have provided excellent reviews of the history, pedagogy, and some of the pros and cons of clicker use in the classroom over the past ca. 40 years. To adopt the technology it is likely true that the instructor has bought in to the pedagogical utility of this style of interactive teaching, although nowadays the instructor is less likely to have to build their own system. But to be effective the students need to be committed to the method as well. As more and more campuses adopt this type of technology, it is imperative that teachers work to maximize its utility. Here I spell out some strategies I have found to be useful to get students to "buy in" to using these clickers. To keep it lighthearted and not reinvent the wheel, I have done so in a series of clichés.

Know Where You Come From

We each bring with us our own set of biases to our teaching based on our backgrounds. I teach at a mid-sized (ca. 22,000) Midwestern University and teach class sizes of between 8 and 350. These classes are either lecture, discussion, or laboratory style and cover freshman-, sophomore-, senior-, and graduate-level courses. I, personally, use clickers in many of them except the smallest senior-level laboratory course. I first saw the effectiveness of clicker systems in enhancing learning as an undergraduate in a physics class of Eric Mazur's in 1993 when

clickers had already been in the classroom over 20 years. (Judson and Sawada 2002) In using this method of lecturing, each student in Mazur's class was able to anonymously respond to questions he posed and the class was able to see how, as a whole, they had responded.(Mazur 1997; Crouch and Mazur 2001) This model of lecturing has been shown to be more interactive than traditional lectures and engage students in active learning, but still has had some shortcomings as the technology has been refined.(Littauer 1972; Duncan 2005; Hatch et al 2005; Casem 2006) To be honest, at the time I was not a big fan of clickers. I did not "buy in" to their use because they were clunky, complicated, and even made us accountable! But as I progressed through my own career to become an educator I came to realize the pedagogical value of clickers outlined elsewhere (Judson and Sawada 2002). Learning from that experience from the student side I have tried to incorporate it in to my own classroom. I have used the ConcepTests (Landis et al 2001) method of teaching in lecture classes – very related to the method of Mazur, but without clickers until very recently. In a pilot project undertaken in a 2006 General Chemistry II course involving clickers, it was enlightening to see the difference that anonymous responses make in giving a true sense of the understanding of a class! As a scientist, specifically a chemist, I have spent my whole research life as an experimentalist. Experimentalists "fail" a large majority of the time. But, if at first you don't succeed, try try again. We learn from our failed experiments and design improvements. The same is true of my teaching classroom. Therefore, I am willing to take more risks in the classroom, perhaps, than others. Many readers of this journal, however, will call themselves experimentalists. Keeping all of this in mind, we approach the problem of students buying in to clicker use.

Know Your Audience

Students are not as naïve as we may wish to believe. They are fairly good at being students and are wise to instructors who are not prepared or who are not committed to the class. I was reminded of this truth when re-reading Frank McCourt's *Teacher Man* (2005), where he states the following regarding the student/teacher relationship:

The kids arriving are juniors, sixteen years old, eleven years in school from kindergarten to today. So, teachers come, teachers go, all kinds, old, young, tough, kind. Kids watch, scrutinize, judge. They know body language, tone of voice, demeanor in general. It's not as if they sit around in toilets or cafeterias discussing these things. They just absorb it over eleven years, pass it on to coming generations.

Perhaps more scientifically, Ambady and Rosenthal (1993) have found that students were able, on average, to judge teachers that they had never seen before on most of the areas commonly found on teaching evaluations in as little as 2 seconds (although much more accurately in 30 s) just as well as students that had spent an entire semester with those teachers. Instructors, then, must be committed in order to convince the students to be committed.

Use It or Lose It

One critical element to getting students to "buy in" to clicker use is to be sure to make the students feel that their investment in the technology is worth it. Some/many will resent having to buy a clicker – this is avoided if an instructor hands out clickers for use in a class. Some students may have to buy multiple clickers if the campus has not adopted a universal standard. Thankfully our campus has adopted a universal standard and this was a major sticking point for me. Despite the long history of clicker use (at least before 1968 (Judson and Sawada 2002)),

some students will still feel as if this is a "new" technology that is untested and a waste. I often draw the comparison with a calculator, though. No one balks that our mathematics department requires the purchase of a ca. $200 calculator when a ca. $10 one will suffice for most of life. Similarly, a device that may be used throughout one's college career is certainly worth a small investment. Even so, I believe students must feel like they get their money's worth and I do so by being sure to use the devices 2-15 times per 50 minute class meeting. In 2 hour class meetings, we have had as many a 30 clicks. My own opinion is that, at present, this is not something you can use every once in a while. The present systems, however, are considerably less expensive than the hard-wired systems of old (Shapiro 1997) and costs are still decreasing, e.g. Miller *et al.* (2003) claim a cost of $50,000-70,000 to purchase a system where a comparable system could cost $1,000-3,000 now.

Fortune Favors the Prepared (or is it Bold?)

One of the most challenging parts of adopting the clicker system is the switch in lecture styles. Moving from acetate overheads to computer-projected presentations is difficult enough for some and involves a certain loss of flexibility in the order of presentation. For example, most available programs offer the ability to create student response questions on the spot ("on the fly" in our software) and, although slides on the fly work fine (if you can type fast), you are better off being much more well prepared. It also becomes more difficulty to "jump around", but some software offers the ability to jump based on the percentages answering correctly if you configure that beforehand. In terms of getting students to buy in, the take home message is that the system will be a tough sell if you are unprepared. Questions, themselves, are getting easier and easier to come by as many textbook publishers are providing content for introductory textbooks. I have had to generate most of my own content for upper level course and have also used the aforementioned ConcepTests.

You Reap What You Sow

To get the students to buy in to the technology, you must invest the time to get them to buy in to the technology. Time spent in class showing them how it works is well worth it in the long run. These time savings are especially noteworthy in large classes! For example on the first day of class, I explicitly point out the sections of my syllabus pertaining to clicker use. I discuss logging on (and/or changing the channel), registering, and use, among other topics that I term "housekeeping." One such slide presented during this section is shown in Figure 1. An explicit policy is critical.

Candy is Dandy, but Clicker is Quicker

The easiest way to engage the students in this technology and get them to buy in is to show them just how much fun clickers are! In all likelihood, many of them have either seen this type of system before (e.g. Who Wants to Be a Millionaire? Or Are You Smarter than a 5th Grader?) or even experienced it themselves (bar trivia)!, Figure 2. On day one, I include all three of the mentioned formats and the majority of students are "hooked" already.

It's the Economy, Stupid

Realistically, however, students and faculty operate in a "points economy" and I, therefore, have to "pay" to get students to really participate. Many of my colleagues employ clickers by having reading quizzes and questions worth points in class that account for varying

percentages of a student's grade, usually small. This type of usage is well discussed. (Ehrlich 1995) Personally, I do not penalize … much. In fact, my clicker questions can only favorably impact a student grade in several of the classes. I use an overly complicated grading algorithm (Figure 3), but it amounts to the fact that any given clicker question is "worth nothing", but all together they become worth something. For instance, in a recent general chemistry class, my students answered over 225 clicker questions over the course of the semester for the chance to *replace* their two worst online quiz scores with their clicker percentage, an absolute maximum of 12 points out of 760 assuming you got a 0/6 on two online quizzes and aced all of the clicker questions. One of my primary motivations for using the devices in my class is to encourage better student engagement in lecture, i.e. increase their participation in class, and my grading system is a reflection of this. My grading scale also reduces the incentive to just send your clicker to class with a friend, i.e. cheat. Perhaps as a result of this grading scale, though, I have not noticed the marked improvement in attendance (ca 80% in a large class) that is often reported.

Winning isn't Everything

Another way to get the students engaged in the class with clicker questions is to include fun questions every class, not just on day one. I ask a question before every class "just for fun" so students can be sure they are logged in… all answers are "correct". Sometimes they pertain to the reading or the material, but usually not. Several examples are shown in Figure 4. My university has been involved in the American Democracy Project (2008), so lately I have been asking civics-related questions before class and this has been enlightening for them to see just how little they know.

You've Got to Be in it to Win It

To be most effective in an engaged classroom, the students need to recognize that they are being engaged, i.e. that a question is being polled. The students also need to be able to monitor their participation to minimize the pain for you, the instructor. Some way to indicate that a response has been recorded is helpful. These vary from vendor to vendor, but some vendors offer a vote status indicator or an LCD screen on the clicker itself that simplifies this process. Else a response table on screen helps! Using this response table type of system, the students can make sure "their number" lights up… assuming they know their number! To achieve that end I have posted their "In Class Clicker number" as a column in my Blackboard (or a similar classroom management system) gradebook. Alternatively, a list of last names and clicker numbers has been posted online by some of my colleagues, but I have privacy concerns on that, myself.

A Stitch In Time Saves Nine

Part of the buy in process is giving the students some responsibility as well. I often tell them that I am not a clicker technician. As with their calculators, it is bring your own (BYO) batteries. Also, they must inform me immediately after class if there is a problem with their device so that I can give them participation credit, if appropriate. This is clearly stated in the syllabus and re-stated more than once. With the low penalty for not having your clicker on a given day, these problems self-correct quickly. Battery or technological issues in one session are much more important to my colleagues with large penalties or, for me, in the summer, when we may have 30 questions in a given class meeting.

Bread and Circuses

Clickers are not the only way to engage students. Another method many science teachers use, of course, is demonstrations. In addition to demonstrating the topic du jour, practically, demonstrations often help to keep attendance up on Fridays! As more than just a magic show or the ancient Roman strategy of bread and circuses, as the title suggests, demonstrations can be used in conjunction with clickers to make demonstrations much more than just something to attract their attention for a minute. This has been employed successfully in physics education (Wieman and Perkins 2005) as well. Students are much more engaged in the demonstration when they have predicted an outcome to the experiment. An example slide is shown in Figure 5.

It's Déjà Vu All over Again

Student responsibility and buy-in can also remind students of material they learned previously and are responsible for. This is another key motivator for my use of the system in class. Questions can be asked in class to gauge if I need to spend a lot of time teaching a subject that is a pre-requisite. This follows the philosophy of Casanova's original work.(1971) I can get a better prediction of whether they have forgotten and/or can be quickly reminded of a topic or if a more thorough review needed. It can also be a wake up call for the small minority that does not remember that they need to brush up (Figure 6). I can also get more accurate/more recent demographic info than from the class roster in some instances. For instance, if a modest percentage of my class has taken calculus (not required for the class), I often include calculus-based examples as supplemental material so that they can more easily integrate the knowledge.

Nothing to Sneeze At

One of the great advantages to such interactive systems is that it is only the creativity of the instructor/question author that restricts the questions that can be asked. This theme has been echoed by others.(Zhu 2007) For example, I have used these systems for simple multiple-choice or true/false questions that test factual recall or pre-course knowledge. In addition, even in a chemistry class I have employed Likert-scale opinions (e.g. for confidence in an answer). The literature of science education is full of examples regarding testing pre-existing and common misconceptions, as well. (Hestenes et al 1992; Nazario et al 2002; Wieman and Perkins 2005) I have also used the clickers for pre-testing and post-testing around a lecture topic. One can also go beyond just text and use graphs, charts, symbols, figures, etc. as shown in Figure 7. The use of visual as well as just textual examples is especially important in many science disciplines where graphical interpretation of data is important.

The more difficult the topic, the more likely I am to employ common think-pair-share techniques.(King 1993) That is, I will poll the audience for their initial response. I may or may not display the outcome of that polling depending on the topic. I then ask them to "convince their neighbor" and then re-poll the class. This peer instruction is a valuable part of the classroom atmosphere and adds greatly to the student engagement and student learning. (Mazur 1997; Crouch and Mazur 2001)

The Proof is in the Pudding

I feel compelled to include some "customer satisfaction data" from one of my larger classes in Figure 8. After four semesters of using the clickers in lecture classes large and small, I have been very pleased with the outcomes. As can be seen from the data presented in Figure 8, student opinion of the use of clickers improved overall during the semester, with 81% having a

positive opinion (N=278) and 88% feeling more engaged (N=276). Although 75% of students reported *feeling* like they were learning more, surprisingly, only 48% reported thinking more. The perceived impact on their grade was 97% positive over all four semesters of polled students. Although the actual impact on grade is difficult to discern (e.g. because changes in the examination style used by the instructor based on the outcomes of previous classes), no significant difference in overall class grade point average is noted.

Part of my own work with clickers has involved loaning sets of clickers to local groups and organizations as well as local Community College faculty for use in their classrooms. Recently the systems have been used for continuing medical education of both nurses and physicians. The use of such systems for continuing medical education is well documented,(Copeland et al 1998; Miller et al 2003) but the feedback I received was that "the technology was well received" and that it "contributed to the success of the symposium"

Through the Community College loan program, one of my collaborators, Prof. Joseph Bergman of Illinois Central College said after his experience, "I have found the "clickers" to be an instructional asset in determining students understanding of chemistry concepts. The clickers have allowed me to adjust my teaching to match the students' learning. I have a greater sense of student progress and feel more comfortable progressing from topic-to-topic knowing that they have a basic understanding.

In part to this clicker loan program provided by Dr. McLauchlan of the ISU Chemistry Department, the college is discussing adopting a clicker program for widespread use starting as early as next spring!."

All's Well That Ends Well

As Bain (2004) has astutely pointed out, each teachers experiences will dictate what they are able to do in the classroom and one cannot merely use someone else's strategies with immediate success. Among experimentalists, there is an old saying that you can learn more in an afternoon in the lab than in three weeks in the library, but the opposite can be true as well. So, too, in the classroom and I hope that my own strategies and experiences may help others to formulate their own successful strategies to getting students to buy in to the more interactive classroom.

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Figure Captions

Figure 1. An example of a "housekeeping" slide shown during the first class meeting. The relevant section of the syllabus is highlighted to draw attention to the class policies.

Figure 2. Examples of question templates used in class based on the popular U.S. television shows a) Who Wants to Be a Millionaire ? and b) Are You Smarter than a 5th Grader, and the common restaurant/bar trivia game c) NTN's Countdown. All templates were created by the author and are used with permission under educational Fair Use.

Figure 3. An example grading algorithm used by the author for clicker use in class. The scores at right are for a student selected at random from a recent class.

Figure 4. Examples of questions used as "Am I Logged In" questions. Typically a question will be on the screen when a student enters the room and they can respond as they get settled in for class. All answers are counted as "correct" and the questions range across a number of topics including civic engagement, sports, local and campus events, and campus history.

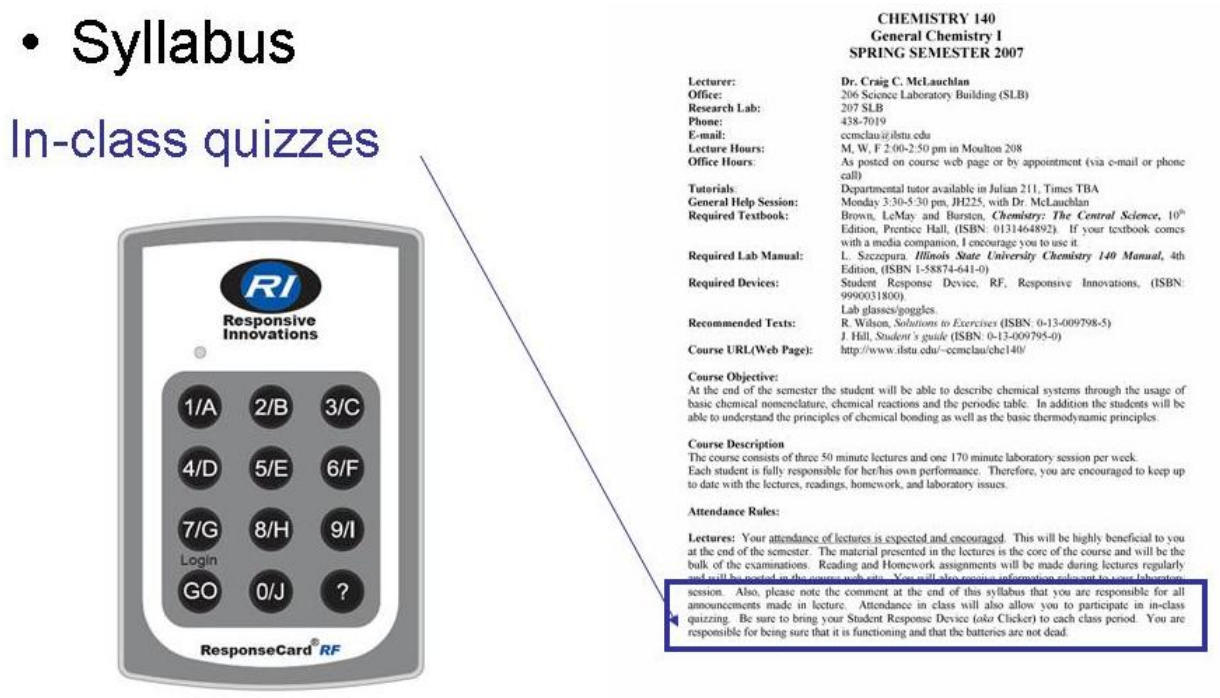
Figure 5. An example of the use of clickers with demonstrations in class. This example involved a density column and the students are asked, "Where would you expect Al to be in the density column?"

Figure 6. Two examples of "higher-level" classes from a sophomore-level descriptive inorganic chemistry class (left), and a junior/senior-level inorganic chemistry class (right). Both questions use pictures to help students to try to "see" symmetry elements in chemical and common objects.

Figure 7. An example of a question of knowledge students should already possess before coming to class. The three thermometers (©2006, Prentice-Hall) are animated to appear after students are responded. They may then vote again.

Figure 8. A compilation of anonymous, in-class end-of-the-semester evaluations from four semesters of General Chemistry I classes. Assuming 100% attendance, a total of 468 students were polled, with a maximum of 284 respondents.

Figure 1.


• Syllabus
In-class quizzes
Responsive Innovations
1/A
2/B
3/C
4/D
5/E
6/F
7/G
8/H
9/I
Login
GO
0/J
?
ResponseCard RF
CHEMISTRY 140
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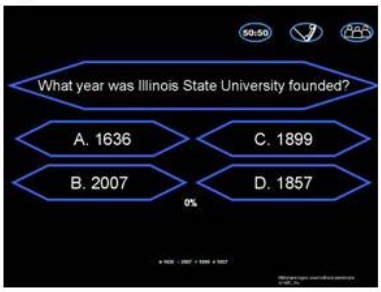
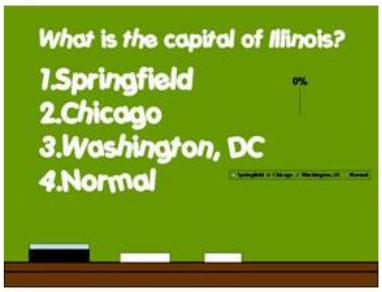
Tutorials: Departmental tutor available in Julian 211, Times TBA
General Help Session: Monday 3:30-5:30 pm, JH225, with Dr. McLauchlan
Required Textbook: Brown, LeMay and Bursten, Chemistry: The Central Science, 10th Edition, Prentice Hall, (ISBN: 0131464892). If your textbook comes with a media companion, I encourage you to use it.
Required Lab Manual: L. Szczepura. Illinois State University Chemistry 140 Manual, 4th Edition, (ISBN 1-58874-641-0)
Required Devices: Student Response Device, RF, Responsive Innovations, (ISBN: 9990031800)
Lab glasses/goggles.
Recommended Texts: R. Wilson, Solutions to Exercises (ISBN: 0-13-009798-5)
J. Hill, Student's guide (ISBN: 0-13-009795-0)
Course URL(Web Page): http://www.ilstu.edu/~ccmclau/che140/
Course Objective:
At the end of the semester the student will be able to describe chemical systems through the usage of basic chemical nomenclature, chemical reactions and the periodic table. In addition the students will be able to understand the principles of chemical bonding as well as the basic thermodynamic principles.
Course Description
The course consists of three 50 minute lectures and one 170 minute laboratory session per week.
Each student is fully responsible for her/his own performance. Therefore, you are encouraged to keep up to date with the lectures, readings, homework, and laboratory issues.
Attendance Rules:
Lectures: Your attendance of lectures is expected and encouraged. This will be highly beneficial to you at the end of the semester. The material presented in the lectures is the core of the course and will be the bulk of the examinations. Reading and Homework assignments will be made during lectures regularly
session. Also, please note the comment at the end of this syllabus that you are responsible for all announcements made in lecture. Attendance in class will also allow you to participate in in-class quizzing. Be sure to bring your Student Response Device (aka Clicker) to each class period. You are responsible for being sure that it is functioning and that the batteries are not dead.

Figure 2.

a)


50:50
What year was Illinois State University founded?
A. 1636
C. 1899
B. 2007
D. 1857
0%

b)


What is the capital of Illinois?
1.Springfield
2.Chicago
3.Washington, DC
4.Normal
0%

c)

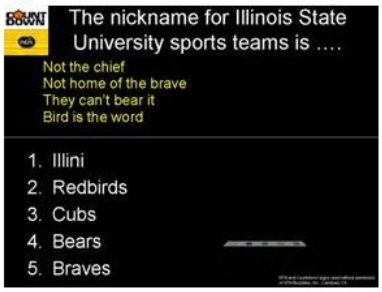

The nickname for Illinois State University sports teams is ....
Not the chief
Not home of the brave
They can't bear it
Bird is the word
1. Illini
2. Redbirds
3. Cubs
4. Bears
5. Braves

Figure 3.

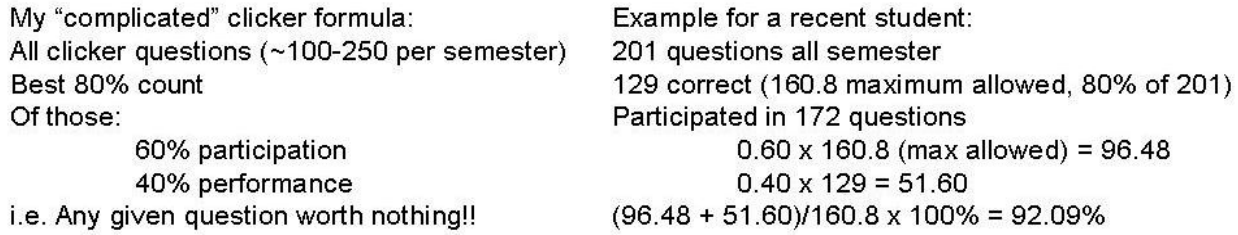

My "complicated" clicker formula:
All clicker questions (~100-250 per semester)
Best 80% count
Of those:
60% participation
40% performance
i.e. Any given question worth nothing!!
Example for a recent student:
201 questions all semester
129 correct (160.8 maximum allowed, 80% of 201)
Participated in 172 questions
0.60 x 160.8 (max allowed) = 96.48
0.40 x 129 = 51.60
(96.48 + 51.60)/160.8 x 100% = 92.09%

Figure 4.

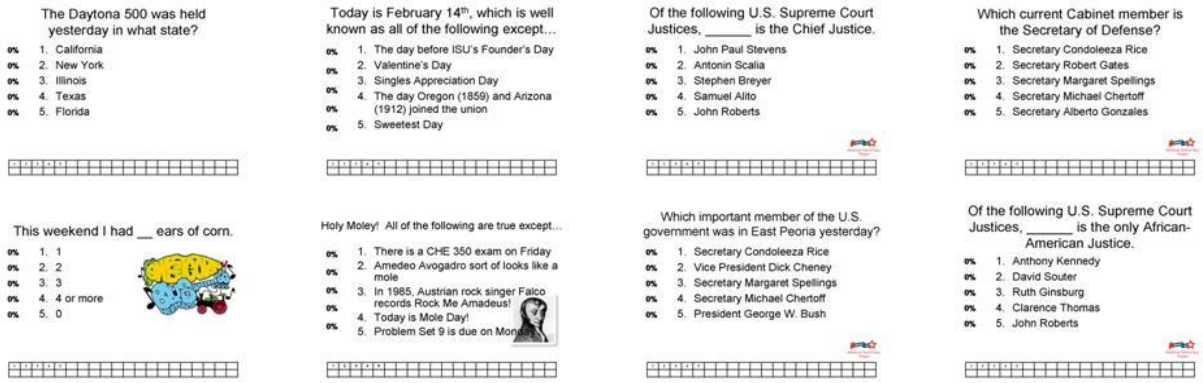
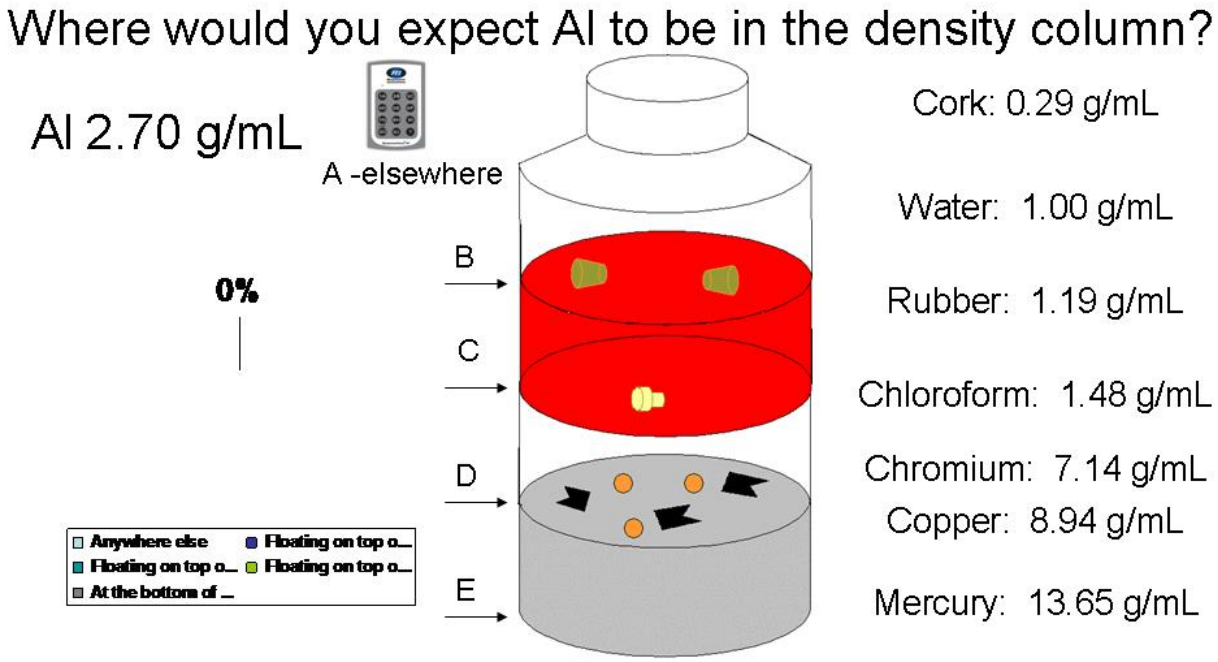

The Daytona 500 was held yesterday in what state?
0% 1. California
0% 2. New York
0% 3. Illinois
0% 4. Texas
0% 5. Florida
Today is February 14th, which is well known as all of the following except…
0% 1. The day before ISU's Founder's Day
0% 2. Valentine's Day
0% 3. Singles Appreciation Day
0% 4. The day Oregon (1859) and Arizona (1912) joined the union
0% 5. Sweetest Day
Of the following U.S. Supreme Court Justices, _____ is the Chief Justice.
0% 1. John Paul Stevens
0% 2. Antonin Scalia
0% 3. Stephen Breyer
0% 4. Samuel Alito
0% 5. John Roberts
Which current Cabinet member is the Secretary of Defense?
0% 1. Secretary Condoleeza Rice
0% 2. Secretary Robert Gates
0% 3. Secretary Margaret Spellings
0% 4. Secretary Michael Chertoff
0% 5. Secretary Alberto Gonzales
This weekend I had __ ears of corn.
0% 1. 1
0% 2. 2
0% 3. 3
0% 4. 4 or more
0% 5. 0
Holy Moley! All of the following are true except…
0% 1. There is a CHE 350 exam on Friday
0% 2. Amedeo Avogadro sort of looks like a mole
0% 3. In 1985, Austrian rock singer Falco records Rock Me Amadeus!
0% 4. Today is Mole Day!
0% 5. Problem Set 9 is due on Mond
Which important member of the U.S. government was in East Peoria yesterday?
0% 1. Secretary Condoleeza Rice
0% 2. Vice President Dick Cheney
0% 3. Secretary Margaret Spellings
0% 4. Secretary Michael Chertoff
0% 5. President George W. Bush
Of the following U.S. Supreme Court Justices, _____ is the only African-American Justice.
0% 1. Anthony Kennedy
0% 2. David Souter
0% 3. Ruth Ginsburg
0% 4. Clarence Thomas
0% 5. John Roberts

Figure 5.



1	2	3	4	5														

Figure 6.

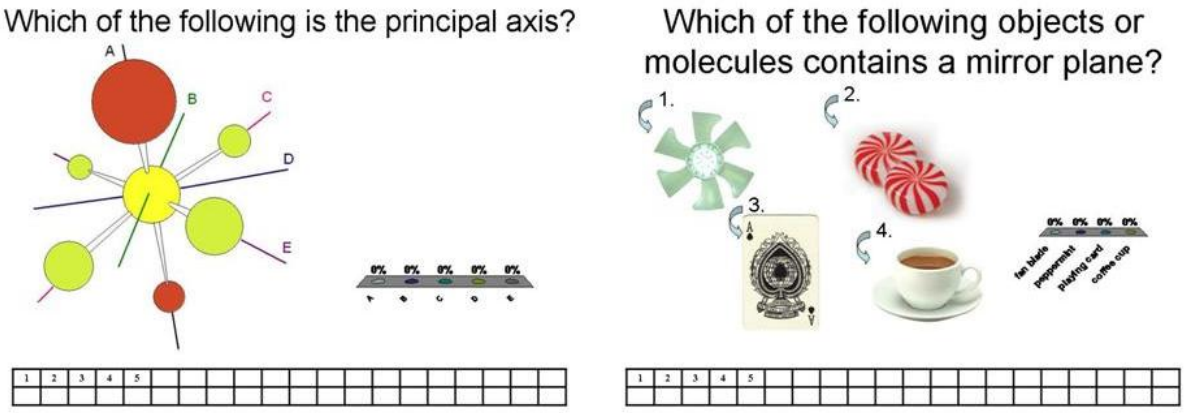
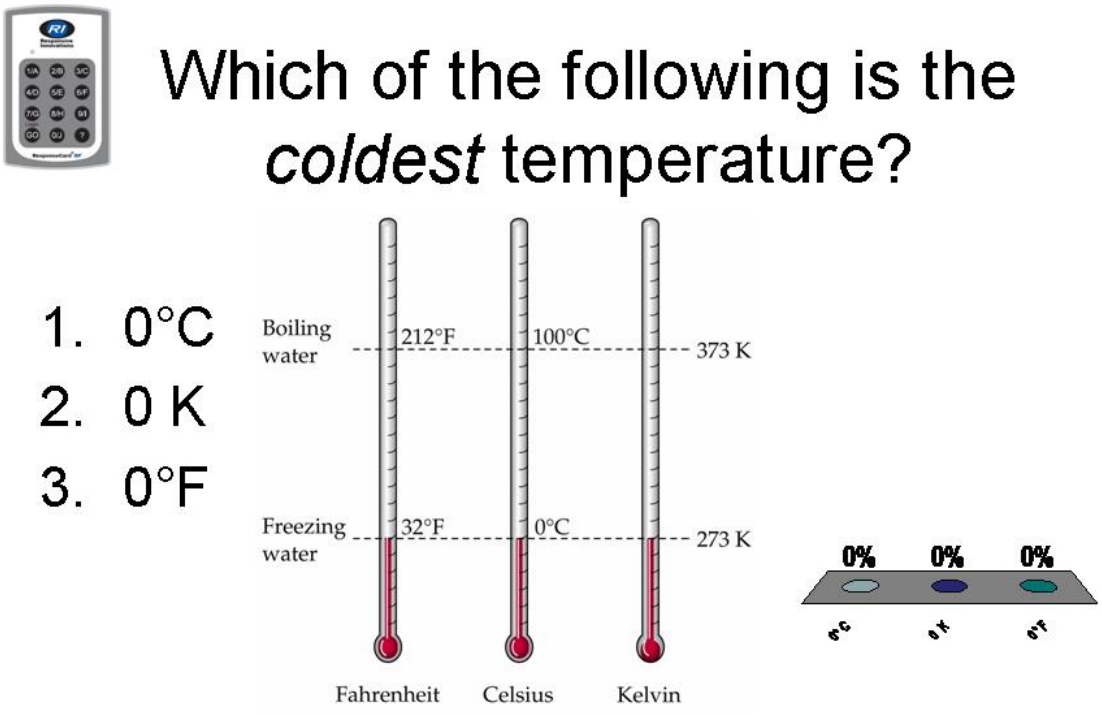
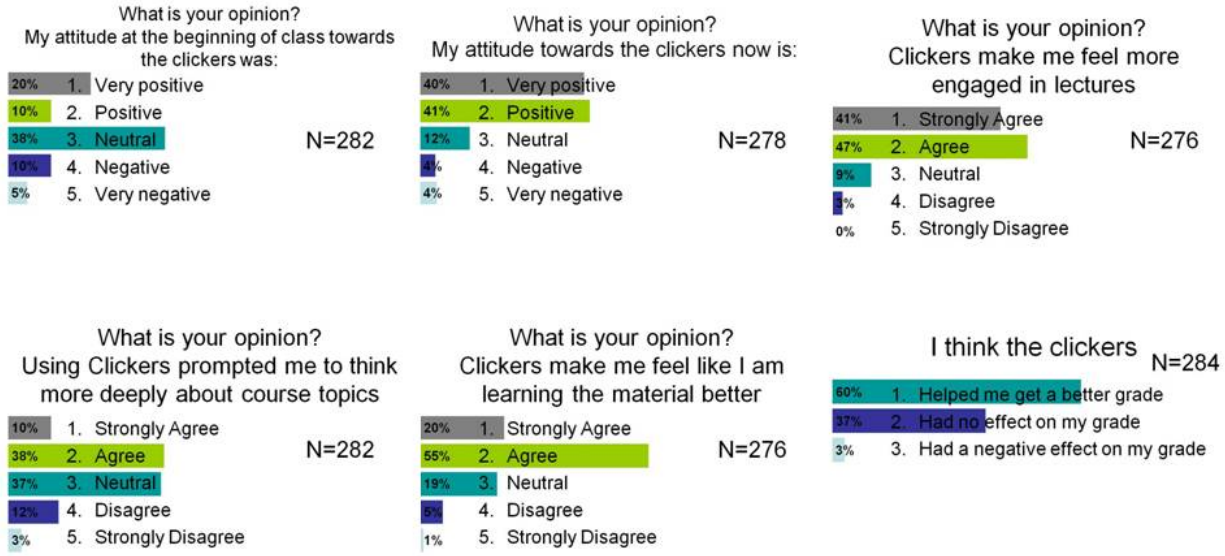

Which of the following is the principal axis?
A
B
C
D
E
0% 0% 0% 0% 0%
1 2 3 4 5
Which of the following objects or molecules contains a mirror plane?
1.
2.
3.
4.
0% 0% 0% 0%
fan blade
peppermint
playing card
coffee cup
1 2 3 4 5

Figure 7.



1	2	3	4	5														

Figure 8.


What is your opinion?
My attitude at the beginning of class towards the clickers was:
20% 1. Very positive
10% 2. Positive
38% 3. Neutral
10% 4. Negative
5% 5. Very negative
N=282
What is your opinion?
My attitude towards the clickers now is:
40% 1. Very positive
41% 2. Positive
12% 3. Neutral
4% 4. Negative
4% 5. Very negative
N=278
What is your opinion?
Clickers make me feel more engaged in lectures
41% 1. Strongly Agree
47% 2. Agree
9% 3. Neutral
3% 4. Disagree
0% 5. Strongly Disagree
N=276
What is your opinion?
Using Clickers prompted me to think more deeply about course topics
10% 1. Strongly Agree
38% 2. Agree
37% 3. Neutral
12% 4. Disagree
3% 5. Strongly Disagree
N=282
What is your opinion?
Clickers make me feel like I am learning the material better
20% 1. Strongly Agree
55% 2. Agree
19% 3. Neutral
5% 4. Disagree
1% 5. Strongly Disagree
N=276
I think the clickers
N=284
60% 1. Helped me get a better grade
37% 2. Had no effect on my grade
3% 3. Had a negative effect on my grade