Keeping students engaged without breaking the bank (for General Chemistry)

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Eastern Connecticut State University
What was your experience for remote learning/teaching in Spring 2020?

“Dddddd”

“...”

“Synchronous”

“Not bad”
50% **Failure rates** of 50% and more in **general chemistry** courses have been reported by certain institutions (Chambers, 2005; Gafney and Varma-Nelson, 2008)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Non-at-risk</th>
<th>At-risk</th>
<th>Cohen's d</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>384</td>
<td>153</td>
<td></td>
</tr>
<tr>
<td>SAT math (mean ± SD)</td>
<td>583 ± 52</td>
<td>476 ± 39</td>
<td>2.32</td>
</tr>
<tr>
<td>Test 1 (%)</td>
<td>71.2 ± 14.0</td>
<td>63.7 ± 14.1</td>
<td>0.53</td>
</tr>
<tr>
<td>Test 2 (%)</td>
<td>69.9 ± 15.9</td>
<td>63.1 ± 14.9</td>
<td>0.44</td>
</tr>
<tr>
<td>Test 3 (%)</td>
<td>52.8 ± 15.2</td>
<td>41.2 ± 14.1</td>
<td>0.79</td>
</tr>
<tr>
<td>Final test (%)</td>
<td>51.2 ± 15.2</td>
<td>44.8 ± 16.3</td>
<td>0.41</td>
</tr>
<tr>
<td>Attendance (%)</td>
<td>82.3 ± 19.4</td>
<td>81.0 ± 20.3</td>
<td>0.07</td>
</tr>
<tr>
<td>HW (%)</td>
<td>94.2 ± 14.9</td>
<td>95.8 ± 11.8</td>
<td>0.12</td>
</tr>
<tr>
<td>Course GPA</td>
<td>2.78 ± 0.76</td>
<td>2.41 ± 0.75</td>
<td>0.49</td>
</tr>
</tbody>
</table>

- Class attendance and homework completion were comparable for the two groups
- At-risk students were displaying as much effort as non-at-risk students but achieving less on the tests.

Study habits predicting academic performance

Table 3 Common study habits by percent of text messages

<table>
<thead>
<tr>
<th>Study habit</th>
<th>Non-at-risk students (%)</th>
<th>At-risk students (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reviewed notes or PowerPoint</td>
<td>18.3</td>
<td>21.8</td>
</tr>
<tr>
<td>Reviewed the textbook</td>
<td>15.4</td>
<td>19.8</td>
</tr>
<tr>
<td>Online homework</td>
<td>13.1</td>
<td>18.0</td>
</tr>
<tr>
<td>Practiced problems</td>
<td>6.6</td>
<td>10.0</td>
</tr>
<tr>
<td>Previous exams or study guides</td>
<td>5.8</td>
<td>9.0</td>
</tr>
</tbody>
</table>

Fig. 2 Study habits predicting final exam scores.

Studying frequency plays a more important role in student academic performance in college General Chemistry for the students who have lower SAT scores as compared to students who have higher SAT scores.

Academic Profile of Our Students

Majors of students take CHE

- Biology
- Finance
- Non-Degree
- Health Sciences
- Biochemistry
- Exploratory STEM
- Environmental Earth Science
- Pre-Secondary Educ Certificate *
- Psychology
Academic Profile of Our Students

Years of students take CHE

- Freshmen
- Sophomore
- Junior
- Senior
Student Engagement In A Virtual Classroom

Lesson Design

Communication

Motivation

Interfaces

Interdependence

Structures

Feedback
Learner Motivation

Honor that different people do the same thing for different reasons—and students are no different.
Interfaces & Interactions

Announcements

New Announcements appear directly below the repositionable bar. Reorder by dragging announcements to new positions. Move priority announcements above the repositionable bar to pin them to the top of the list and prevent new announcements from superseding them. The order shown here is the order presented to students. Students do not see the bar and cannot reorder announcements.

Create Announcement

<table>
<thead>
<tr>
<th>New announcements appear below this line</th>
</tr>
</thead>
</table>

**Day 17 lecture video and pre-lecture quiz**

Posted on: Monday, October 5, 2020 9:40:42 PM EDT

Day 17 lecture video and pre-lecture quiz are posted.

The pre-lecture quiz is due on **Wednesday, Oct 7th, at 11:59 PM**

**Course Link** /Lecture/in-class assignments/Module II. Bonding, Geometry, and Intermolecular Forces/Unit 4. Chemical Bonding

**Day 16 lecture video and pre-lecture quiz**

Posted on: Sunday, October 4, 2020 10:59:27 AM EDT

Day 16 lecture video and pre-lecture quiz are posted as well as the lecture slides.

The pre-lecture quiz is due on **Monday, Oct 5th, at 11:59 PM**

**Course Link** /Lecture/in-class assignments/Module II. Bonding, Geometry, and Intermolecular Forces/Unit 4. Chemical Bonding
Lesson Design & Context

Understand
• What is to be taught (class objective)
• How to teach it

Learning models that require
• active learning and
• participation
• from every student
• every day*

*every day*
Lesson Design & Context

Asynchronous
• Flexibility in time and location
• Students control the pace of their learning
• Students work independently
• There is a lot of skill-building (academic and self-regulation) involved

Synchronous
• Real-time feedback on work in progress
• Guided practice/application
• Foster collaboration among students
Communication & Access

Be aware of how frustrating the remote learning experience might be for your students.
Communication & Access

Send encouragement

Section related instructions
Communication & Access

Relevant real-life events

Social event

Rules for participation:
- Sign up for at least one WebEx session on Mar 23 Monday.
- Show off your furry for non-furry study companion.
- Study corner or home office.
- New hobby or challenges.
- Daily productivity routine.
- Or anything creative.
- Post a photo of your entry with #KedanHe on Slack "Random" channel.
- Have fun!

Remote Learning Challenge

"Every hand that we don't shake must become a phone call that we place."

"Every embrace that we avoid must become a verbal expression of warmth and concern."

"Every inch and every foot that we physically place between ourselves and another, must become a thought as to how we might be of help to that other, should the need arise."
Structures & Flexibility

Provide Structure Without Being Inflexible

“anxiety”

“juggling all my coursework for each class”

“Focusing issues”

“Anxiety”

“Being remote”

“staying motivated doing online school”

“Anxiety”

“Money”

“Time management”

“All online”

“The possibility of having to leave campus earlier because of an outbreak. I'm an out of state student.”

“Staying focused”

“Previously really struggled with understanding chemistry, organization and working a stressful job”

“purchasing textbooks”

“Time management and being on my own”

“Anxiety”

“Time management”

“anxiety”

“juggling all my coursework for each class”
Structures & Flexibility

• Set clear and regular deadlines
• Detailed lesson plan for each lecture
• Reminder via multiple format
• Allow late submission
Structures & Flexibility

- Lead by learning objectives

Module I. Fundamental concepts. Atomic perspective of substances
In this module:
- We explore the particulate nature of matter, understand and describe the structures of materials at the atomic level.
- Then we explore the structure of atoms to better understand why they form the ions and molecules they do.
- Finally, we learn how to use the atomic structure the explain the properties of elements.

Module II. Bonding, Geometry, and Intermolecular Forces
In this module:
- We learn how the electronic structure of atoms is related to the ways atoms bond together, forming molecules.
- We learn how to draw Lewis structures to represent bonds within a compound and use this as a tool to understand and predict molecular geometry.
- Finally, we explore the connections between the structure of molecules and the ways they interact with each other.

Module III. Stoichiometry. Reaction in Aqueous Solutions
Availability: Item is hidden from students.
In this module:
- We get to observe the mass relationships in chemical reactions, which is a demonstration of the law of conservation of mass.
- We also explore the types of reactions that can occur when aqueous solutions of ionic compounds are mixed together.

Module IV. Thermochemistry part I. Gases
Availability: Item is hidden from students.
In this module:
- We explore the energy changes that accompany both physical and chemical changes.
- In addition, we explore the physical and chemical properties of gases.
Structures & Flexibility

- Plan by each lecture

Module I. Fundamental concepts, Atomic perspective of substances

**Content Information**

**Curriculum Resources**

Build Content ▼  Assessments ▼  Tools ▼  Partner Content ▼

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**CHE 210 Fall 2020, Weekly Schedule - Module I**

**Unit 1. Matter and Energy, Atomic Perspective**

- Day 2. Classes and properties of matter, States of matter
- Day 3. Sig figure rules, precision & accuracy, unit conversion

**Unit 2. Atoms, Ions, and Molecules**

- Day 4. Atoms and Atomic structure, atomic symbols, Periodic table
- Day 5. Masses of atoms, ions, molecules. Mole and molar masses
- Day 6. Isotope Abundances and Molar mass

**Unit 3. Atomic Structure**

- Day 7. Electromagnetic radiation and atomic spectra
- Day 8. Bohr model
- Day 9. Electron wave property, Heisenberg uncertainty principle
- Day 10. Sizes and shapes of atomic orbitals
- Day 11. Electron configuration
- Day 12. Periodic trends: atomic radius, Ionization energy, and Electron affinity
Structures & Flexibility

- Learning materials by day
Structures & Flexibility

The course calendar details what you can expect during each scheduled class session in addition to due dates for all of your assignments.

The flow chart below summarizes your tasks (and the order in which you should complete them) for each topic area. Most importantly, you’ll need to watch the lecture videos and submit any discussion questions before the date of each class session.

1. Watch the lecture videos and related materials
2. Complete pre-lecture quiz
3. Attend scheduled class session, complete in-class assignments
4. Attend recitation session, complete tasks and earn bonus participation points
5. Homework!
   Assessments: weekly quizzes and monthly exams

--- BEFORE CLASS ---  --- DURING ---  --- AFTER ---
Structures & Flexibility

Our class meetings will take two forms: the MWF sessions will be devoted to discussion of the videos you will have already watched and complete an in-class assignment (individually or with group members). Weekly recitation sessions allow you to review and earn bonus participation points by complete assigned tasks.

It’s going to be quite an adventure, but hopefully, this flipped class format will help you demonstrate all your newfound knowledge with as much support as possible. Throughout the semester I will frequently seek feedback and constructive advice, your input is always greatly appreciated!

LEARNING OBJECTIVES AND ASSESSMENT

How will your success be measured?

<table>
<thead>
<tr>
<th>45%</th>
<th>5%</th>
<th>10%</th>
<th>10%</th>
<th>15%</th>
<th>15%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exams</td>
<td>Pre-lecture quiz</td>
<td>In-class assignment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemistry in life</td>
<td>Homework</td>
<td>Quizzes</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Authentic Assessment

• Case studies

• Scenario-based projects

• Real-life examples writing assignments

• Video assignments to record a brief spoken-word explanation

Why Biodegradable Isn’t What You Think

By John Schwartz
Oct. 1, 2020

You care about the planet, and would like to avoid bottles and other goods made of single-use plastic. But it’s complicated.

Choosing products with packaging that claims to be “biodegradable” or “compostable” might mean that they degrade only under special conditions, and could complicate recycling efforts, said Jason Locklin, the director of the New Materials Institute at the University of Georgia. “It’s tremendously confusing, not just to the consumer, but even to many scientists,” he said.
The first resonance structure of the thioformate ion is shown. Determine the correct second resonance structure of thioformate ion?
## Feedback loop

<table>
<thead>
<tr>
<th>CHAPTER TITLE</th>
<th>ACTIVE STUDENTS</th>
<th>AVG. TIME SPENT (MM:SS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter 1: Matter and Energy: An Atomic Perspective</td>
<td>91</td>
<td>47:32</td>
</tr>
<tr>
<td>Chapter 2: Atoms, Ions, and Molecules: The Building Blocks of Matter</td>
<td>86</td>
<td>67:49</td>
</tr>
<tr>
<td>Chapter 3: Atomic Structure: Explaining the Properties of Elements</td>
<td>79</td>
<td>62:15</td>
</tr>
<tr>
<td>Chapter 4: Chemical Bonding: Understanding Climate Change</td>
<td>45</td>
<td>41:44</td>
</tr>
</tbody>
</table>
Quiz 2

Grades were accepted for this assignment until September 9th, 2020, at 11:59 PM (Eastern Time)

84% Average score on assignment

92% of students completed the assignment

00:13:28 Average time spent on assignment
<table>
<thead>
<tr>
<th>Question</th>
<th>Average Score</th>
<th>Student Submissions</th>
<th>Average Attempts</th>
<th>Average Time Spent</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 The periodic table</td>
<td>0.85/1pt</td>
<td>122</td>
<td>1.3/3</td>
<td>00:03:23</td>
</tr>
<tr>
<td>02 Subatomic Particles [POOL]</td>
<td>2.52/3pts</td>
<td>122</td>
<td>1.78/3</td>
<td>00:03:21</td>
</tr>
<tr>
<td>03 Subatomic particles in... [POOL]</td>
<td>1.52/2pts</td>
<td>122</td>
<td>2.06/3</td>
<td>00:03:34</td>
</tr>
<tr>
<td>04 Interpreting Atomic Mass</td>
<td>0.92/1pt</td>
<td>122</td>
<td>1.01/3</td>
<td>00:01:13</td>
</tr>
<tr>
<td>05 Eqn for Isotope Abund... [POOL]</td>
<td>0.88/1pt</td>
<td>122</td>
<td>1.42/3</td>
<td>00:01:58</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Learning Objective</th>
<th>Average Time Spent</th>
<th>Average Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.G Use isotope abundance data to calculate average atomic mass.</td>
<td>00:01:03</td>
<td>94.22%</td>
</tr>
<tr>
<td>2.D Write atomic symbols to describe isotopes at the subatomic level.</td>
<td>00:00:40</td>
<td>91.76%</td>
</tr>
<tr>
<td>2.E Describe ions at the subatomic level.</td>
<td>00:01:11</td>
<td>83.18%</td>
</tr>
<tr>
<td>2.C Identify elements by name, symbol, and periodic table location.</td>
<td>00:03:23</td>
<td>85.25%</td>
</tr>
</tbody>
</table>
Schrödinger’s Cat Explained
#BeautyofChemistry
What is Colaboratory?

Colaboratory, or "Colab" for short, allows you to write and execute Python in your browser, with:

- Zero configuration required
- Free access to GPUs
- Easy sharing

Whether you’re a student, a data scientist or an AI researcher, Colab can make your work easier. Watch Introduction to Colab to learn more, or just get started below!

Getting started

The document you are reading is not a static web page, but an interactive environment called a Colab notebook that lets you write and execute code.

For example, here is a code cell with a short Python script that computes a value, stores it in a variable, and prints the result:

```python
secondas_in_a_day = 24 * 60 * 60
```
Join a Community