TEACHING CHEMISTRY IN A TEXTBOOKLESS CLASSROOM

AACT WEBINAR - FEB. 20, 2020
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STRUCTURE OF THIS WEBINAR

• Things to think about in a textbookless classroom
• Establishing structure
• Sharing resources
  – Online content
  – Interactive notebooking
    • Input Ideas
    • Output Ideas

I’ve shared a lot!

This PowerPoint is designed to be revisited later - hyperlinks to sites and many pictures and ideas are included. Please think about getting the overview in the initial presentation, and then go back later to dive into the details.
THINGS TO THINK ABOUT IN A TEXTBOOKLESS CLASSROOM
CHALLENGES

• Lack of flow/organization/structure that students may be accustomed to
• Loss of ready-made…
  – Examples
  – Figures
  – Practice problems
  – Easy-to-assign homework
• Planning for class is different! No more…
  – “Turn to p.32 and read…”
  – “Homework is p.102 #1-35 odds only”
• Students may not know how to find trustworthy help outside of class
HOW CAN WE HELP STUDENTS LEARN TO READ CONTENT?

**Traditional Texts**
- Online textbooks
  - Chemistry Libretexts
  - Openstax chemistry
  - Learnchem.net
- Online content
  - [https://www.chem.purdue.edu/gchelp/](https://www.chem.purdue.edu/gchelp/)
  - Chem4Kids
  - Chem collective
- Articles
  - ChemMatters articles
    - [webinar](#) on improving literacy using ChemMatters articles
    - [lesson](#) based on ChemMatters article
  - C&E News
  - Popular media

**Non-traditional Texts**
- Infographics
  - [Compound interest](#)
  - Scientific American
- Videos
  - [Reactions by ACS](#)
  - NOVA
  - TED-Ed
  - (more to be discussed soon)
- Social Media
  - Twitter
  - Snapchat
OPPORTUNITIES FOR THE TEACHER

• Content that is outside of your specific standards is not included

• Teacher is forced to deeply consider the standards as well as scope and sequence
  – Scope: no need to tell students to “ignore” parts of the book
    • No examples that are “too much” for your course level
    • No text that ends up muddying thoughts that were clear during class
  – Sequence: teach in the sequence that makes sense for you, your students, your schedule and your standards
    • Pick your favorite flow: modeling, atoms first, project-based, etc.
      – Realize: You can STILL FOLLOW the textbook order, even without using the book
      – You are not BOUND to following that order
    • Move units around due to school closures
      – Nuclear can be taught online easily
    • Personal Example: order of teaching gas laws
OPPORTUNITIES FOR STUDENTS

• We can help them learn how to find reliable sources
  – Google searches on chemistry topics lead to thousands of hits
  – Class time can (should?) be spent on helping them learn to recognize valid sources
    • many lessons available online, including this one from AACT and this one (p. 65) from NSTA
    • Remind students:
      – .edu, .org, .gov are usually good
      – Wikipedia is a good starting place, but needs to be taken with a grain of salt
      – Videos on youtube can be great
      – Discussion boards should be approached with caution

• They get the opportunity to probe lots of ways of exploring content, and find what works best for them

• Variety of sources present different methods of approaching content, multiple perspectives, many examples, etc.
SURPRISES WHEN I WENT TEXTBOOKLESS

• I didn’t expect to find much difference to my planning, and while I used many of the same resources in class I found that I had to curate an out-of-class resource collection for students.

• My students really struggled with connecting one day’s content to the next, even when it seemed obvious to me.

• Resources and references I handed out would never return.

• I received more frequent messages from parents saying “I don’t know how to help them.”
CHANGES IN MY PLANNING

• I had to be intentional in…
  – Finding Figures/graphs/diagrams
  – Imbedding examples that students would be able to reference again later
  – Providing structure and connections within the content
  – Providing “vetted” or “endorsed” sources of information for students (and parents)

• I had extra successes in…
  – Finding meaningful activities
  – Making my classroom more student-centered
  – Encouraging collaborative learning

• I spent more time in planning how to present and practice content.
  – This extra thought trimmed some fat.
  – I gave additional scrutiny to problems which meant less confusion for my students.
  – Additional thinking on my part about presenting content led to more creative use of our class time. Student engagement increased.
ESTABLISHING STRUCTURE

**YOU MUST HELP STUDENTS FIND STRUCTURE AND CONNECTIONS IN YOUR COURSE.**
LMS OPTIONS

- Google Classroom
- Canvas
- Moodle
- Blackboard
- and others

Need a free LMS?

The PRISM Project at Rose-Hulman Institute of Technology will host your site for free. PRISM is supported by the Lilly Endowment to provide the Moodle LMS to K-12 teachers. The PRISM team offers support and online distance training to teachers using the LMS.

Visit www.rose-prism.org/ to create an account. Feel free to contact the PRISM team for further information. There is a “contact us” link on the main webpage.
NON-DIGITAL OPTIONS

• Notebooking (a focus topic of this webinar)
• Class folders
• Portfolios
• Learning contracts
• Mastery checkpoints/standards based learning
WHAT DO STUDENTS NEED TO “SEE”? 

Students need to be able to physically see the flow and structure of a course. This is necessary so they can:

• Engage prior knowledge
• Make connections with material
• Know where to look for review of specific topics
MIMICKING THE PARTS OF A TEXTBOOK

- Table of contents/menu
- Glossary
  - Google doc/sheet
  - ABC list in binder or notebook
- Captions/diagrams/figures
  - Include diagrams/figures and have students create the captions
  - Have students find a diagram or figure online that matches a caption you give them
  - Have students draw a diagram or figure that corresponds to a caption/prompt you give them
SHARING RESOURCES

ONLINE CONTENT AND INTERACTIVE NOTEBOOKING
ONLINE CONTENT

Finding and presenting digital content
TYPES OF VIRTUAL CONTENT

• Videos
• Flip or virtual lessons
• Online practice
• Sims
• Virtual labs
• Games
• Traditional practice

Good sources of ideas for all of these kinds of content:

AACT
www.teachchemistry.org

Chem Ed Xchange
https://www.chemedx.org/
FINDING CONTENT: VIDEOS

• Great for content introduction:
  – TED-Ed
  – ChemistryUTAustin (top)

• Content Tutorials/Lessons
  – Bozeman Science
  – Professor Dave Explains (middle)
  – Mr. Causey
  – Tyler DeWitt
  – The Organic Chemistry Tutor

• Science Songs
  – ASAP SCIENCE (bottom)
  – Acappellascience

https://www.youtube.com/watch?v=X7ckfeRjyI
https://www.youtube.com/watch?v=rz4Dd1I_fX0
https://www.youtube.com/watch?v=U2ZNP5cSBRs
FLIP AND VIRTUAL LESSONS

- Flip lessons – students intake the content introduction out of class and practice in class
  - Ed puzzle
  - Examples to check out:
    - Ms. Drury
    - Mr. Palermo

- Virtual lessons that you create or use as made
  - text embedded with practice problems, videos, sims
  - TED-Ed
  - CK-12
  - Sophia
  - Schmoop
  - Unit conversions tutorial
  - Lessons on Moodle
  - Kent Chemistry
FINDING CONTENT: ONLINE PRACTICE

- Sciencegeek
- Mr. Carman – Kent Schools
- Random problem generator for dozens of topics – Widener University
- Algebra lab (Search “chemistry”)
- AACT

Hess’ Law

This page is an exercise in using Hess’ Law. When you press “New Problem” a reaction set with a single missing ent press the “Check Answer” button. The results will appear in the table on the main page. This page is complex, but if:

- Pressing the “Show Answer” will cause the correct answer to appear and you will no longer be able to submit.

<table>
<thead>
<tr>
<th>New Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enter your answer: kJ</td>
</tr>
<tr>
<td>Check Answer</td>
</tr>
<tr>
<td>Results</td>
</tr>
<tr>
<td>2</td>
</tr>
</tbody>
</table>

Use the thermochemical equations shown below to determine the enthalpy for the final reaction:

(1) \( H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l) \ q = 285.8 \text{ kJ} \)
(2) \( CO_2(g) + \frac{1}{2}O_2(g) \rightarrow CO(g) \ q = -296.8 \text{ kJ} \)

\[ Q = (285.8 - 296.8) \text{ kJ} = -11 \text{ kJ} \]

http://www.sciencegeek.net/Activities/Hesslaw.html

GAS LAWS PRACTICE QUIZ


Predicting Products

https://teachchemistry.org/classroom-resources/predicting-products-simulation

https://www.kentschools.net/ccarman/cp-chemistry/practice-quizzes/gas-laws/

FINDING CONTENT: SIMS, ANIMATIONS

Note: some (not all) of the sims below require flash which may not be supported by student devices.

- PhET
- NCSSM TIGER
- General Chemistry Interactive Simulations
- Chemistry solutions (available on AACT site)
- Chem collective
- ChemDemos
- Learner.org digital course – includes animations and videos
- Chem Files
- Chemsite
- CK-12
- Google research interactive periodic table
- AACT Sims with accompanying lessons

- Great ACS article with more listings
FINDING CONTENT: VIRTUAL LABS

- PhEt
- Chem collective
- Goreact! (great for bonding)
- Molecular workbench
- RSC Screen Experiments
- Kent Chemistry
- ChemReaX

http://www.kentchemistry.com/moviesfiles/Units/Redox/VoltaicCellEMF.htm
https://www.msichicago.org/play/goreact/
https://www.sciencebysimulation.com/chemreax/Analyzer.aspx
http://www.rsc.org/learn-chemistry/resources/screen-experiment/titration/experiment/2/5
FINDING CONTENT: GAMES

- Quizlet live
- Kahoot!
- Quizizz
- Collisions
- Legends of Learning
- PhET

https://phet.colorado.edu/en/simulation/legacy/radioactive-dating-game
https://games.legendsoflearning.com/games/WyJnYW1lcyIsNjExXQ==
https://app.playmada.com/Collisions/
https://phet.colorado.edu/en/simulation/legacy/radioactive-dating-game
FINDING CONTENT: TRADITIONAL PRACTICE

- **Chemmybear** – Paul Groves
- **The Cavalcade o’ Chemistry** – (Ian Guch)
- **Math-Aids** for measurement
- **Teachers Pay Teachers**
  – (you can download things for free as well!)
- **AACT**

![Reading a Metric Ruler](https://www.math-aids.com/Measurement/Reading_Metric_Ruler.html)

![Stoichiometry Practice](https://teach-chemistry.s3.amazonaws.com/2017/05/04/14/39/18/3af80552-98f7-46e6-acec-04a95cc07d3c/lesson-stoichnotes-worksheet.pdf)
INTERACTIVE NOTEBOOKING

Student-created “textbook”
BASICS OF INTERACTIVE NOTEBOOKING (INB)

• Each 2-page spread covers the same content
• A page may be a day or more than a day – typically I cover 1-2 learning objectives per page
• Group content by topic:
  – Right side is teacher directed
    • presentation of content
  – Left side is student response
    • interact with content
• Notebooks can be graded for accountability; sample rubric is available in resources
• A document with suggestions on setting up the notebook is also available in resources
EXAMPLES OF INB PAGES

AMOUNT OF COLOR AND INTERACTIVITY CAN VARY BY STUDENT, BY PAGE, BY TOPIC

Ionic compounds
Little color and interactivity

Layout of the Periodic Table
Moderate Color and Interactivity

Thermal Energy
High Color and Interactivity
IDEAS FOR INTEGRATING READING INTO AN INB

- Students fill in guided notes paste-in by referencing online textbook (example: covalent compounds page - available in resources)
- Students research to fill in model of atom timeline (see resources)
- Students create their own foldable, or fill in a template, based on research or online textbook reading (see 5 types of reactions foldable in resources)
- Have students dissect, reorganize and/or illustrate a dense text (Example: Lab safety flipbook used to dissect safety contract)
- Use a short article or reading to introduce a topic – include a flap or foldable with pre-reading predictions and then text information comparison
INPUT IDEAS

Teacher Directed Content
DESIGNING YOUR INB - INPUT

- Input ideas:
  - Foldables (see handout)
  - Flaps/Pockets
  - Tables/graphics to fill in or annotate
  - Labels
  - Slider/spinners
  - Timeline
  - Dry-erase duct tape
  - Sim/online lab
  - Graphic organizer
  - Flipbooks

Let your unit plan guide your INB layout
INPUT IDEAS: FOLDABLES AND FLAPS/POCKETS

Flaps and Foldable Page
Flaps: Definition of Radiation, Review of Nuclear Symbol, Venn Diagram
Foldable: Types of radioactive decay

Foldable/flaps blend
pH and pOH modified shutter foldable

Foldable
Tables and Graphs mini accordion foldable

Foldable
Gas Laws Hamburger Foldable

Foldable and Pocket Stoichiometry
INPUT IDEAS:
TABLES/GRAPHICS AND LABELING

Tables and Graphics with or without labeling
Flaps can be used either on top of graphics or with the graphic serving as the flap (see targets above) to reveal more information; Labeling can be used on the graphic, as can color coding; graphic flaps can have information underneath

Ex: (left to right) Periodic trends page; Meaningful Measurements (available in resources); student-made phase changes page; blank phase changes template; mole map shown open on a page
INPUT IDEAS: SLIDERS/SPINNERS AND TIMELINES

Slider
good for tables of info
Ex: Metric prefixes slider

Spinner
good for groupings and cycles
Ex: Indications of a chemical change spinner

Timeline
this type of model can also be applied to steps or sets (i.e. states of matter)
Example: Models of the atom timeline (see resources to download this template)
**INPUT IDEAS: DRY-ERASE DUCT TAPE AND SIMS/ONLINE LABS**

**Dry Erase Duct Tape**
- good for working problems with a scaffold
- *Write scaffold in permanent marker, work in dry-erase*
- *Ex: Mole Conversions*

**Sim**
- Guided practice in a sim can be a great intro
- *Ex: Reactants, Products and Leftovers PhET*
- *available in resources*

**Online Lab**
- Input can also be traditional lab data
- *Ex: Radioactive Decay of Candy*
INPUT IDEAS: GRAPHIC ORGANIZER AND FLIPBOOKS

Graphic Organizer
Flaps make this an interactive Venn diagram
Ex: Fission and Fusion Venn Diagram

Graphic Organizer
Ex: Types of bonds
See resources to download this template

Flipbook
A large amount of related info can be in a small space; Optional tabs (i.e. lab safety) help organize categories or steps
Ex: Aspirin Flipbook (see resources to download Aspirin)
OUTPUT IDEAS

Student Generated Response
THINGS TO REMEMBER ABOUT OUTPUT

• Output activity should be directly related to the content delivered on the right side page
• Output can be graded, but doesn’t have to be
• Output should generally be done in class, as closely following the input page as possible
• Output can fall anywhere on this continuum:

  - Student Created
  - Teacher Guided
  - Teacher Directed

• Try to vary the kinds of output within a unit, and try to hit multiple places on the continuum above
# DESIGNING YOUR INB - OUTPUT

<table>
<thead>
<tr>
<th></th>
<th>Student created</th>
<th>Teacher Guided</th>
<th>Teacher Directed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>KWL</strong></td>
<td>Sim Data</td>
<td>Worksheet/practice problems</td>
<td></td>
</tr>
<tr>
<td><strong>ASN</strong></td>
<td>Inquiry Lab</td>
<td>“Cookbook” lab</td>
<td></td>
</tr>
<tr>
<td><strong>Word cloud</strong></td>
<td>Demo observations</td>
<td>Online practice</td>
<td></td>
</tr>
<tr>
<td><strong>Mind Map</strong></td>
<td>Label/annotate illustration</td>
<td>Questions on sim/video</td>
<td></td>
</tr>
<tr>
<td><strong>Create a cartoon/sketch</strong></td>
<td>Sketch features/procedure/process</td>
<td>Fill in table/chart</td>
<td></td>
</tr>
<tr>
<td><strong>Design graphic organizer</strong></td>
<td>POGIL</td>
<td>Color-by-number</td>
<td></td>
</tr>
<tr>
<td><strong>Response to writing prompt</strong></td>
<td>Find a diagram/image to match a caption</td>
<td>Cut-and-paste</td>
<td></td>
</tr>
<tr>
<td><strong>Student-designed foldable</strong></td>
<td>Open sort</td>
<td>Closed sort</td>
<td></td>
</tr>
</tbody>
</table>
**Student Created Output Examples**

Generally has little teacher guidance, but always relates to the content on the input side; teacher can set what kind of product students create or provide a starting point (i.e. scientist picture)

*Ex: (left to right) Chemist word association; Thermochemistry KWL; Sketch of the atom based on provided rubric (available in resources); Gases graphic organizer; Cartoon illustration of types of reactions*
Teacher Guided Output Examples
This option is great when students may need some scaffolding from the teacher, but still have options in the way in which they are interacting with the material

Ex: (left to right) Tools of the Chemist stations activity (available in resources); Safety Features of the lab sketch; pH of Common Substances lab results; Color-Coded Periodic Table
Teacher Directed Output Examples

Can vary from a traditional worksheet to cut-and-paste sort or lab data; when possible, modify a traditional worksheet to include color, interactivity or something to engage students in a different way

Ex: (left to right) Ideal Gas Laws color coding practice (available in resources); Interactive Calorimetry Practice Problems (available in resources); Molarity Sim (available in resources); Metric Mania with Dry-Erase Duct Tape at the top; Physical and Chemical Properties and Changes Closed Sort; Nomenclature Flashcards Closed Sort with Pockets
To complete a brief survey about this webinar, and to generate your certificate of attendance, visit:

To Download Resources:

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