NSDL in Pre-service Science Teacher Education

NSDL Annual Meeting
Washington DC, November 1-3, 2010

Cases compiled by Laura Moin
NSDL - Resource Center
Outreach and Professional Development Manager

A very simple agenda

- **Introduction**
  - Why is it important that NSDL has a presence in pre-service science and math teacher education?
- **Cases compiled**
- **Your cases**
- **Discussion**
  - Can we synthesize effective models or principles for including NSDL in pre-service science and math teacher education?
  - What should NSDL do to more effectively be included in pre-service science and math teacher education?

Introduction

Mid-1990s: first entire state digital libraries

→ Phase 1: getting it started
(growth and initial success)

→ Phase 2: consolidation
(transition stage)

→ Phase 3: sustainability
(overarching strategic plan supported by budget, marketing, projects, business, operations)

Teachers have to become a strategic focus for the success of digital libraries … [digital libraries have] to help them change the way they teach.

The school faculty needs to know how to use the electronic resources aligned with state standards

Fuller, D. (2006)

Introduction

The *incunabula* of digital material in SOE libraries

Bull & Sites (2009): Curry School of Education library of the University of Virginia is the first known instance in which a school of education made a transition from physical to digital books. It is likely the harbinger of a significant evolution that will affect both schools and society.

A new definition of effective teachers

U.S. Secretary of Education Arne Duncan (2009): "This new report reinforces that effective teachers need to incorporate digital content into everyday classes and consider open-source learning management systems, …"

Why digital libraries in pre-service science and math teacher education?

Policy and demographic perspectives

NASBE symposium (December 2009): the need for improved access to OERs is perhaps more critical than ever in light of adequate yearly progress requirements and the growing diversity of the student population, as well as the movement toward voluntary, common state standards.

Providing math & science OER's PD for school staff is a challenge

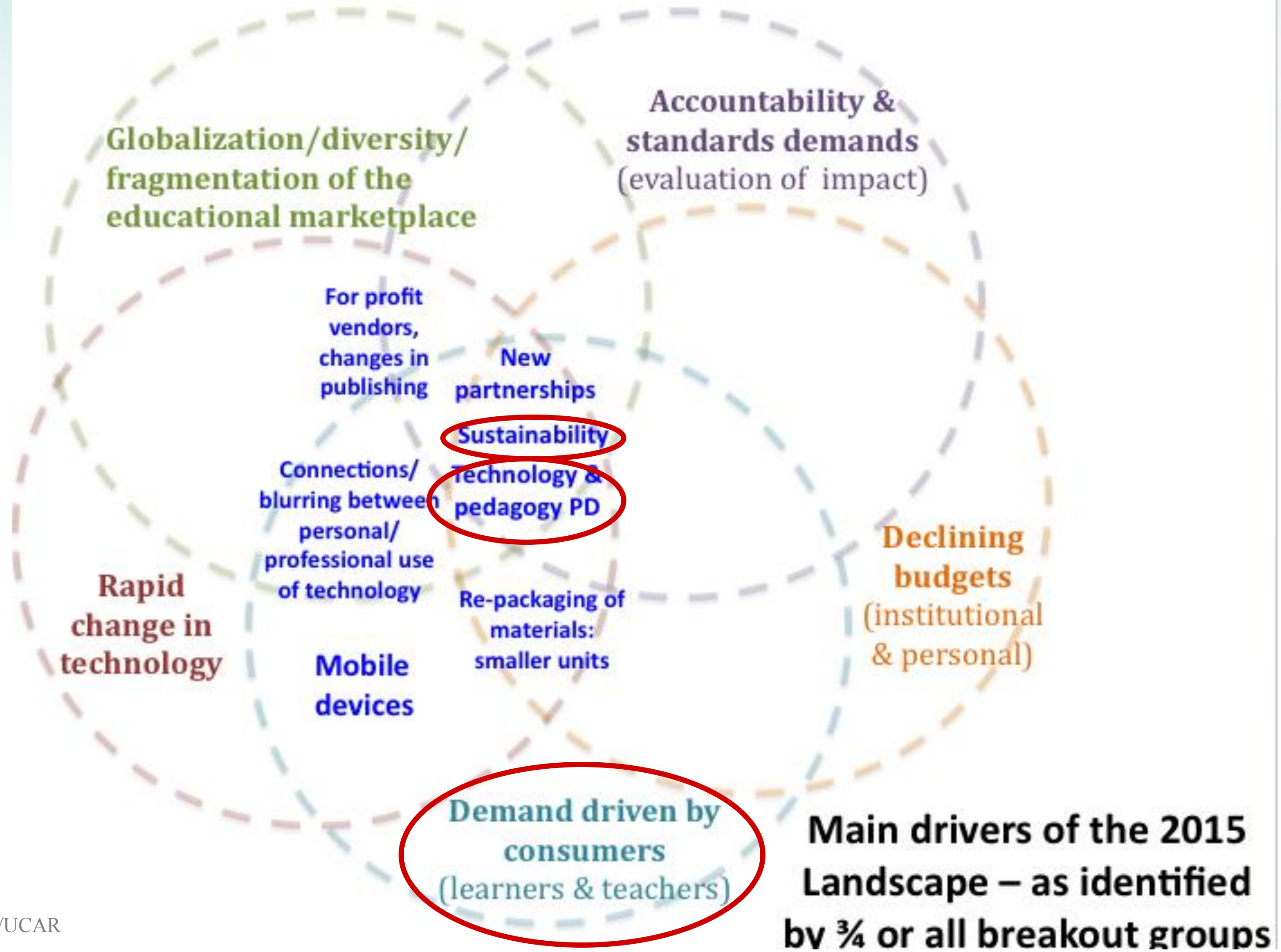
NASBE

Speak Up 2009 survey – Project Tomorrow

Recker et al. (2005): discoverability of resources by standards

Linn (2003), the kinds of technologies that have had an advantageous impact on instruction are those that support user customization.

Introduction



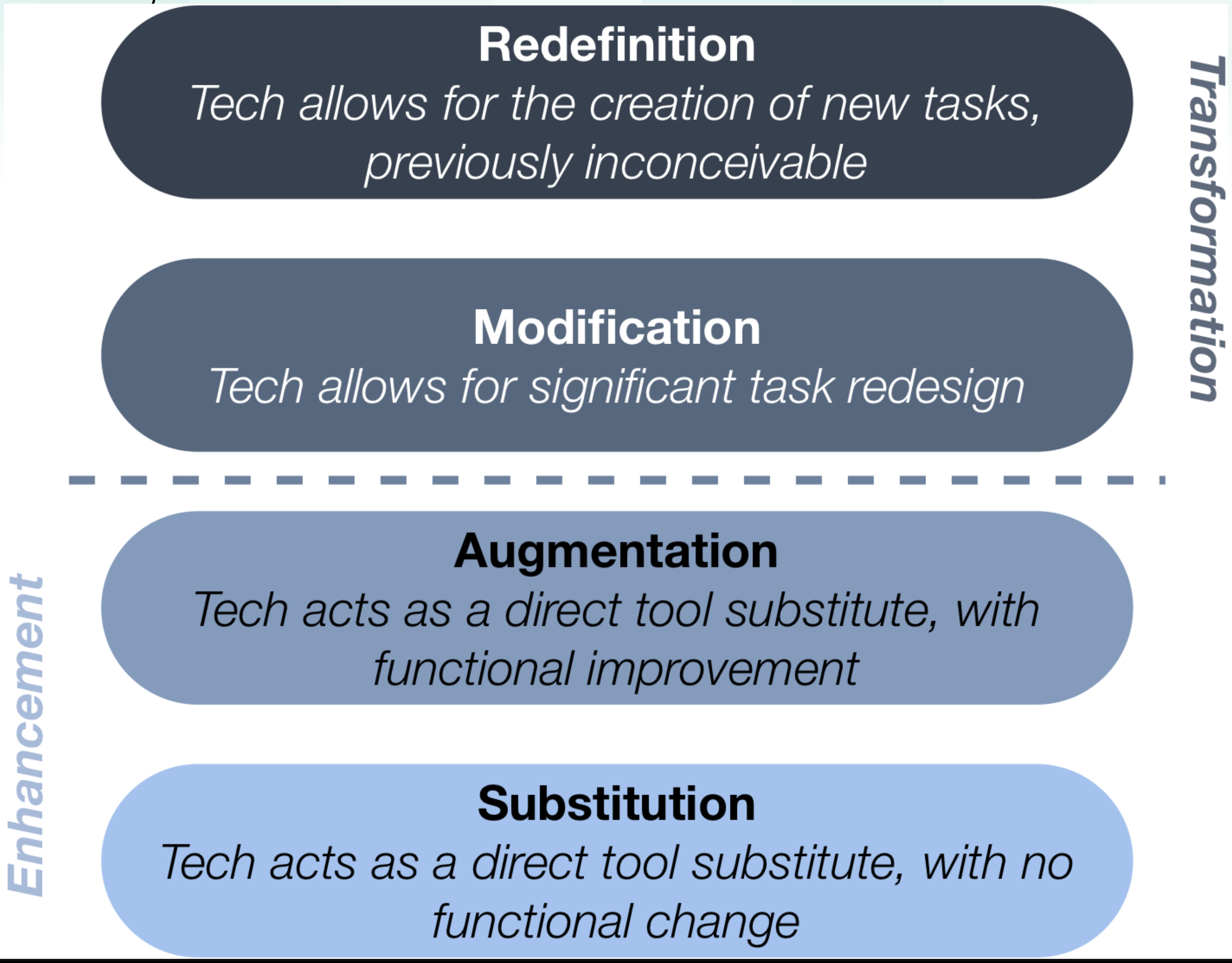
Introduction

Other conclusions from the PW meeting – August 2010, Boulder, CO

- There is a movement toward digitalization of the curriculum
- There is a need to articulate NSDL niche/value-added/unique value propositions by looking comprehensively at systemic educational landscape (pre-service teachers explicitly mentioned)
- Focus on early adopters of instructional digital content

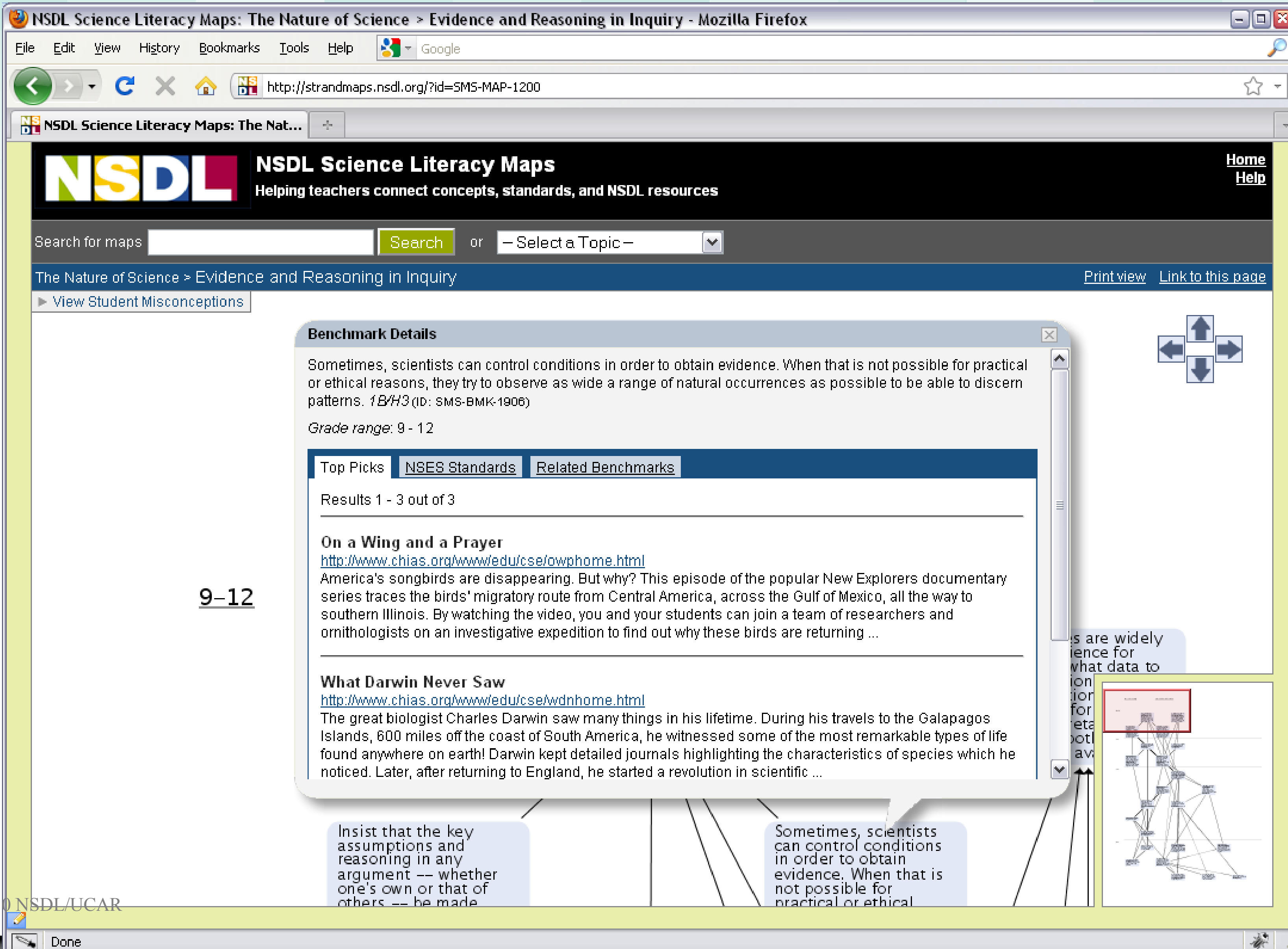
The SAMR Model

Cynthia Curry, Steve Garton, Jeff Mao, and Ruben Puentedura
Leading Teachers from Substitution to Redefinition
ISTE 2010 - Denver, CO



The three cases compiled from non-NSDL community members

Strand Maps – as a planning tool



Case 1

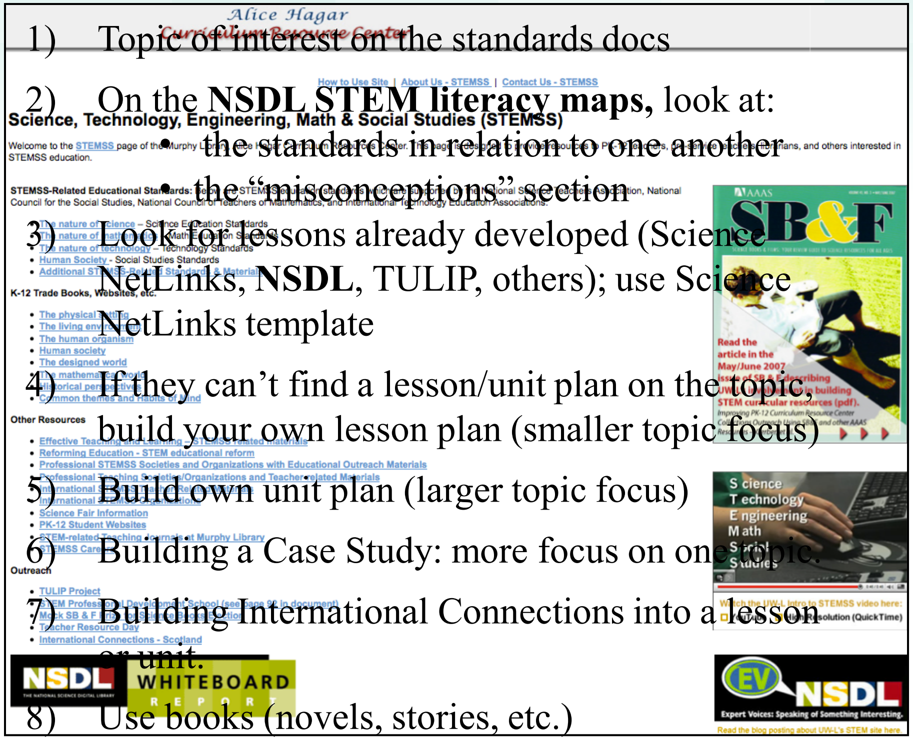
Daniel Timothy (Tim) Gerber: **NSDL Use in "Broader Impacts"**

Assoc. Prof., Biology Dept.
University of Wisconsin – La Crosse

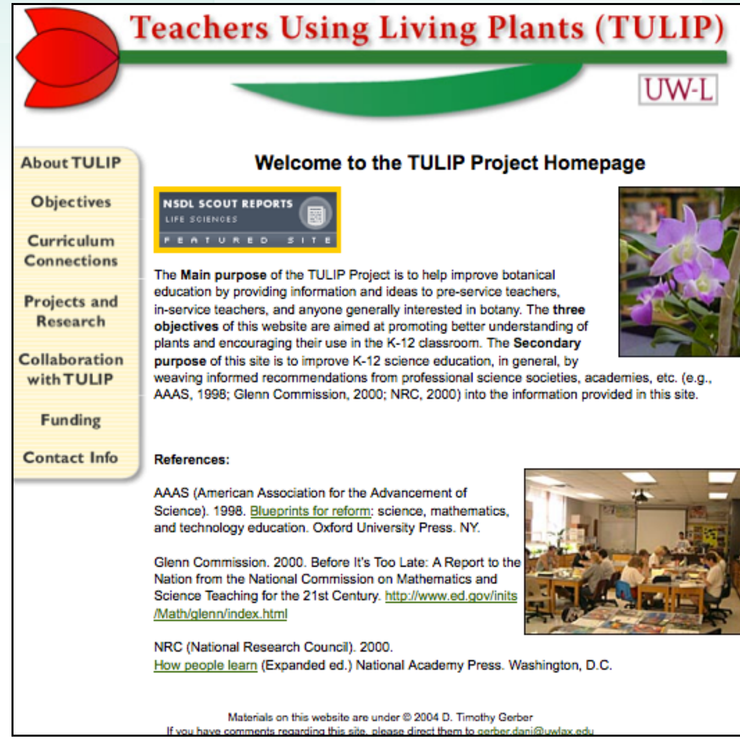
<u>Audience</u>: Pre-service teachers in science methods class
(initial certification for MS and HS science, 80% undergrads, 20% grads)

<u>Task</u>: Look for science lessons (in NSDL, NetLinks, and other sources) and identify the benchmarks they address within a large printout of the NSDL science literacy maps.

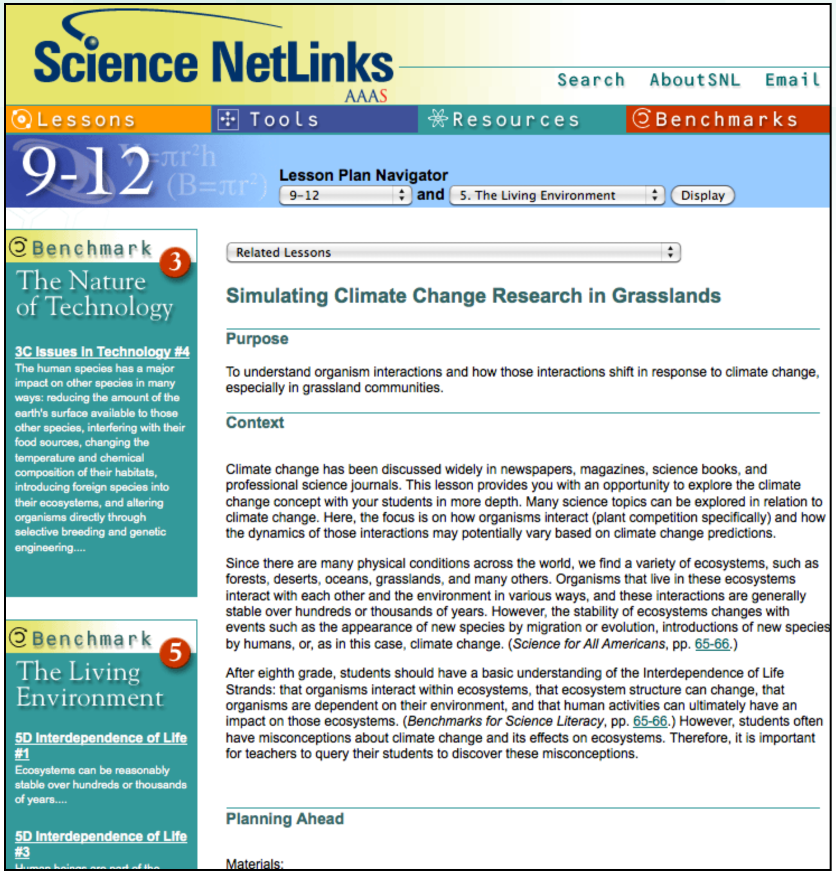
Dr. Gerber developed two websites:



1) Topic of interest on the standards docs
2) On the **NSDL STEM literacy maps,** look at:
   - the standards in relation to one another
   - the "misconceptions" section
3) Look for lessons already developed (Science NetLinks, **NSDL**, TULIP, others); use Science NetLinks template
4) If they can't find a lesson/unit plan on the topic, build your own lesson plan (smaller topic focus)
5) Build own unit plan (larger topic focus)
6) Building a Case Study: more focus on one topic.
7) Building International Connections into a lesson or unit.
8) Use books (novels, stories, etc.)



First, the team develops the HS lesson



Science NetLinks AAAS

Search AboutSNL Email

Lessons Tools Resources Benchmarks

9-12

Lesson Plan Navigator

9-12 and 5. The Living Environment Display

Benchmark 3

The Nature of Technology

3C Issues in Technology #4

The human species has a major impact on other species in many ways: reducing the amount of the earth's surface available to those other species, interfering with their food sources, changing the temperature and chemical composition of their habitats, introducing foreign species into their ecosystems, and altering organisms directly through selective breeding and genetic engineering....

Benchmark 5

The Living Environment

5D Interdependence of Life #1

Ecosystems can be reasonably stable over hundreds or thousands of years....

5D Interdependence of Life #3

Related Lessons

Simulating Climate Change Research in Grasslands

Purpose

To understand organism interactions and how those interactions shift in response to climate change, especially in grassland communities.

Context

Climate change has been discussed widely in newspapers, magazines, science books, and professional science journals. This lesson provides you with an opportunity to explore the climate change concept with your students in more depth. Many science topics can be explored in relation to climate change. Here, the focus is on how organisms interact (plant competition specifically) and how the dynamics of those interactions may potentially vary based on climate change predictions.

Since there are many physical conditions across the world, we find a variety of ecosystems, such as forests, deserts, oceans, grasslands, and many others. Organisms that live in these ecosystems interact with each other and the environment in various ways, and these interactions are generally stable over hundreds or thousands of years. However, the stability of ecosystems changes with events such as the appearance of new species by migration or evolution, introductions of new species by humans, or, as in this case, climate change. (*Science for All Americans*, pp. 65-66.)

After eighth grade, students should have a basic understanding of the Interdependence of Life Strands: that organisms interact within ecosystems, that ecosystem structure can change, that organisms are dependent on their environment, and that human activities can ultimately have an impact on those ecosystems. (*Benchmarks for Science Literacy*, pp. 65-66.) However, students often have misconceptions about climate change and its effects on ecosystems. Therefore, it is important for teachers to query their students to discover these misconceptions.

Planning Ahead

Materials:

Then, they develop the MS lesson

Science NetLinks AAAS

Search AboutSNL Email

Lessons Tools Resources Benchmarks

6-8

Lesson Plan Navigator

6-8 and 5. The Living Environment Display

Benchmark 4

The Physical Setting

4C Processes that Shape the Earth #7

Human activities, such as reducing the amount of forest cover, increasing the amount and variety of chemicals released into the atmosphere, and intensive farming, have changed the earth's land, oceans, and atmosphere....

Benchmark 5

The Living Environment

5D Interdependence of Life #1

In any particular environment, the growth and survival of organisms depend on the physical conditions....

5F Evolution of Life #2

Individual organisms with certain traits are more likely than others to survive and have offspring....

Related Lessons

Grasslands and Climate Change

Purpose

To understand the underlying ecological properties of grassland communities and to distinguish between short- and long-term responses to climate change, which allows the prediction of changes in grassland reproductive mechanisms and community structure.

Context

Since global climate change can vary local environmental conditions, organisms may need to adapt to new conditions. Will these new environmental conditions change the amounts of fruits and seeds produced by the plants? This is an important question to ask since the new environmental conditions may affect plant survival and reproductive output.

This lesson provides students with an opportunity to explore the climate change concept in greater depth. Many science topics can be explored in relation to climate change. However, here the focus is on plant competition, reproductive output, and how these concepts may vary based on climate change predictions. The emphasis in this lesson is the effect of increasing amounts of water, predicted by global climate change models for some parts of the United States, on the production of fruits and seeds (measures of reproductive output). Equally, some parts of the United States are predicted to get dryer; however, it is easier to simulate water additions rather than trying to simulate dryer conditions.

Organisms that live in ecosystems interact with each other and the environment in various ways. Ecosystems are shaped by the nonliving environment (e.g., land, topography, water, solar radiation, rainfall, mineral concentrations, and temperature). In ecosystems, organisms use vital earth resources, each seeking their share of resources for survival in specific ways that are limited by other organisms. (*Science for All Americans*, pp. 65-6.) Reproduction is also necessary for species survival. Limitations, such as competition, on resource acquisition can limit growth, survival, and affect reproductive output. Change in resource supply and acquisition, whether by competition or changing environmental conditions due to global climate change, can therefore affect species survival by limiting growth and/or changing reproductive output (production of fruits, seeds, cones, or other reproductive plant structures).

By the end of the fifth grade, students should have a basic understanding that for any particular

NSDL Use in “Broader Impacts”

Audience: PD for in-service teachers

Objective: to highlight the functionalities of the interactive NSDL science literacy maps and using them as a method for better understanding K-12 science both horizontally within a grade band and across grade bands.

Task: Examine the structure of the map and its content, find resources that address a given sequence of benchmarks, and discuss the resources and their sequences.

Case 2

Ted Fowler, Professor Emeritus
Kathie Maynard, Visiting Assist. Prof. in Teacher Ed.
CECH, University of Cincinnati

"Re-calibration"

Audience: pre-service and in-service teachers

Re-calibration main features:

- Focus on a particular part, topic, or process of curricular and instructional planning
- Aim at establishing a habit of mind that gets a teacher to engage with rather than side-step weak areas of content
- Teachers need to reflect in a structured manner on what they know themselves and what is known about a topic as they plan and execute instruction

While recalibration can be accomplished in many ways (such as reading or discussing with colleagues), *NSDL* and the interactive *NSDL science literacy maps* facilitate this process.

"Re-calibration"

1. Content coherence through "learning progressions"
2. Missing or mis-understandings
3. Deeper accessing of NSDL resources
4. Deeper Inquiry
5. Richer Design Process
6. Structuring of Project/Problem-Based Learning actives
7. Considering Social Justice

1. Identify target benchmark on NSDL science literacy map
2. Identify related benchmarks looking for necessary pre-requisite knowledge or analogous knowledge.
3. Assemble relevant instructional activities, using NSDL and other resources.

1. Identify mis-understandings
2. Identify benchmarks on the NSDL science literacy maps that could be contributing to the mis-understanding
3. Assemble relevant instructional activities, using NSDL and other resources to address mis-understandings.

1. Access the instructional resources for the primary, pre-requisite, and following benchmarks
2. Gather a sample that has coherence and is rich in examples and applications.

1. Select an inquiry lesson and identify what the lesson is trying to accomplish
2. Using the Atlas Nature of Science map, choose one "big idea" that could improve this lesson and reflect on how it could be accomplished.

1. Select a design challenge lesson and identify what the lesson is trying to accomplish
2. Using the Atlas Designed World map, choose one "big idea" that could improve this lesson and reflect on how it could be accomplished.

1. Using the Atlas Energy Resources map, identify a big idea that could be used to frame a PBL.
2. Paraphrase the idea into a *PBL Driving Question.*
3. Identify sub-questions to get at the details

1. Select a lesson or unit that could be extended by connecting the topic with an appropriate societal implication strand.
2. Using the Human Society map, choose one "big idea" that could be used to teach the societal implication of the topic being studied.

"Re-calibration"

1.Content coherence through "learning progressions"

1. Identify target benchmark on **NSDL science literacy map**
2. Identify related benchmarks looking for necessary pre-requisite knowledge or analogous knowledge.
3. Assemble relevant instructional activities, using NSDL and other resources.

2. Missing or mis-understandings

1. Identify mis-understandings
2. Identify benchmarks on the NSDL science literacy maps that could be contributing to the mis-understanding
3. Assemble relevant instructional activities, using NSDL and other resources to address mis-understandings.

3. Deeper accessing of NSDL resources

1. Access the instructional resources for the primary, pre-requisite, and following benchmarks
2. Gather a sample that has coherence and is rich in examples and applications.

4. Deeper Inquiry

1. Select an inquiry lesson and identify what the lesson is trying to accomplish
2. Using the **Atlas Nature of Science map**, choose one "big idea" that could improve this lesson and reflect on how it could be accomplished.

5. Richer Design Process

1. Select a design challenge lesson and identify what the lesson is trying to accomplish
2. Using the **Atlas Designed World map**, choose one "big idea" that could improve this lesson and reflect on how it could be accomplished.

6. Structuring of Project/Problem-Based Learning actives

1. Using **the Atlas Energy Resources map**, identify a big idea that could be used to frame a PBL.
2. Paraphrase the idea into a *PBL Driving Question.*
3. Identify sub-questions to get at the details

7. Considering Social Justice

1. Select a lesson or unit that could be extended by connecting the topic with an appropriate societal implication strand.
2. Using the **Human Society map**, choose one "big idea" that could be used to teach the societal implication of the topic being studied.

Case 3

Steven Haderlie: **NSDL Use in HS, College Freshman Chem., & Teacher Ed.**

Springville High School
Chemistry Dept.

Brigham Young University (BYU)
Provo, UT 84602

Audience:

High School:

•Regular Chemistry and AP Chemistry high school students

•On-line high school chemistry class for BYU Independent Study (asynchronous class that enrolls 1,500 students world-wide)

College:

•Second semester freshman chemistry at BYU in the summer

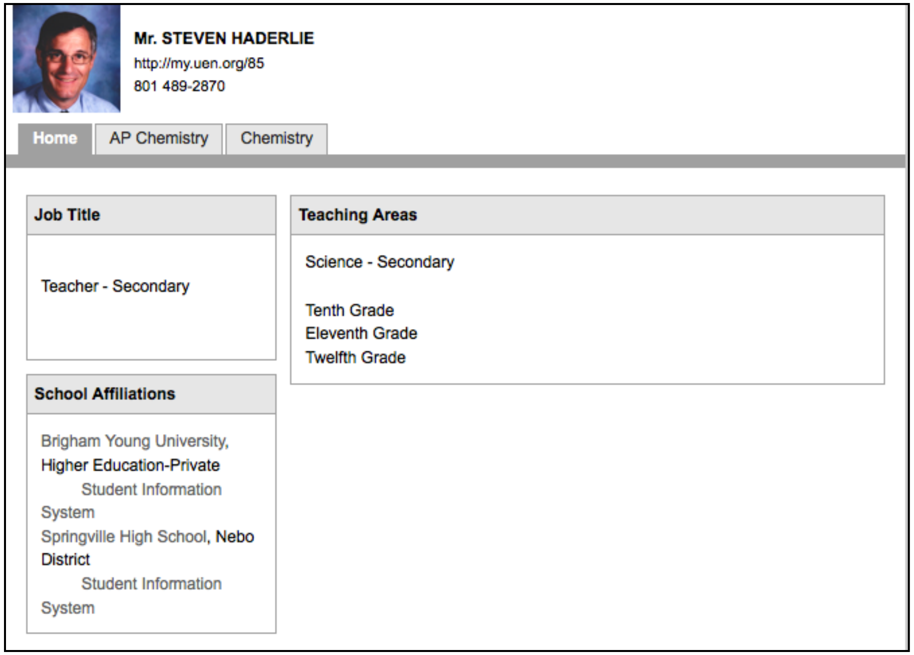
Teacher Ed.:

•Chemistry teaching methods for Chem Ed majors (3-5 students) in winter

Case 3

Steven Haderlie: **NSDL Use in HS, College Freshman Chem., & Teacher Ed.**

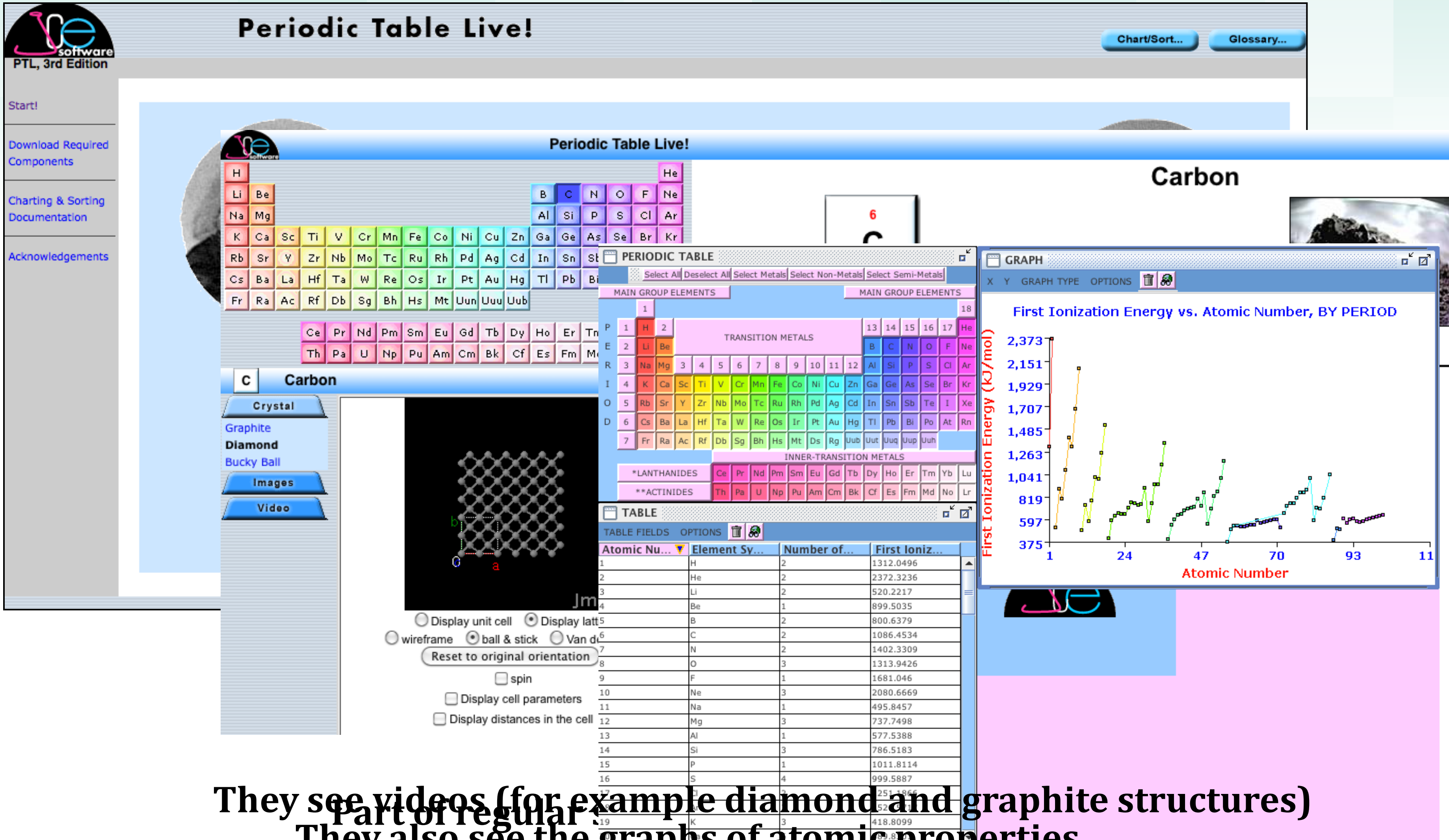
Mr. Haderlie's UT Education Network webpages



Mr. Haderlie's HS webpage

In both sites, Mr. Haderlie includes links for students to use

High School



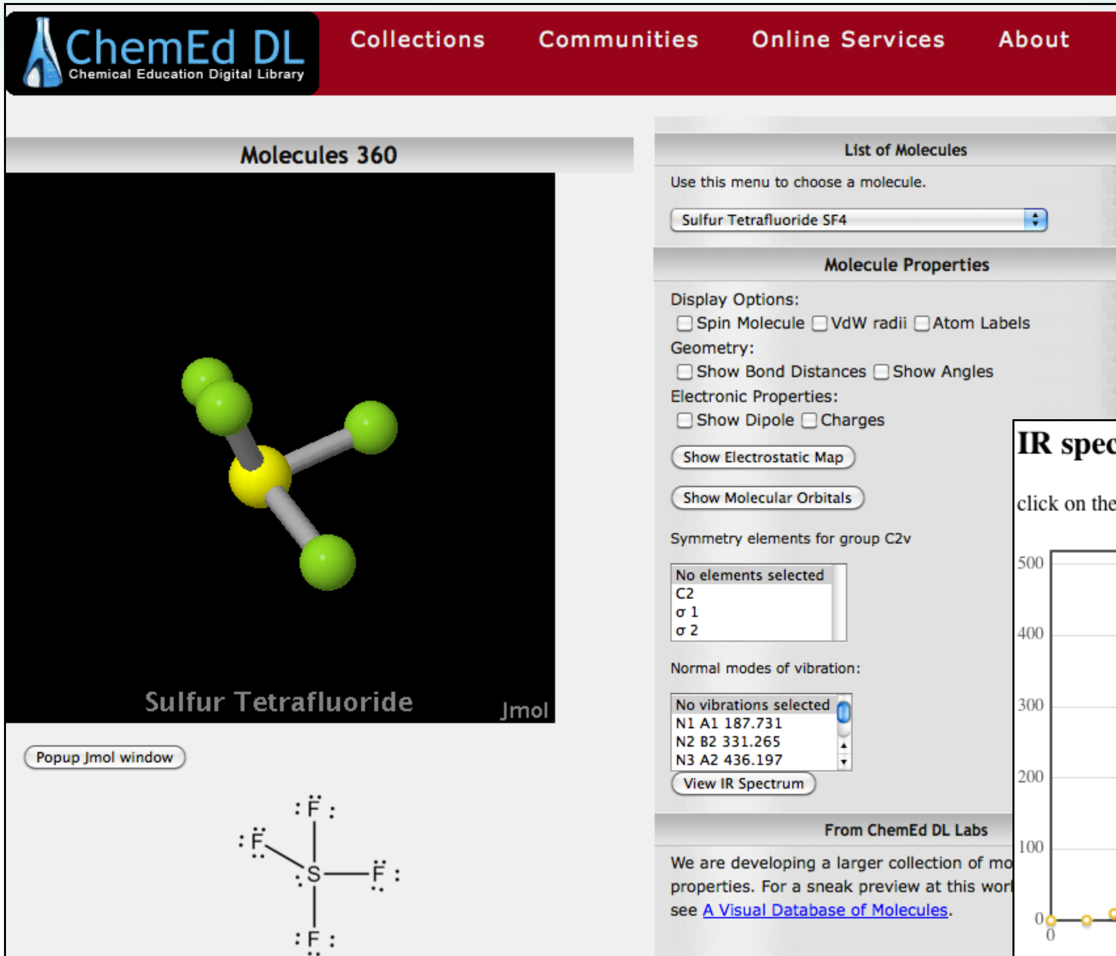
They see videos (for example diamond and graphite structures)

Part of regular ...

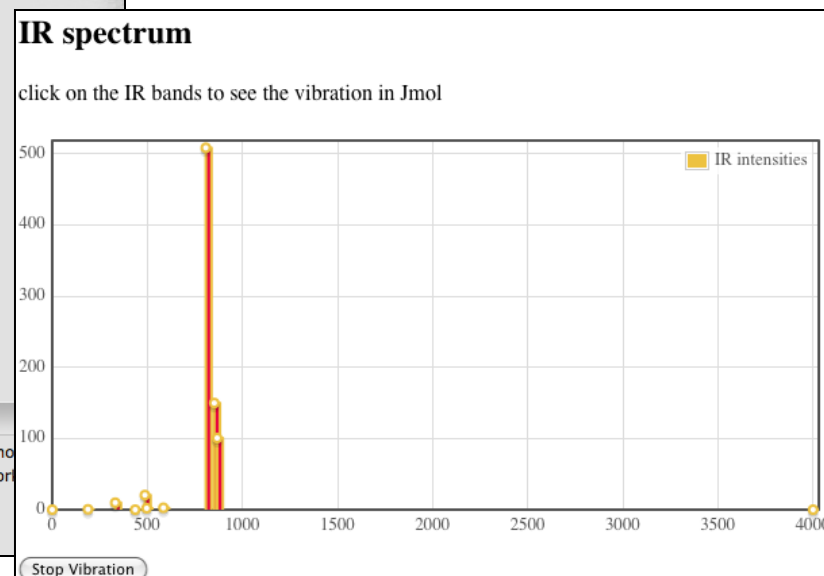
They also see the graphs of atomic properties

High School and College freshman classes

Molecules 360 in regular Chemistry high school classes as a visualization tool for molecular geometry



In AP Chemistry and College freshman classes, they also use Molecules 360 to demonstrate how entropy increases with increasing molecular complexity and add vibrational modes linked to IR



Chemical Education (BYU)

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ChemPRIME

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1. Introduction: The Ambit of Chemistry [+]

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Mars Meteor ALH84001 and Extraterrestrial Life

From ChemPRIME

back to Properties of Organic Compounds and Other Covalent Substances

The search for life elsewhere in the universe has centered on finding ***organic compounds*** because they are the stuff of all life on earth. Organic compounds are easily synthesized by abiotic (non-living) processes, however, so the search for extraterrestrial life has occasionally centered on other "biomarkers" (chemical structures that are typically found in living things).

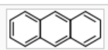
Contents [hide]

1 ALH84001
2 Abiotic Organic Compounds
3 Other Biomarkers
4 Weird Life
5 Physical Properties
6 References

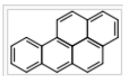
ALH84001

A meteorite from Mars collided with the earth and was collected in 1984 from the Allan Hills region of Antarctica [1] and thus designated ALH84001. An asteroid probably collided with Mars, breaking off the chunk which circled the sun for eons before colliding with the earth as a meteorite.

The meteorite contained PAHs (Polycyclic Aromatic Hydrocarbons) containing rings of six carbon atoms, fused together in arrays like those shown below. Benzo-α-pyrene is formed when meat is barbecued (it may be a carcinogen) and anthracene is found in coal as a relic of it's biological origin.



Anthracene[2]



Benzo-alpha-Pyrene[3]

Note that these organic compounds have even numbers of carbon atoms (a sign of biotic origin). They are considered **organic** because they contains carbon chains and hydrogen atoms (H atoms are not shown in the figure by convention; organic chemists know that there must be hydrogen atoms where necessary to make a total of four bonds to each carbon). Carbon-carbon bonds are quite strong, allowing formation of long chains to which side branches and a variety of functional groups may be attached. Hence the number of molecular structures which can be adopted by organic compounds is extremely large. PAHs are ***hydrocarbons*** because they contain only carbon and hydrogen, like the simpler hydrocarbon ethane (shown below). Hydrocarbons are further categorized as alkanes, cycloalkanes, aromatic compounds, alkenes and alkynes,

Organic compounds often also contain oxygen, nitrogen, and small proportions of other elements. Addition elements other than

v · cp · e ChemPRIME [–]

1. Introduction: The Ambit of Chemistry [+]
2. Atoms, Molecules, and Chemical Reactions [+]
3. Using Chemical Equations in Calculations [+]
4. The Structure of Atoms [+]
5. The Electronic Structure of Atoms [+]
6. Chemical Bonding - Electron Pairs and Octets [+]
7. Further Aspects of Covalent Bonding [+]
8. Properties of Organic Compounds ... [–]

- Covalent Compounds and Intermolecular Forces
- Dipole Forces
- London Forces
- Organic Compounds: Hydrocarbons
- Alkanes
- Cycloalkanes
- Properties of Alkanes
- Aromatic Hydrocarbons
- Unsaturated Hydrocarbons
- Hydrogen Bonding: Water
- Ice and Water
- Organic Compounds-Some Additional Classes
- Alcohols
- Ethers
- Aldehydes and Ketones
- Carboxylic Acids
- Esters
- Organic Nitrogen Compounds
- Macromolecular Substances
- Diamond and Graphite
- Silicon Dioxide
- Synthetic Macromolecules: Some Applied Organic Chemistry
- Addition Polymers
- Condensation Polymers
- Cross-Linking

Students learn