

Science in the News **Improving Students' Scientific Literacy** Academy of Singapore Teachers **Teacher Led Workshop** Traisi Code 41170 Training Room 28 (Block C Level 4) Thursday 14th April 2016 2.30 to 5.30 p.m. Acader of Singapore eac lead. care. inspire

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Nanyang Girls' High School





 This presentation and accompanying resources can be found online at...





www.Scientist.sg







www.Scientist.sg

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Science in the News Programme **1.** Learning Objectives 2. Introduction **3.** Classroom Strategies 4. Tea Break **5.** Hands-on Component 6. Summary of Today's Workshop 7. Reflection and Evaluation









Science in the News Learning Objectives

- Unpack the meaning and importance of a scientifically literate society.
- Discuss issues that affect the scientific literacy of our students, and hence society.
- Discuss possible strategies for improving students' scientific literacy.
- Discuss possible strategies for engaging students in their learning of science.







- Enduring understandings about science:
 - \rightarrow Science is a human endeavour.
 - \rightarrow The natural world is understandable.
- \rightarrow Scientific ideas are subject to change.

 \rightarrow Scientific knowledge is durable.

- \rightarrow Science cannot provide complete answers to all questions.
- \rightarrow Science is a blend of logic and imagination.
 - \rightarrow Science demands evidence.

 \rightarrow Science explains and predicts.



• Rutherford, F. J., & Ahlgren, A. (1990). *Science for all Americans*. New York: Oxford University Press.

Essential Question

→ Why do humans engage in the pursuit of scientific knowledge?



Essential Question

→ Why do humans engage in the pursuit of scientific knowledge?

"I have no special talents. I am only passionately curious."

Albert Einstein (1952)

"The true scientist never loses the faculty of amazement. It is the essence of his being."

Hans Selye (1958)





Note: These questions are more likely to be discussed in a Language Arts Lesson than a Science lesson.



Further Questions

Qu. What problems do our students face when studying science (compared to other subjects)?

Qu. How can we encourage our students to become more engaged by science?



Further Questions

Qu. What problems do our students face when studying science (compared to other subjects)?

→ Many facts to learn. Facts do not always seem to be related. Abstract. Unable to see relationship between the science classroom and world around them.

Qu. How can we encourage our students to become more engaged by science?

→ Make science less abstract. Connect science to the students' lives. Make science more interesting.

Further Questions

Qu. Why is it important for our students be scientifically literate?

Qu. How can we encourage our students to become scientifically literate?



Further Questions

Qu. Why is it important for our students be scientifically literate?

→ Short Term: Exams, presentations, discussions. Long Term: Improvement of self and society.

Qu. How can we encourage our students to become scientifically literate?

→ Look beyond the textbook to interesting real world examples. Use these as opportunities to engage students & introduce the language of science.

- Further Questions
- Qu. Do our students read about science beyond their text books?

Qu. Do our students fully appreciate the impact that science has on their lives / the world around them?



Further Questions

Qu. Do our students read about science beyond their text books?

→ Do students know where to look for science articles to read? Can they trust what they read online?

Qu. Do our students fully appreciate the impact that science has on their lives / the world around them?

→ They may recognise the impact of technology, (e.g. smartphones) and undesirable consequences of science (e.g. climate change and pollution).



"We live in a society exquisitely dependent on science and technology, in which hardly anyone knows anything about science and technology." Carl Sagan, 1934 - 1996



"Every kid starts out as a natural born scientist, and then we beat it out of them. A few trickle through the system with their wonder and enthusiasm for science intact." Carl Sagan, 1934 - 1996





 Science is a "verb", but communication is also very important (reading instructions, writing reports, giving presentations).



Video = 13.5 seconds

ARTRETS



Why do I need to know this?

It's tested on the exam.



Why do I need to know this?

It's tested on the exam.





Why do I need to know this?

It's interesting and has a real world application.



Why do I need to know this?

It's interesting and has a real world application.



- Students' experience of learning science at school.
 - Transmissively taught (soaked up like a sponge).
 - Boring and irrelevant content (compared to the students' lives).
 - Difficult to learn (compared to other subjects).



- Chemical knowledge has been developed by Chemists for use by Chemists.
- As a consequence, chemical knowledge is not automatically useful for school students.
 - The knowledge of Chemistry needs to be transformed to be useful in schooling.



- Qualities needed in research scientists:
 - \rightarrow Communication skills.
 - \rightarrow Creativity.
 - \rightarrow Curiosity.
 - \rightarrow Perseverance.
 - \rightarrow Personal Interest.
 - \rightarrow Social concerns.
 - \rightarrow Subject knowledge.
 - \rightarrow Team spirit.



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Public understanding of Chemistry:

 \rightarrow Bottled water.

 \rightarrow Clean energy.

- \rightarrow Climate change and environment.
- \rightarrow Contents labelling (<u>Chemistry shopping list</u>).

 \rightarrow Cosmetics advertisements.

 \rightarrow Organic food.

 \rightarrow Supermarket "best before" dates.



 Advertisement about Spelt (*Triticum spelta*) natural grain bread:

"Like liquid nitrogen, the grains vital substances can be absorbed quickly by the body."




Advertisement for a water purifier:

"Small-cluster water molecules in antioxidant alkaline water are more easily absorbed by the body."





 Professor Peter Fensham, Emeritus Professor of Science Education, University of Queensland, Brisbane, Australia.

 What is the educational purpose of Chemistry in compulsory schooling?
Does it need a purpose?



 Professor Peter Fensham, Emeritus Professor of Science Education, University of Queensland, Brisbane, Australia.

- Some educational purposes for Chemistry (Science):
 - \rightarrow Developing curiosity and wonder about the natural world.
- \rightarrow Engaging in decision making about socio-chemical issues.
- \rightarrow Gaining confident understanding of how Chemistry regulates our lives.
 - \rightarrow Improving the quality of personal life involving chemicals.
 - Recognising Chemistry's role in environmental quality.

 Professor Peter Fensham, Emeritus Professor of Science Education, University of Queensland, Brisbane, Australia.



- Each student comes to class with their own tacit knowledge and their own vocabulary.
- Do students have the necessary vocabulary (and the correct understanding of that vocabulary) to understand the problem / question?
- Do students have the necessary vocabulary (and the correct understanding of that vocabulary) to solve the problem / answer the question?



 Communication is important in order to make thinking visible. Students must communicate ideas clearly to their teachers and peers if misconceptions and errors in their way of thinking are to be identified.



Classroom

Language

Everyday Language

• Students use language to socialise.

• Teachers use language to build rapport, and to introduce new concepts in terms that are familiar to the students. • Teachers and students use language in classroom routines and discussions.

 Teachers model and scaffold academic language. Teachers and students use
language to describe, understand and apply new concepts and understandings.

Academic

Language

Adapted from Chadwick, T. (2012). Language Awareness in Teaching. A Toolkit for content and language teachers. Cambridge: Cambridge University Press.



 Students need to be able to use correct academic language to demonstrate their understanding of concepts in science.

• A major challenge to students learning science is the academic language in which science is written.

 Academic language is designed to be concise, precise and authorise. To achieve these goals, it uses sophisticated words and complex grammatical constructions which may block reading comprehension and also block learning.



- The relative atomic mass of a chemical element is the average mass of one atom of the element compared to one-twelfth the mass of an atom of 12-carbon.
- The oxidation state of an atom in a compound is given by the hypothetical charge on the corresponding atomic ion that is obtained by heterolytically cleaving its bonds such that the atom with the higher electronegativity value in the bond is allocated all of the electrons in this bond.



Word Used in Math

 $\rightarrow \text{Odd}$

 \rightarrow Plane

 \rightarrow Order

 \rightarrow Rational

 \rightarrow Differentiate



Word Used in Math

 $\rightarrow \text{Odd}$

 \rightarrow Plane

 \rightarrow Order

 \rightarrow Rational

 \rightarrow Differentiate

Everyday Meaning

 \rightarrow Strange

 \rightarrow Aircraft

 \rightarrow Command

 \rightarrow Sane

 \rightarrow Tell when things are not the same



- Chemistry as Third Language
- \rightarrow Bubbles
- \rightarrow Cloudy
 - \rightarrow Litre
- \rightarrow Liquid?
- \rightarrow Evaporating?
 - \rightarrow Particle?



- Chemistry as Third Language
- \rightarrow Bubbles
- \rightarrow Cloudy
 - \rightarrow Litre
- \rightarrow Liquid?
- \rightarrow Evaporating?
 - \rightarrow Particle?

- \rightarrow Effervescence
 - \rightarrow Precipitate
- \rightarrow Decimetre Cubed
 - \rightarrow Solution?
 - \rightarrow Boiling?
 - → Atom? Ion? Molecule?



 Students need help in learning academic vocabulary and how to process academic language if they are to become independent learners of science.



 To effectively understand and explain the subject concepts, students must develop the language to do so.

 Subject literacy is the ability to use language appropriately, meaningfully and precisely in a given subject area. It requires proficiency in both language and subject knowledge.



Content Vocabulary

 What subject specific words will my students need to know.
Which words have previous students had

problems with?How will I help my students with these

unfamiliar words?

Functional Language

• What thought processes / critical thinking skills / creative thinking skills will my students use?

 How will I help my students with this language? Spoken & Written Word

 How will my students
communicate their knowledge and understanding?

• How will I help my students communicate clearly and accurately?

> TANYAAC CALS' HIGH

• Adapted from Chadwick, T. (2012). *Language Awareness in Teaching. A Toolkit for content and language teachers*. Cambridge: Cambridge University Press.

 Disciplinary literacy is defined as the confluence of content knowledge, experiences, and skills merged with the ability to read, write, listen, speak, think critically and perform in a way that is meaningful within the context of a given field.

> • Wisconsin Common Core State Standards for Literacy in All Subjects. http://standards.dpi.wi.gov/sites/default/files/imce/cal/pdf/section2.pdf



 Scientific literacy is the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity. It also includes specific types of abilities.

> National Science Education Standards. Copyright 1996 by the National Academy of Sciences. Courtesy of the National Academy Press, Washington, D.C.



- Scientific literacy means that a person can ask, find, or determine answers to questions derived from curiosity about everyday experiences.
 - It means that a person has the ability to describe, explain, and predict natural phenomena.

• Scientific literacy entails being able to read with understanding articles about science in the popular press and to engage in social conversation about the validity of the conclusions.

> National Science Education Standards. Copyright 1996 by the National Academy of Sciences. Courtesy of the National Academy Press, Washington, D.C.



 Scientific literacy implies that a person can identify scientific issues underlying national and local decisions and express positions that are scientifically and technologically informed.

• A literate citizen should be able to evaluate the quality of scientific information on the basis of its source and the methods used to generate it.

 Scientific literacy also implies the capacity to pose and evaluate arguments based on evidence and to apply conclusions from such arguments appropriately.

National Science Education Standards. Copyright 1996 by the National Academy of Sciences. Courtesy of the National Academy Press, Washington, D.C.







• The most serious problems that humans now face are global: unchecked population growth in many parts of the world, acid rain, the shrinking of tropical rain forests and other great sources of species diversity, the pollution of the environment, disease, social strife, the extreme inequities in the distribution of the Earth's wealth, the huge investment in preparing for and conducting war, scarce resources invested in human intellect and the ominous shadow of nuclear holocaust.



• What the future holds in store for individual human beings, the nation, and the world depends largely on the wisdom with which humans use science and technology. And that, in turn, depends on the character, distribution, and effectiveness of the education that people receive.



 Education should prepare people to read or listen to statements critically, deciding what evidence to pay attention to and what to dismiss, and distinguishing careful arguments from careless ones.

Although most people cannot be expected to become experts in technical fields, everyone can learn to detect the symptoms of doubtful assertions and arguments.
These have to do with the ways in which purported results are reported. Students should learn to notice and be put on their guard by the signs of weak arguments in the articles that they read.



• Critical Thinking – Paul's Wheel of Reason





Critical Thinking – Intellectual Standards





(a) The premises of the argument are not made explicit.

(b) The conclusions do not follow logically from the evidence given (for example, the truth of "Most tall people are left-handed" does not prove the truth of the converse, "Most left-handed people are tall").

(c) The argument is based on analogy but the comparison is not appropriate.

(d) Fact and opinion are intermingled, opinions are presented as facts, or it is not clear which is which.



(e) Vague attributions are used in place of specific references. For example, such common attributions as "leading doctors say ...," "science has shown that ...".

(f) Graphs are used that – by chopping off part of the scale, using unusual scale units, or using no scale at all – distort the appearance of results.

(g) Average results are reported, but not the amount of variation around the average.



(h) Celebrity is used as authority ("Film star endorses new diet").

(i) Absolute and proportional quantities are mixed (as in "3,400 more robberies in our city last year, whereas other cities had an increase of less than 1 percent").

(j) Explanations or conclusions are represented as the only ones worth consideration, with no mention of other possibilities.



outcry, but steadfastly clung to his opinion that the amendof disci interest

You Introduction

Despite recent reports of several leading indicators showing a slightly positive trend, experts generally agree that the current reach the healthy levels we enjoyed a decade ago, and experts and economists fear that some sectors, such as health, care

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Few environmental issues are as

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Science in the News out Introduction

- Scientists do not communicate directly with the general public very often.
- Contemporary activities and discoveries in Science are normally communicated to the general public through the media.
 - The media affects the general public's perception of Science.

• The general public must be able to critically evaluate what the media says about Science.



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Science in the News on Introduction

- When reading media reports, the public should...
 - Consider the credibility of the source.
 - Consider the agenda of the source.
 - Consider who is being interviewed. Are they an expert in the field of knowledge?
- Consider whether there is any conflict of interest.
 - Consider what is being offered, fact or opinion.
- For example, conflicting articles in the media over global warming and its causes.

his quarter, according to a Brown

Science in the News





 Learning takes place when a person in *cognitive equilibrium* encounters new knowledge. *Cognitive disequilibrium* then occurs as the individual connects and assimilates the new knowledge with what they already know. As new *schemata*, or knowledge structures, are formed, the individual returns to cognitive equilibrium.

(Jean Piaget, 1896 - 1980)



 When a more capable person (teacher) helps another person (student) through the period of cognitive disequilibrium to successfully acquire a new skill or knowledge, then the student is said to be in the zone of proximal development.

(Lev Vygotsky, 1896 - 1934)



- Using narratives are a useful pedagogy that can be used to teach many different subjects.
 - Remembering individual facts is difficult.
 - Humans think in narratives.
 - Narratives help to connect discrete facts together.
- Teachers teach by using narratives, analogies and ideas that students are interested in / familiar with.



Use of narratives or stories to make science more interesting to learn.



In subrequent millermis, our molecule finds its way into a whale to train, and Antardic ice ohoot, a glass of water and a human heart. Later, it waters a pine tree. It also for decades in the calculose fitters of the fitters' hardwood before the pine is fitted and sturned into pint. The water molecule stays in place as the pulp goes through chemical reactions, manipulations and dryings until it finds teef locked inside a sheet of paper. That paper is printed with ink. It is out, folded and stapled. The water molecule site, motions, at the ond of a sentence, this way one.

Alor Jhe, Your Blood Wes Once Dinostur Uline, Mew Scientist, 14¹¹ November 2015, page 31.

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"Your blood was once dinosaur urine."


Sources of Information – Journals and Magazines



• For example, New Scientist, Scientific American and BBC Knowledge.



• Sources of Information – Reliable Websites



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http://www.bbc.co.uk/news/science_and_environment

Sources of Information – Digital Media



• ChemMatters by the American Chemical Society.



Science in the News **Classroom Strategies** Sources of Information – Newspaper Articles

60 science

TODAY · FRIDAY 8 JANUARY 2016

Japan team first outside West to name element

Discovery joins those of US and Russian teams to complete the bottom row of the periodic table

NEW YORK - Since the 19th century, European and American discoveries have monopolised the naming of elements on the periodic table. It is evident in entries such as francium. germanium, scandium, polonium, europium, californium, berkelium and americium.

But now researchers in Asia will add to chemistry's most fundamental catalogue for the first time.

Scientists from the Riken institute in Japan will bestow an official name on Element 113, currently known by the placeholder name ununtrium, the International Union of Pure and Applied Chemistry announced last week.

The organisation said that studies published by the Japanese scientists from 2004 to 2012 give the team the strongest claim to having discovered the element. The declaration comes more than 12 years after the Japanese team first attempted to synthesise the superheavy element, by firing beams of zinc at a thin bismuth film.

Led by Dr Kosuke Morita, the group began to bombard bismuth atoms in



Dr Kosuke Morita of the Riken institute in Japan shows off Element 113 on the periodic table, more than a dozen years after his team of scientists began working to synthesise it. PHOTO: AP

a particle accelerator at 10 per cent the speed of light in 2003. A year later, they successfully fused two atomic nuclei from these elements, creating their first nucleus of Element 113, but it decayed in less than a thousandth of a second. In 2005, the team produced **ELEMENTS** Element 113 in a second event, but the chemistry union did not consider the demonstration strong enough to denote a discovery.

"For over seven years, we continued to search for data conclusively identifying Element 113, but we just never saw another event," said Dr Morita in TEMPORARY NAMES OF FOURNEW Ununtrium (Uut) 113 Ununpentium (Uup) 115

Ununseptium (Uus) 117 Ununoctium (Uuo) 118

PERSEVERANCE UNTIL LADY LUCK SMILED AGAIN

For over seven years, we continued to search for data conclusively identifying Element 113, but we just never saw another event. I was not prepared to give up, however, as I believed that one day, if we persevered, luck would fall upon us again.

Dr Kosuke Morita LEAD SCIENTIST OF JAPANESE TEAM THAT DISCOVERED ELEMENT 113

a statement. "I was not prepared to give up, however, as I believed that one day, if we persevered, luck would fall upon us again."

In 2012, the team finally produced strong evidence that they had synthesised Element 113. Over the course of those nine years, the beam was active for 553 days and launched more than 130 quintillion zinc atoms, according to Nature.

the International Union of Pure and Applied Physics, granted the Riken researchers naming rights to Element 113 over a joint Russia-United States team that had also claimed to discover the element.

The chemistry union's decisions are detailed in two reports to appear in the journal Pure and Applied Chemistry. In addition to Element 113, Elements 115, 117 and 118 will also receive official names. Teams from Russia and the United States discovered those elements.

With their discovery, the bottom row of the periodic table will be complete. Elements are numbered by the protons they have in their nucleus, and Elements 114 (flerovium) and 116 (livermorium) had previously been confirmed and named.

Dr Morita has not yet announced what he intends to name Element 113, but according to a 2004 article in The Japan Times when the team first published its results, one likely contender The chemistry union, along with maybe "japonium". THE NEW YORK TIMES



Science in the News Classroom Strategies • Sources of Information – Books







 Encourage students to write their own news or magazine articles. They could prepare a news report to be read out at assembly, or prepare a news video to be shown on a school-wide platform.





al of Franklin, however, was made worse by his cavalier disclosure: Rosy her data." And there it was, a stunning admission hidden between chapters gged on the dangling thread, Watson's portrayal of Franklin began to found her someone unpleasant to work with, but his experience was by e was a competitor - and far ahead of Watson and Crick during much of rival pair simply wouldn't have made their discovery when they did had it seces of information passed from Franklin's lab at King's College in rick at Cambridge without her knowing it.

otograph of the structure of DNA, captured and calibrated by Franklin. y circulated report that recapped the results of her recent work. Watson de some headway into the structure of DNA, but they had gotten the of the phosphate-sugars wrong. Without Franklin's data, they ential pieces they needed to solve the puzzle. Franklin would eventually anclusion as Watson and Crick - the double helix, the base pairs, the e-sugar chains - some say, had her work not been shared. id knew exactly where she was going " her mother recalled. Once her

thing she was all in. At age six. Franklin was described by her aunt as he spends all of her time doing arithmetic for pleasure. Jacoff invariably gets was precise. Iteral, and always more at home with data than with

is studying at Cambridge, her father complained that she felt about science igion. Franklin held her ground, "You frequently state ... that I have one-sided outlook and look at everything and think of everything in terms in a letter. "Obviously my method of thought and reasoning is influenced by that were not so my scientific training will have been a waste and a failure . life cannot and should not be separated.

entribute to the World War II offert, since her father insisted? Science was llowing her graduation from Cambridge in 1941 and a research position, across prime air raid territory to a post she'd found at the Coal Utilisation There her job was to figure out why some kinds of coal allowed gas and and why others put up a more efficient blockade (charcoal had been used in stant wartime research). Franklin had published five papers on the y the time she was twenty-six. Her thesis, which covered "solid organic ference to coal and related materials," earned her a Ph.D. Additionally, her ould help advance the development of carbon fibre later on. nd recommended her for a job in Paris as a physical chemist, again e years she spent abroad were perhaps her happiest. She made friends

nd by the feeling that England would accelerate her career, at age

is College in London upon her arrival. There she took over the study disciplinary team that had set it aside for the better part of a ut DNA's molecular structure. To do so, Franklin lined-up DNA fibres, rayed the carefully prepared samples in seventy-five percent and ninety-five percent, the molecules elongated, which Franklin called DNA in this case looked like the lines of an "X" blinking in-and-out of al structure, although she didn't yet know it.



didn't have any formal collaborators. The most obvious choice

ns, also at King's, but an early misunderstanding about Franklin's

adversaries. Their relationship had consequences for Franklin when

about his colleague, pulled out her beautiful B-form of DNA and

DNA - taken by Franklin - was a major revelation for Watson, who

images that were a mix of DNA's dry and wet form. Franklin's clear

s asked to summarise her previous year's work for a government

wasn't intended for any eyes outside the committee). The report

rucial information about the dry and wet forms of DNA. Combined

re. Announcing their discovery in Nature - that DNA was a helica and the other side going down - they claimed the Nobel Prize for

's pieces were enough for Watson and Crick to form a solid

f revealing Franklin's part in their discovery

er summary to Watson and Crick (the paper was not marked

news of X-ray crystallography

ing at Cambridge without her approval.

ed the way Watson and Crick understood DNA.

breakthrough also came thanks to Franklin, and ag

ransferred to Birkbeck College and away from DNA rch group that looked at ribonucleic acid's role in virus us's molecular structure with X-rays, her group was the er things, how proteins and nucleic acids fit together to

dge team at the same time as she was leaving King's

asn't good for her, and many of her colleagues agreed. As

ito, Franklin convinced the wife of a colleague to sneak ed States to London on a plane. anklin became good friends with Crick and his wife, who

her work got a moment of public recognition. For the 1958 assive six-foot-tall display of the tobacco mosaic virus, a

the discovery of DNA did not get out until Watson himself e the subject of several biographies and a poster child for ved. Franklin, who was always heavily invested in to know that so many people cared about her contribution

- Adenine

= Thymine

= Cytosine

= Guanine

= Phosphale

nucleic acid (DNA) double help

noe - and the Washi log. 105 1121 New York. 1

 Studying the biographies of famous scientists provides a human perspective on a discipline that is often perceived to be very clinical.





• Raffles Girls' School (Secondary) End-of-year exam paper including comprehension question.





 Crosswords and word-search puzzles are a simple way of encouraging students to remember key terms and their definitions.







• <u>The Bloodhound SSC Project</u> aims to set a world land speed record of 1609 km/h (1000 mph). The project has been used to increase interest in science and engineering in schools in the United Kingdom.



 Taboo: Taboo is a word game. The objective of the game is for a player to have his / her partner(s) guess the word on his / her card by describing it. However, the player is not allowed to use the actual word, or any associated words that are printed on the card.



Chemistry Taboo!

Get your partner to guess the following word / term by defining it for them.

Diffusion

 The movement of a chemical (usually a gas or dissolved in solution) from a region of high concentration to a region of lower concentration.



Chemistry Taboo!

Get your partner to guess the following word / term by defining it for them.

Isotope

 Atoms of the same chemical element with the same number of protons (atomic number) but a different number of neutrons (mass number).



Chemistry Taboo!

Get your partner to guess the following word / term by defining it for them.

Valency

 The number of electrons lost by an atom of a metal, or gained by an atom of a non-metal, in order to obtain the electronic configuration of a noble gas (complete valence shell).





• Pictionary:

In small groups, the students take turns to write words associated with a certain topic on pieces of paper. These pieces of paper are then exchanged with another group.





• Pictionary:

Members of the second group then take turns to represent each word in the form of a diagram while their friends try to guess the word from the drawing.





 Encourage students' critical thinking skills by encouraging them to evaluate the claims made in advertisements.

 Cosmetic Advertisement banned for using "waffle" science.







netic Ad Banned for using "Waffle" Science

In the UK, a television advectment for Oay Regiments Face Oream has been berned for using bogus science. Calmain in the act that "prestingative" could reach the appearance of whelle lives and caude to used as a whether for commits surgory were deemed mitiativity. In the ad, a voice over from UK beady journalite Camerion actic "Waven who aren't ready" for commition injections constantly ask me to recommend a skin cream that healty works. So I was exciled when this study, revealed at the World Cangress of Demmitiday, showed any perspectives are effective in reducing the appearance of lines and versities." There there perspectives are relative in endocryptic complete complexity of the detective previous complexity of the set of the uphela complexit challenging the evidence for the effectiveness of perspectices in skin care products.



· Claims that regenerist cream could substitute for cosmetic surgery were rejected

However, this is not the first time expensive "oscineoutides" have been detard as in pdf 100%, accounter organisation in the Vict Kreuna sk Wirkh, Megazina's fund time care comparies were "billinding consumers with science" using terms like nanoparticles, pertapeptides, lipopeptides and hysiturino add. These are all legitimals scienceffic words, and whils some have been associated with sciences of the science of the science of the science of the been associated with the regard Ubarra and words having. For account, plustered and is a component of the extraoritizer and words having.

Some studies also show injections of hyaluronic acid can relieve mild arthritis pain but the literature remains divided and further research is required. Hyaluronic acid has replaced bovine or human collagen as an injectable soft-tissue filler, and there are serveral types currently licensed by the FOAIn America. Assist Passid, a biologist from Sansa About Seisnee, usid that the column for commercially available creams verter: insulting to poople is intelligence. "There may be oddence to justify using some these chemicals — but not in product a claiming to improve the signs of againg or having an active offect on the skin. The companies are taking the real science out of content to it becomes bad solvers."

But as for the use of nanoparticles? Well, not even customer service representatives could explain what these were doing in the moisturising aream. Which Magazine discovered that the use of scientific jargen by skin care products, had become so widespread and complex that these "commonituals" could no longer be explained by customer service.

They contacted customers service for Garrier, L'Oreal and Oiky to ask for explanations of their sciencey sounding products. For example, when asked what was the hyalaronic acid contained in the L'Oréal maisturiaing cream, the company's customers service representative incernedity stated: "It's not an actual acid" before adding. "The product replanation acid liminatures to give andiance to the skin". Gary Mass, a planamenia from the University of Herfordshine, dismissed this explanation as "uter vetifti", Hyalaronic acid is indeed an acid, and there is no evidence that is planatis as skin when applied topically, any uten, it is injected like bolos. "Inscreptisets" on the other hand, included in some products may actually be harmful, and ehoud be avoided, dormatologists suggest. Adding scientific jargon to a tiny bottle of cream, is just another vety manufacturent can get away with charging you an arm and alog for a tub of sorbolne and where with some nice portune added.

Buyer beware.

http://scepticsbook.com/2009/03/09/cosmetic-ad-banned-for-containing-waffle-science/

2

 Cosmetic Advertisement banned for using "waffle" science.





• Experimental Design: Students learn about dependent variables, independent variables and control experiments through a narrative.





Case #4: The Laboratory Note Book

You begin working in Dr. Ackroyd's reaarch is bat the same time as his other pedigaduate research assistant. Catherine Because dis anne cutadadis in the chemistry department's research funds. Dr. Advoyd can now only pay one assistant. Neither Catherine nor you can afford to work in the lab without pay. When you propose that each dryou works apartme, Dr. Advoyd will not garee. He believes that having to poratime assistants would be an inefficient use of his measurch funds. Since both of you are quilled and both need the lob, he is unconfortable dociding between the two rights. To make experting ther, Dr. Advoyd proposes that you both work independently for the next two weeks and the student who makes the mort corpress will see the ion.

The lab is open all days to that students can work at their convenience. Today is Tuesday of the second week, and Catherine mentions that the cannot find her laboratory need book. Dr. Acknoyd daes not know that Catherine's lab book is missing, but he would probably be angered by Catherine's lack of caution. Dr. Acknoyd hes repeatedly warmed the two of you to take great care of your lab books and never leave them unattended. Shortly after Catherine leaves the lab for lunk you discover that her hab book has failen behind a deek. Do you retrieve the lab book? Do you keep it? De you give the lab book personally to Dr. Acknoyd or to Catherine, or do you just glace it on the desk for someone to find? What is the bost course of actor?

> kon from Kovac, J. (2004). The Ethical Chemist: Professionalism and Ethics in Science. New Jersey: Pearson Prentice Hall. (SBN: 0-13-141132-2

Commentary: The Laboratory Note Book

is quartice is, how services a transgression has Catherine committed? If the is a less easierch escaland in the having lot the motebook, it is importent that Dr. Ackvord how he other hand, you might judge either that losing the lab notabook is early a minor of their values such as compassion and charity towards Catherine are more important responsibility your applife feel to report this transgression.

The best course of action is to give the aboratory note book to Cathenine and not her carefereances to Dr. Akotyot. Catherine has mode a missike by migolaching her book, but hardly a mistake that she should be severely punished for. Dr. Ackroyd is mous about taking care of kar hortes, telling him about the incident would cartainly alternine's chances to keep the job.

There is cartainly a templation for you either to give the tab notebook to Dr. Adorogi him where you found it, or give it to Catherine and but attill let Dr. Adorogi know about in a cartesisses. These actions would notes you chances of keeping the paid a postion. Another option is to leave the notebook behind the desk for someone else down wy fest you are avoiding any movement, but in fact you are making a moral to a decision not to help Catherine or Dr. Adorogil. It is also a decision to help yourself, e avving the lab notebook relation the desk will certainly impade Catherine's research and probably make sure that ad books on get the permanent (b). If another would be wuit a few days to "find" the book and return it to Catherine. This would y give you a time advantage, although Catherine would probably atili be able to whom bit his holebook for avrite, cooling the results in a new notebook. Choe tauted baroode. The ord here brind the permanent record and proceed as if his honourd.

eth of these options hurl catherne's chances to retain the job, thus making yours non a puryle yolfic perspective they yours mattexitor. And "at jony one person can pot. Why not you? There is of course the issue of harness Dr. Actoryd is interested the beat researcher. Keeping track of also hotas is part of research, but only a minor more important guilles are good laboratory technique, scientific involvidege and loth Dr. Activyd and he scientific community will benefit most if the truly better regists the pesitor. From a utilization prepercieve, the beat option is lo quelty return to the science of the regists the pesitor. From a utilization prepercieve, the beat option is lo quelty return.

2

blebok to Catherine and let Dr. Advroyd make his decision at the end of the week, a generous course of action also makes sense from a variety of other moral was. Cartainky, Hyou had mispicade your its in onteolock, you would like Catherine to you without telting Dr. Advroyd about your caretesaness.

sensitive down and power and power in the case. You down in the case in the tools wanted sense that is a sense of a find, differing Caffletine and Dr. Ackroyd the same stry to find I. II. U. Ackroyd finds the lab notbeok, carelessly hing around while an Caffletine. Although this octon seems to absolve you of any responsibility if a lareptimeteries. Although this octon seems to absolve you of any responsibility if a lareptimeteries and where to leave the lab notbeoks, it is not quilte that simple activate of choices. A set of the set of the lab notbeoks, it is not quilte that simple scores by you can certainly set-up the situation so that Dr. Ackroyd is more likely than the find the lab notbeok, or the revene.

nally, and the most extreme, you could discard the lab notebook. While this would uarantee you the job, the lab notebook certainly contains information that is important anall research project, so you will be doing a disservice to science, no matter who y kreeps the research assistant position.

Ethics in Science: Links to Character
Education. Students read and discuss moral dilemmas related to science.





Penicillin





Penicillin



Science in the News **Classroom Strategies** Penicillin was discovered by Sir Alexander Fleming on 28th September 1928. It was not tested on a large scale until 1940. It is understood that the 12 year gap between the discovery of penicillin and its large scale extraction and purification is due to Fleming's inability to communicate his discovery clearly. Nobel Prize for Physiology or Medicine 1945. → Sir Alexander Fleming → Ernst Boris Chain → Sir Howard Walter Florey



 Developing Clear Communication: Simple Lego[®] models can be used to show students the importance of clear, unambiguous communication.





 In this activity, one student is given the *instructions* to build the model, while a second student is given the *bricks*.

 The students can not see each other. The student with the instructions must describe – very clearly – how to put the bricks together in order for their partner to make the model.



Science in the News



Laboratory Bench



Science in the News



Science in the News







Miley Cyrus "Wrecking Ball" used to teach the frequency of a pendulum.

CARLS HIGH

 http://www.smh.com.au/technology/sci-tech/how-do-we-engage-young-people-in-science -20141016-1170vt.html

1250



 A Boeing 767 airplane flying for Air Canada on 23rd July 1983 consumed its complete supply of fuel only an hour into its flight. It was headed to Edmonton from Montreal, but it received low fuel pressure warnings in both fuel pumps at an altitude of 12, 500 m; engine failures followed soon after. Fortunately, the captain was an experienced glider pilot and the first officer knew of an unused air force base about 20 kilometres away.

www.chemwiki.ucdavis.edu/analytical_chemistry/quantifying_nature



 Together, they landed the plane on the runway, and only a few passengers sustained minor injuries. This incident was due partially to the airplane's fuel indication system, which had been malfunctioning. Maintenance workers resorted to manual calculations in order to fuel the craft. They knew that 22,300 kg of fuel was needed, and they wanted to know what volume in litres should be pumped.



 They used 1.77 as their density ratio in performing their calculations. However, 1.77 was given in *pounds* per litre, not *kilograms* per litre. The correct number should have been 0.80 *kilograms* per litre; thus, their final figure accounted for less than half of the necessary volume of fuel.

www.chemwiki.ucdavis.edu/analytical_chemistry/quantifying_nature


Tokyo Disneyland's Space Mountain roller coaster came to a sudden halt just before the end of a ride on 5th December, 2003. This startling incident was due a broken axle. The axle in question fractured because it was smaller than the design's requirement. Because of the incorrect size, the gap between the bearing and the axle was over 1 mm – when it should have been a mere 0.2 mm.



 The accumulation of excess vibration and stress eventually caused it to break. Though the coaster derailed, there were no injuries. Once again, unit systems caused the accident. In September 1995, the specifications for the coaster's axles and bearings were changed to metric units. In August 2002, however, the imperial units (English units) plans prior to 1995 were used to order 44.14 mm axels instead of the needed 45.00 mm axels.







 The Mars Climate Orbiter, meant to help relay information back to Earth, is one notable example of the unit system struggle. The orbiter was part of the Mars Surveyor '98 program, which aimed to better understand the climate of Mars. As the spacecraft journeyed into space on September 1998, it should have entered orbit at an altitude of 140 - 150 km above Mars, but instead went as close as 57km.



 This navigation error occurred because the software that controlled the rotation of the craft's thrusters was not calibrated in SI units. The spacecraft expected *newtons*, while the computer, which was inadequately tested, worked in *pound forces*; 1.00 *pound force* is equal to about 4.45 *newtons*. Unfortunately, friction and other atmospheric forces destroyed the Mars Climate Orbiter. The project cost US\$ 327.6 million in total.



 At a factory making nylon in Flixborough, a small town in England, a cigarette ignited a cloud of highly flammable cyclohexane vapour, which had escaped from a leaking pipe. A tiny amount of energy from the cigarette was enough to start the reaction that released the vast amount of energy stored in the cyclohexane. This destroyed 100 houses and killed 29 people.



 The causes of the Chernobyl incident, which released a cloud of radioactive material into the atmosphere, are misunderstood. The cause was chemical rather than nuclear. A series of operator errors produced steam inside the reactor.



• Zirconium metal reacted with the steam to produce hydrogen which ultimately exploded and set fire to the graphite rods that were used to absorb neutrons in the reactor. Radioactive material was then released from the damaged reactor. Essentially, this was a case of a high temperature increasing the rate of a chemical reaction.





• At Bhopal, in India, an insecticide called carbamyl was being manufactured. The process involved several poisonous gases and one of these, methyl isocyanate, was the cause of the disaster. One theory is that a reaction between methyl isocyanate and water caused a build-up of pressure.



 This normally slow reaction was made much faster by sodium hydroxide (from a cleaning system) acting as a catalyst. The build-up of pressure caused toxic gases to be released into the surrounding area, killing over 2000 people.





 On 13th August 2015 a warehouse complex at Tianjin in China was destroyed by two massive explosions.

 Seismologists were able to measure the strength of the two explosions. The first explosion was equivalent to 3 tonnes of TNT detonating. The second explosion was equivalent to 21 tonnes of TNT detonating, and the explosion could be observed from space.

 Initial reports stated that the explosions killed dozens of people, injured hundreds more, and devastated a large area of the city.

 It is believed that the warehouse complex was used to store hazardous chemicals such as calcium carbide (CaC₂), which is used in the manufacture of plastics, and potassium nitrate KNO₃, which is used in the manufacture of fertilisers and explosives.



 First Explosion: Could have been caused by the civil defence force spraying water onto the *calcium carbide* (CaC₂). This reaction would have produced *ethyne*(C₂H₂) and calcium hydroxide.

 $CaC_2(s) + 2H_2O(I) \rightarrow C_2H_2(g) + Ca(OH)_2(aq)$



• Ethyne is a *highly flammable* gas that releases a very large amount of energy when it burns.

 $\begin{array}{l} 2C_2H_2(g) \ + \ 5O_2(g) \ \rightarrow \ 4CO_2(g) \ + \ 2H_2O(l) \\ \\ \Delta H = -1300 \ kJ/mol \ of \ C_2H_2(g) \end{array}$



- Second Explosion: This was most probably triggered by the first explosion.
- Potassium nitrate (KNO₃) is an excellent oxidising agent. Above its melting point of 334 °C, potassium nitrate rapidly decomposes into potassium nitrite (KNO₂) and oxygen.

 $2KNO_3(s) \rightarrow 2KNO_2(s) + O_2(g)$



 Heat from the first explosion would have caused the potassium nitrate to decompose, releasing enormous quantities of oxygen which would have reacted explosively with other chemicals.



 In addition, it is also believed that the warehouse complex was used to store 700 tonnes of sodium cyanide (NaCN) which is used in the mining of precious metals. Sodium cyanide is a highly toxic chemical. Once it enters the body, it is rapidly converted into hydrogen cyanide (HCN) which inhibits cellular respiration.





Duration: 1 minute

- Video downloaded from www.theguardian.co.uk
 - Warning: Video contains some expletives.



• Why encourage students to read beyond the textbook (as if often done in languages and General Paper)?





Science in the News





Science in the News Tea Break

 Enjoy your tea break, kindly provided by the Academy of Singapore Teachers.

 Please be back by 4.00 p.m. so that we can continue with the second part of the workshop and finish on time.



Science in the News





Science in the News Hands on Component

- There are a variety of different science magazines available for you to read.
- Links to online BBC News stories can be found at

http://www.scientist.sg/literature/bbc_news_stories.pdf.





Science in the News Hands on Component

• Browse through the articles.

→ Read the ones that you find interesting. Catch-up on what is happening in the world of science!

→ Make notes about the ones that you want to briefly mention to your students because:
a) It is contemporary and interesting.
b) It illustrates something about the nature of science.

c) It is related to the topic that they are studying.



Science in the News Hands on Component

• Browse through the articles.

→ Write-out and / or photograph the ones that you intend on using for class discussions of for turning into comprehension questions.

 Essential: Find at least one article that you and your students will find interesting to discuss in class. Focus on using the discussion to improve your students' scientific literacy / interest in science / understanding of science.

• Optional: Share your work with your peers.



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Summary of Today's Workshop

Scientific literacy is...

- It is important for our students to be scientifically literate because...
- It is important for society to be scientifically literate because...

• Some strategies that can be used to improve our students' understanding and use of scientific terms...

 Some strategies that can be used to improve our students' scientific literacy...



Science in the News





Science in the News Reflections and Evaluation

• What questions would you like to ask?

• Please complete the online feedback form.



Science in the News

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