SCIENTIFIC LITERACY RE-VISIONED

SAM DONOVAN, DIRECTOR OF OUTREACH, BIOQUEST
GORDON UNO, UNIVERSITY OF OKLAHOMA
guno@ou.edu
CALL FOR NATIONAL SCIENCE EDUCATION SUMMIT

To address the Teaching of Science in the U.S. today
How can science be taught in the current climate?

Rapid spreading scientific misinformation and disinformation via social media;
Anti-science sentiments and vocal distrust of and threats to scientific and health experts;
Anti-DEI proclamations and legal impositions;
Rise of AI use and its influence in the classroom;
Disruptions in educational and socialization opportunities for students caused by the COVID pandemic leading to student preparedness concerns;
Challenges to democratic institutions by low-information (high misinformation) voters;
The marginalization of groups of people due to uneven distribution of resources and information;
Global challenges caused by climate change and political unrest and turmoil
How do we assist/implement change when there’s no money or time---for individuals or organizations?
PERHAPS, A FOCUS ON SCIENTIFIC LITERACY CAN BE USED IN ALL OF OUR CLASSES AS AN ORGANIZING, AND UNIFYING, CONSTRUCT
Gordon Uno, University of Oklahoma and James Collins, Arizona State University
THE LIBERAL ART OF SCIENCE
(AAAS, 1990)

Science influences every aspect of contemporary American life, yet the United States has been described as a nation of scientific illiterates. The appraisal of leaders in government, education, and the private sector is that the welfare of the nation and the individual will be improved when all citizens have sufficient understanding of science to make soundly based personal, civic, and professional decisions. This national goal can be achieved only through the radical reform of science education at all levels. Of critical concern is education in the natural sciences at the undergraduate level. The Liberal Art of Science; Agenda for Action addresses this concern. (1990)
THE LIBERAL ART OF SCIENCE

The document recognized a need for greater scientific literacy in the American public.

Initial question--what preparation in undergraduate science/science courses do future pre-college teachers need?

Recommended that ALL students take more science courses, more science should be taught in courses of other disciplines, and new interdisciplinary courses should be developed.
More than eight-in-ten Americans get news from digital devices

BY ELISA SHEARER

The transition of news from print, television and radio to digital spaces has caused huge disruptions in the traditional news industry, especially the print news industry. It is also reflected in the ways individual Americans say they are getting their news. A large majority of Americans get news at least sometimes from digital devices, according to a Pew Research Center survey conducted Aug. 31-Sept. 7, 2020.

---

Large majority of Americans get news on digital devices

% of U.S. adults who get news from...

<table>
<thead>
<tr>
<th>Device</th>
<th>Often</th>
<th>Sometimes</th>
<th>NET</th>
</tr>
</thead>
<tbody>
<tr>
<td>A smartphone, computer, tablet</td>
<td>60%</td>
<td>20%</td>
<td>80%</td>
</tr>
<tr>
<td>Television</td>
<td>40%</td>
<td>28%</td>
<td>68%</td>
</tr>
<tr>
<td>Radio</td>
<td>16%</td>
<td>34%</td>
<td>50%</td>
</tr>
</tbody>
</table>
Within digital platforms for news, most age groups turn to news websites at higher rates than other platforms, with one exception. Americans ages 18 to 29 stand out in that the most common digital way they get news is social media, with 42% saying they get news
Whether it is about the presidential election, climate change, or Covid-19 vaccines and the delta variant, misinformation continues to spread rampant across social media. According to a Pew Research Service study from January, more than eight-in-ten U.S. adults (86 percent) said they get their news from a smartphone. It is easy to see why
Anti-vaxxer tells supporters the new COVID antidote is in 'urine therapy'
How Social Media Amplifies Misinformation More Than Information

A new analysis found that algorithms and some features of social media sites help false posts go viral.

By Steven Lee Myers

Oct. 13, 2022

It is well known that social media amplifies misinformation and other harmful content. The Integrity Institute, an advocacy group, is now trying to measure exactly how much — and on Thursday it began publishing results that it plans to update each week through the midterm elections on Nov. 8.

The institute’s initial report, posted online, found that a "well-crafted lie" will get more engagements than typical, truthful content and that some features of social media sites and their algorithms contribute to the spread of misinformation.

Twitter, the analysis showed, has what the institute called the great misinformation amplification factor, in large part because of its feature allowing people to share, or "retweet," posts easily. It was followed by TikTok, the Chinese-owned video site, which uses machine-learning models to predict engagement and make recommendations to users.

"We see a difference for each platform because each platform has different mechanisms for virality on it," said Jeff Allen, a former integrity officer at Facebook and a founder and the chief research officer at the Integrity Institute. "The more mechanisms there are for virality on the platform, the more we see misinformation getting additional distribution."

The institute calculated its findings by comparing posts that members of the International Fact-Checking Network have identified as false with the engagement of previous posts that were not flagged from the same accounts. It analyzed nearly 600 fact-checked posts in September on a variety of subjects, including the Covid-19 pandemic, the war in Ukraine and the upcoming elections.

Facebook, according to the sample that the institute has studied so far, had the most instances of misinformation but amplified such claims to a lesser degree, in part because sharing posts requires more steps. But some of its newer features are more prone to amplify misinformation, the institute found.
COVID-19 vaccine tweet about swollen testicles signals the dangers of celebrity misinformation and fandom

My cousin in Trinidad won’t get the vaccine cuz his friend got it & became impotent. His testicles became swollen. His friend was weeks away from getting married, now the girl called off the wedding. So just pray on it & make sure you’re comfortable with ur decision, not bullied

4:44 PM · Sep 13, 2021

149.2K · See the latest COVID-19 information on Twitter

Read 43.6K replies
Study: 80 percent of students can’t tell the difference between an ad and a news story
I must buy this anti-aging cream, Nina says it's very effective!

Anecdotal Evidence is information based on nonfactual data.
ANECDOTAL EVIDENCE

Evidence collected in an informal way and relying on personal testimony.

Limited in value because uncorroborated by objective, independent evidence.

Unreliable because evidence may be cherry-picked and non-representative sample of typical cases.
FROM "THE LIBERAL ART OF SCIENCE (AAAS, 1990) TO "THE LIBERATING ART OF SCIENCE"

How do we best prepare our students for their future interactions with science?

How do we engage learners in ways that acknowledge the reality of the world they are inheriting, increasingly compromised by regional and global issues?
HOW DO WE BEST ENGAGE AND PREPARE OUR STUDENTS FOR THEIR FUTURE INTERACTIONS WITH SCIENCE?

The goal is to prepare self-efficacious participants in society who are interested in and know how to deal with personal, professional, and civic issues related to science, to think critically for themselves with a scientific attitude, and who make the best, informed, decisions about their own welfare and democratic processes and institutions.
STUDENT-CENTERED FUNCTIONAL SCIENTIFIC LITERACY
Empower Students to Engage With Science In Their Personal, Professional, and Civic Futures

1. **Focus on Learning How Science Is Relevant to Individual Students and Other People: Can I Explain This Information in My Own Words, and How Is This Important to Me and My Family?**
   - **Encourage Students to Participate and Help Them Reach Their Potential in Science While Boosting Scientific Self-efficacy:** What Do I Need to Do to Be More Involved in Science, and Who Can Help Me Excel in Whatever I Choose to Do?
   - **Develop Science Process, Inquiry, Quantitative, and Analytical Skills**

2. **Teach Science as a Way of Discovering How the World Works: How Did They Discover or Figure Out This Information, and How Can I Explore More About It Myself?**
   - **Help Students Gain a ‘Scientific Attitude’ to Deal With Scientific Information They Receive and Questions That Arise In and Outside of Class:** What’s the Evidence for This Claim, Does It Make Sense, and Can I Defend It?
   - **Improve Information Literacy By Practicing Evaluation of Scientific Information and Using Evidence-based Reasoning and Decision-making; Recognizing Expertise vs. Anecdotal Evidence, Misinformation, and Pseudoscience**

3. **Focus on Learning How Science Is Relevant to Individual Students and Other People: Can I Explain This Information in My Own Words, and How Is This Important to Me and My Family?**
   - **Use Independent, Innovative, and Collaborative Learning Strategies, Seek a Broad Range of Perspectives, and Employ a Variety of Thinking Practices and Actions in Scientific Studies; Cultivating a Growth Mindset**

4. **Help Students Gain a ‘Scientific Attitude’ to Deal With Scientific Information They Receive and Questions That Arise In and Outside of Class:** What’s the Evidence for This Claim, Does It Make Sense, and Can I Defend It?
   - **Improve Information Literacy By Practicing Evaluation of Scientific Information and Using Evidence-based Reasoning and Decision-making; Recognizing Expertise vs. Anecdotal Evidence, Misinformation, and Pseudoscience**

5. **Prepare Students to Engage In Real-World Problem-Posing and Problem-Solving, Contribute to Society, and Create Their Own Journey in or with Science: How Are My Community and the World Affected by This Issue, and What Can I Do About It?**
   - **Cultivate Life-long Interests in Science and Integrate Information from Different Areas of Scholarship to Address Community and Societal Challenges**

6. **Develop Science Process, Inquiry, Quantitative, and Analytical Skills**
   - **Encourage Students to Participate and Help Them Reach Their Potential in Science While Boosting Scientific Self-efficacy:** What Do I Need to Do to Be More Involved in Science, and Who Can Help Me Excel in Whatever I Choose to Do?

7. **Teach Science as a Way of Discovering How the World Works: How Did They Discover or Figure Out This Information, and How Can I Explore More About It Myself?**
   - **Help Students Gain a ‘Scientific Attitude’ to Deal With Scientific Information They Receive and Questions That Arise In and Outside of Class:** What’s the Evidence for This Claim, Does It Make Sense, and Can I Defend It?
   - **Improve Information Literacy By Practicing Evaluation of Scientific Information and Using Evidence-based Reasoning and Decision-making; Recognizing Expertise vs. Anecdotal Evidence, Misinformation, and Pseudoscience**

8. **Focus on Learning How Science Is Relevant to Individual Students and Other People: Can I Explain This Information in My Own Words, and How Is This Important to Me and My Family?**
   - **Use Independent, Innovative, and Collaborative Learning Strategies, Seek a Broad Range of Perspectives, and Employ a Variety of Thinking Practices and Actions in Scientific Studies; Cultivating a Growth Mindset**

9. **Help Students Gain a ‘Scientific Attitude’ to Deal With Scientific Information They Receive and Questions That Arise In and Outside of Class:** What’s the Evidence for This Claim, Does It Make Sense, and Can I Defend It?
   - **Improve Information Literacy By Practicing Evaluation of Scientific Information and Using Evidence-based Reasoning and Decision-making; Recognizing Expertise vs. Anecdotal Evidence, Misinformation, and Pseudoscience**

10. **Focus on Learning How Science Is Relevant to Individual Students and Other People: Can I Explain This Information in My Own Words, and How Is This Important to Me and My Family?**
    - **Use Independent, Innovative, and Collaborative Learning Strategies, Seek a Broad Range of Perspectives, and Employ a Variety of Thinking Practices and Actions in Scientific Studies; Cultivating a Growth Mindset**

11. **Help Students Gain a ‘Scientific Attitude’ to Deal With Scientific Information They Receive and Questions That Arise In and Outside of Class:** What’s the Evidence for This Claim, Does It Make Sense, and Can I Defend It?
    - **Improve Information Literacy By Practicing Evaluation of Scientific Information and Using Evidence-based Reasoning and Decision-making; Recognizing Expertise vs. Anecdotal Evidence, Misinformation, and Pseudoscience**

12. **Focus on Learning How Science Is Relevant to Individual Students and Other People: Can I Explain This Information in My Own Words, and How Is This Important to Me and My Family?**
    - **Use Independent, Innovative, and Collaborative Learning Strategies, Seek a Broad Range of Perspectives, and Employ a Variety of Thinking Practices and Actions in Scientific Studies; Cultivating a Growth Mindset**

13. **Help Students Gain a ‘Scientific Attitude’ to Deal With Scientific Information They Receive and Questions That Arise In and Outside of Class:** What’s the Evidence for This Claim, Does It Make Sense, and Can I Defend It?
    - **Improve Information Literacy By Practicing Evaluation of Scientific Information and Using Evidence-based Reasoning and Decision-making; Recognizing Expertise vs. Anecdotal Evidence, Misinformation, and Pseudoscience**

14. **Focus on Learning How Science Is Relevant to Individual Students and Other People: Can I Explain This Information in My Own Words, and How Is This Important to Me and My Family?**
    - **Use Independent, Innovative, and Collaborative Learning Strategies, Seek a Broad Range of Perspectives, and Employ a Variety of Thinking Practices and Actions in Scientific Studies; Cultivating a Growth Mindset**

15. **Help Students Gain a ‘Scientific Attitude’ to Deal With Scientific Information They Receive and Questions That Arise In and Outside of Class:** What’s the Evidence for This Claim, Does It Make Sense, and Can I Defend It?
    - **Improve Information Literacy By Practicing Evaluation of Scientific Information and Using Evidence-based Reasoning and Decision-making; Recognizing Expertise vs. Anecdotal Evidence, Misinformation, and Pseudoscience**

16. **Focus on Learning How Science Is Relevant to Individual Students and Other People: Can I Explain This Information in My Own Words, and How Is This Important to Me and My Family?**
    - **Use Independent, Innovative, and Collaborative Learning Strategies, Seek a Broad Range of Perspectives, and Employ a Variety of Thinking Practices and Actions in Scientific Studies; Cultivating a Growth Mindset**

17. **Help Students Gain a ‘Scientific Attitude’ to Deal With Scientific Information They Receive and Questions That Arise In and Outside of Class:** What’s the Evidence for This Claim, Does It Make Sense, and Can I Defend It?
    - **Improve Information Literacy By Practicing Evaluation of Scientific Information and Using Evidence-based Reasoning and Decision-making; Recognizing Expertise vs. Anecdotal Evidence, Misinformation, and Pseudoscience**

18. **Focus on Learning How Science Is Relevant to Individual Students and Other People: Can I Explain This Information in My Own Words, and How Is This Important to Me and My Family?**
    - **Use Independent, Innovative, and Collaborative Learning Strategies, Seek a Broad Range of Perspectives, and Employ a Variety of Thinking Practices and Actions in Scientific Studies; Cultivating a Growth Mindset**

19. **Help Students Gain a ‘Scientific Attitude’ to Deal With Scientific Information They Receive and Questions That Arise In and Outside of Class:** What’s the Evidence for This Claim, Does It Make Sense, and Can I Defend It?
    - **Improve Information Literacy By Practicing Evaluation of Scientific Information and Using Evidence-based Reasoning and Decision-making; Recognizing Expertise vs. Anecdotal Evidence, Misinformation, and Pseudoscience**

20. **Focus on Learning How Science Is Relevant to Individual Students and Other People: Can I Explain This Information in My Own Words, and How Is This Important to Me and My Family?**
    - **Use Independent, Innovative, and Collaborative Learning Strategies, Seek a Broad Range of Perspectives, and Employ a Variety of Thinking Practices and Actions in Scientific Studies; Cultivating a Growth Mindset**

21. **Help Students Gain a ‘Scientific Attitude’ to Deal With Scientific Information They Receive and Questions That Arise In and Outside of Class:** What’s the Evidence for This Claim, Does It Make Sense, and Can I Defend It?
    - **Improve Information Literacy By Practicing Evaluation of Scientific Information and Using Evidence-based Reasoning and Decision-making; Recognizing Expertise vs. Anecdotal Evidence, Misinformation, and Pseudoscience**

22. **Focus on Learning How Science Is Relevant to Individual Students and Other People: Can I Explain This Information in My Own Words, and How Is This Important to Me and My Family?**
    - **Use Independent, Innovative, and Collaborative Learning Strategies, Seek a Broad Range of Perspectives, and Employ a Variety of Thinking Practices and Actions in Scientific Studies; Cultivating a Growth Mindset**

23. **Help Students Gain a ‘Scientific Attitude’ to Deal With Scientific Information They Receive and Questions That Arise In and Outside of Class:** What’s the Evidence for This Claim, Does It Make Sense, and Can I Defend It?
    - **Improve Information Literacy By Practicing Evaluation of Scientific Information and Using Evidence-based Reasoning and Decision-making; Recognizing Expertise vs. Anecdotal Evidence, Misinformation, and Pseudoscience**

24. **Focus on Learning How Science Is Relevant to Individual Students and Other People: Can I Explain This Information in My Own Words, and How Is This Important to Me and My Family?**
    - **Use Independent, Innovative, and Collaborative Learning Strategies, Seek a Broad Range of Perspectives, and Employ a Variety of Thinking Practices and Actions in Scientific Studies; Cultivating a Growth Mindset**

25. **Help Students Gain a ‘Scientific Attitude’ to Deal With Scientific Information They Receive and Questions That Arise In and Outside of Class:** What’s the Evidence for This Claim, Does It Make Sense, and Can I Defend It?
    - **Improve Information Literacy By Practicing Evaluation of Scientific Information and Using Evidence-based Reasoning and Decision-making; Recognizing Expertise vs. Anecdotal Evidence, Misinformation, and Pseudoscience**
Empower Students to Engage With Science In Their Personal, Professional, and Civic Futures


2. Develop Science Process, Inquiry, Quantitative, and Reasoning Skills (Foundational research and critical thinking skills to investigate science and science-related issues. Ability to ask scientific questions, design experiments, analyze and interpret data, reason about alternative explanations, and predict consequences and results of specific actions. Understand the iterative process, value, strengths, and limitations of science and the dynamic tension between correlations and cause-and-effect relationships.)

3. Focus on Learning How Science Is Relevant to Individual Students and Other People: Can I Explain This Information in My Own Words, and How Is This Important to Me and My Family?

4. Improve Information Literacy By Practicing Evaluation of Scientific Information and Using Evidence-based Reasoning and Decision-making; Recognizing Expertise vs. Anecdotal evidence, Pseudoscience, and Misinformation (Value the use of evidence and the importance of expertise to construct arguments and make decisions, and understand the importance of developing consensus. Develop a healthy skepticism about scientific claims and assess the relevance and credibility of evidence used in claims and opinions made personally or by others. Recognize confirmation bias and receive inoculation against the misuse of science information. Cultivate an appropriate scientific attitude, a respect for valid evidence and logic, and an ability to change thinking based on new information.)

5. Prepare Students to Engage in Real-World Problem-Posing and Problem-Solving, Contribute to Society, and Create Their Own Journey in or with Science: How Are My Community and the World Affected by This Issue, and What Can I Do About It?

- Teach Science as a Way of Discovering How the World Works: How Did They Discover or Figure Out This Information, and How Can I Explore More About It Myself?

- Cultivate Life-long Interests in Science and Integrate Information from Different Areas of Scholarship to Address Community and Societal Challenges (Promote life-long appreciation for learning about science and an understanding of the interdisciplinary nature of science while promoting personal responsibility and civic engagement. Foster innovative thinking and an ability to determine the process and information needed for problem-solving, contributions to public policy, and resolution of community-based scientific issues.)

- Help Students Gain a Scientific Attitude to Deal With Scientific Information They Receive and Questions That Arise In and Outside of Class: What’s the Evidence for This Claim, Does It Make Sense, and Can I Defend It?

- Use Independent, Innovative, and Collaborative Learning Strategies, Seek a Broad Range of Perspectives, and Employ a Variety of Thinking Practices and Actions in Scientific Studies (Gain self-confidence in using the science process and a sense of belonging in science. Practice self-reflection and value alternative viewpoints and ideas. To conduct research or solve problems, learn to ask questions, seek information, and interact with people having a range of backgrounds and expertise gained from relevant experience to help generate strategies and answers. Cultivating a growth mindset.)

- Understand and Apply Essential Science Content to the Real World While Communicating and Reflecting on What Is Learned (Develop an understanding of and an ability to connect important disciplinary knowledge to what is being studied, investigated, or what is happening in the world. Gain an ability to clearly and simply explain scientific concepts and the underlying disciplinary principles and to recognize the impact of science on a person’s life and community.)
WHAT’S DIFFERENT ABOUT THIS MODEL OF SCIENTIFIC LITERACY?

1. IT’S STUDENT-CENTERED
2. IT’S HOLISTIC
3. IT’S INTENDED FOR BOTH MAJORS AND NON-MAJORS
4. IT HELPS PREPARE STUDENTS TO ENGAGE WITH SCIENCE THROUGHOUT THEIR LIVES
5. IT FOCUSES ON IMPROVING REASONING OF STUDENTS AND SHOWING RELEVANCE OF SCIENCE TO THEM
STUDENT-CENTERED FUNCTIONAL SCIENTIFIC LITERACY
Empower Students to Engage With Science In Their Personal, Professional, and Civic Futures

1. Encourage Students to Participate and Help Them Reach Their Potential In Science While Boosting Scientific Self-efficacy: What Do I Need to Do to Be More Involved in Science, and Who Can Help Me Excel in Whatever I Choose to Do?
   - Use Independent, Innovative, and Collaborative Learning Strategies, Seek a Broad Range of Perspectives, and Employ a Variety of Thinking Practices and Actions in Scientific Studies; Cultivating a Growth Mindset
   - Understand and Apply Essential Science Content to the Real World While Communicating and Reflecting on What Is Learned

2. Teach Science as a Way of Discovering How the World Works: How Did They Discover or Figure Out This Information, and How Can I Explore More About It Myself?
   - Develop Science Process, Inquiry, Quantitative, and Analytical Skills

3. Focus on Learning How Science Is Relevant to Individual Students and Other People: Can I Explain This Information in My Own Words, and How Is This Important to Me and My Family?
   - Prepare Students to Engage In Real-World Problem-Posing and Problem-Solving, Contribute to Society, and Create Their Own Journey in or with Science: How Are My Community and the World Affected by This Issue, and What Can I Do About It?
   - Cultivate Life-long Interests in Science and Integrate Information from Different Areas of Scholarship to Address Community and Societal Challenges

4. Help Students Gain a ‘Scientific Attitude’ to Deal With Scientific Information They Receive and Questions That Arise In and Outside of Class: What’s the Evidence for This Claim, Does It Make Sense, and Can I Defend It?
   - Improve Information Literacy By Practicing Evaluation of Scientific Information and Using Evidence-based Reasoning and Decision-making; Recognizing Expertise vs. Anecdotal Evidence, Misinformation, and Pseudoscience

5. Prepare Students to Engage In Real-World Problem-Posing and Problem-Solving, Contribute to Society, and Create Their Own Journey in or with Science: How Are My Community and the World Affected by This Issue, and What Can I Do About It?
Nearly Half of Americans Are Sure Global Warming Is Happening
- Certainty that global warming is happening at highest level since 2008 -

---

How sure are you that global warming is/is not happening?
HOW CAN WE EXPLAIN WHY MORE AMERICANS ARE NOT SURE GLOBAL WARMING IS HAPPENING?

5-point assignment:
Google “Exxon global warming denial”
Read any 2 articles BUT NOT from Exxon, Wikipedia, or article labeled “ad”
Cite your two references and write a short (~6 sentences) summary answering the question—make sure you refer to your articles). Upload to Canvas in Assignments by next Tuesday at 5.
If the Earth is getting warmer, why is Kentucky getting colder?

The most serious problem with catastrophic global warming is—it may not be true.

CHERRY PICKING DATA (1991)
Exxon’s 2007 Corporate Citizenship Report announces that the company will “discontinue contributions to several public policy research groups whose position on climate change could divert attention from the important discussion on how the world will secure the energy required for economic growth in an environmentally responsible manner.” In other words, it will stop funding climate-denying groups. Funding is cut to some climate-denying groups.
CONFUSING THE PUBLIC ABOUT SMOKING TOBACCO

highly addictive product which causes diseases that lead to a staggering number of deaths per year, an immeasurable amount of human suffering and economic loss, and a profound burden on our national health care system. [The tobacco companies] have known many of these facts for at least 50 years or more. Despite that knowledge, they have consistently, repeatedly and with enormous skill and sophistication, denied these facts to the public, the Government, and to the public health community."

DENY, FIND EXPERT TO FOCUS ON CHERRY-PICKED DATA, REPEAT MISINFORMATION, PROMOTE DOUBT in PUBLIC: SMOKING, CLIMATE CHANGE, COVID-19, EVOLUTION
HOW BUSINESS/INDUSTRY/POLITICAL GROUPS CAN INFLUENCE THE PUBLIC'S UNDERSTANDING OF SCIENCE
HOW DO YOU INOCULATE STUDENTS AGAINST MISINFORMATION, DISINFORMATION, AND MISUSE OF DATA?

SHOW STUDENTS THE MOST COMMON WAYS THAT MISUSE OF INFORMATION HAPPENS---ON A REGULAR BASIS

GET STUDENTS TO EVALUATE CLAIMS BY LOOKING AT DATA

HELP STUDENTS DEVELOP A B.S. DETECTOR
WHEN WE TALK ABOUT CELLS, WE DISCUSS CELL DIVISION, AND RAPID, UNCONTROLLED DIVISION

MUTATIONS CAN CAUSE CANCER

MUTAGENS CAN CAUSE MUTATIONS

THE GREATER THE EXPOSURE TO MUTAGENS, THE GREATER THE RISK OF MUTATIONS and CANCER
Per capita cigarette consumption

Year
Trends in Tobacco Use and Lung Cancer Death Rates in the U.S.

HOW WOULD YOU CONVINCE A JURY THAT THIS EVIDENCE SHOWS THAT SMOKING CIGARETTES CAUSES LUNG CANCER?

WHAT IS THE STRONGEST AND WEAKEST PART OF YOUR CASE?

GROUP BREAKOUT
Tobacco Use in the US, 1900-2006

*Age-adjusted to 2000 US standard population.

DO THESE DATA HELP OR HURT YOUR CASE/ARGUMENT?

WHAT DATA DO YOU NEED?
Fighting cancer from the cabbage patch

Sauerkraut a health food? Not yet. But midwestern scientists have found evidence that something in this pickled cabbage and related foods blocks the action of estrogen, a hormone that can fuel the growth of breast cancer and other reproductive-tract malignancies.

Nutritionist William G. Helferich of the University of Illinois at Urbana-Champaign and his colleagues were trying to tease out why Polish women who have moved to the United States are far more likely to develop breast cancer than their kin remaining in the Old Country are. One distinguishing factor turned out to be consumption of cabbage. European Poles eat far more.

Cabbage belongs to the Brassica family. A host of recent studies has shown that brassicas—which include broccoli, cauliflower, brussels sprouts, and mustard—possess cancer-fighting compounds. Helferich wondered whether fermenting such veggies, as in making sauerkraut, would create new anticancer agents. Others might arise when stomach juices acidify vegetable compounds. Specifically, the researchers wondered whether the brassicas give rise to estrogen blockers.

To investigate, the researchers stimulated test-tube colonies of human breast-cancer cells with estrogen, then added extracts of plain cabbage, sauerkraut, or acidified brussels sprouts.

Low-concentration extracts of the samples—typically 5 to 25 parts per billion—not only slowed the growth of estrogen-fed cells but also blocked estrogen’s ability to turn on a particular gene. The scientists found little difference in the three vegetable preparations’ potencies. At parts-per-million concentrations, however, each extract mimicked estrogen—spurring cell growth and gene activity, the researchers found.

“Though it’s very unlikely you’d get those higher concentrations in the blood from eating brassicas,” Helferich says, he suspects that “it is realistic you could get the antiestrogenic doses.” His group’s findings, which will appear in the JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY, are currently available on the Internet.

The Illinois scientists have partially purified antierostrogenic constituents of the extracts and distributed portions to other researchers who study brassicas’ cancer-fighting compounds. It appears these newly isolated antioestrogenic agents “are novel,” Helferich told SCIENCE NEWS.

The study wins high marks for its methodology from endocrinologist Ana Soto of the Tufts University School of Medicine in Boston. Although she finds the brassicas’ dose-dependent activities interesting, both she and Paul Talalay of the Johns Hopkins School of Medicine in Baltimore point out that until the active agents are purified and individually tested in animals, it will be impossible to gauge whether these compounds might persist in people. Such experiments will be critical for estimating the cancer-fighting prospects of the vegetables.

Scientists had thought that any anticancer benefits from brassicas traced to sulforaphane (SN: 9/20/97, p. 183) and indole-3 carbinol (SN: 3/6/99, p. 157). The findings by Helferich’s team suggest these foods might offer even more “potentially important” agents and point toward a new class of drugs to reduce cancer risk, observes Barnett Zumoff, chief of endocrinology at Beth Israel Medical Center in New York.

—J. Rafaloff

Private chat to lab partner/friend—Would you recommend that a person should eat more cabbage at the level of parts per billion or parts per million?
HOW DO YOU INOCULATE STUDENTS AGAINST MISINFORMATION, DISINFORMATION, AND MISUSE OF DATA?

SHOW STUDENTS THE MOST COMMON WAYS THAT MISUSE OF INFORMATION HAPPENS---ON A REGULAR BASIS

GET STUDENTS TO EVALUATE CLAIMS BY LOOKING AT DATA

HELP STUDENTS DEVELOP A B.S. DETECTOR
Baloney Detection
How to draw boundaries between science and pseudoscience

By MICHAEL SHERMER

When lecturing on science and pseudoscience at colleges and universities, I am inevitably asked, after challenging common beliefs held by many students, "Why should we believe you?" My answer: "You shouldn't."

I then explain that we need to check things out for ourselves and, short of that, at least to ask basic questions that get to the heart of the validity of any claim. This is what I call baloney detection, in deference to Carl Sagan, who coined the phrase Baloney Detection Kit. To detect baloney—that is, to help discriminate between science and pseudoscience—I suggest 10 questions to ask when encountering any claim.

1. How reliable is the source of the claim?
Pseudoscientists often appear quite reliable, but when examined closely, the facts and figures they cite are distorted, taken out of context or occasionally even fabricated. Of course, everyone makes some mistakes. And as historian of science Daniel Kevles showed so effectively in his book The Baltimore Affair, it can be hard to detect a fraudulent signal within the background noise of sloppiness that is a normal part of the scientific process. The question is, Do the data and interpretations show signs of intentional distortion? When an independent committee established to investigate potential fraud scrutinized a set of research notes in Nobel laureate David Baltimore's laboratory, it revealed a surprising number of mistakes. Baltimore was exonerated because his lab's mistakes were random and nondirectional.

2. Does this source often make similar claims?
Pseudoscientists have a habit of going well beyond the facts. Flood geologists (creationists who believe that Noah's flood can account for many of the earth's geologic formations) consistently make outrageous claims that bear no relation to geological science. Of course, some great thinkers do frequently go beyond the data in their creative speculations. Thomas Gold of Cornell University is notorious for his radical ideas, but he has been right often enough that other scientists listen to what he has to say. Gold proposes, for example, that oil is not a fossil fuel at all but the by-product of a deep, hot biosphere (microorganisms living at unexpected depths within the crust). Hardly any earth scientists with whom I have spoken think Gold is right, yet they do not consider him a crank. Watch out for a pattern of fringe thinking that consistently ignores or distorts data.

3. Have the claims been verified by another source?
Typically pseudoscientists make statements that are unverified or verified only by a source within their own belief circle. We must ask, Who is checking the claims, and even who is checking the checkers? The biggest problem with the cold fusion debacle, for instance, was not that Stanley Pons and Martin Fleischman were wrong. It was that they announced their spectacular discovery at a press conference before other laboratories verified it. Worse, when cold fusion was not replicated, they continued to cling to their claim. Outside verification is crucial to good science.

4. How does the claim fit with what we know about how the world works?
An extraordinary claim must be placed into a larger context to see how it fits. When people claim that the Egyptian pyramids and the Sphinx were built more than 10,000 years ago by an unknown, advanced race, they are not presenting any context for that earlier civilization. Where are the rest of the artifacts of those people? Where are their works of art, their weapons, their clothing, their tools, their trash? Archaeology simply does not operate this way.
5. Has anyone gone out of the way to disprove the claim, or has only supportive evidence been sought?
This is the confirmation bias, or the tendency to seek confirmatory evidence and to reject or ignore disconfirmatory evidence. The confirmation bias is powerful, pervasive and almost impossible for any of us to avoid. It is why the methods of science that emphasize checking and rechecking, verification and replication, and especially attempts to falsify a claim, are so critical.

When exploring the borderlands of science, we often face a "boundary problem" of where to draw the line between science and pseudoscience. The boundary is the line of demarcation between geographies of knowledge, the border defining countries of claims. Knowledge sets are fuzzier entities than countries, however, and their edges are blurry. It is not always clear where to draw the line. Last month I suggested five questions to ask about a claim to determine whether it is legitimate or baloney. Continuing with the baloney detection questions, we see that in the process we are also helping to solve the boundary problem of where to place a claim.

6. Does the preponderance of evidence point to the claimant's conclusion or to a different one?

The theory of evolution, for example, is "proved" through a convergence of evidence from a number of independent lines of inquiry. No one fossil, no one piece of biological or paleontological evidence has "evolution" written on it; instead tens of thousands of evidentiary bits add up to a story of the evolution of life. Creationists conveniently ignore this confluence, focusing instead on trivial anomalies or currently unexplained phenomena in the history of life.

7. Is the claimant employing the accepted rules of reason and tools of research, or have these been abandoned in favor of others that lead to the desired conclusion?

A clear distinction can be made between SETI (Search for Extraterrestrial Intelligence) scientists and UFOlogists. SETI scientists begin with the null hypothesis that ETIs do not exist and that they must provide concrete evidence before making the extraordinary claim that we are not alone in the universe. UFOlogists begin with the positive hypothesis that ETIs exist and have visited us, then employ questionable research techniques to support that belief, such as hypnotic regression (revelations of abduction experiences), anecdotal reasoning (countless stories of UFO sightings), conspiratorial thinking (governmental cover-ups of alien encounters), low-quality visual evidence (blurry photographs and grainy videos), and anomalistic thinking (atmospheric anomalies and visual misperceptions by eyewitnesses).

8. Is the claimant providing an explanation for the observed phenomena or merely denying the existing explanation?
This is a classic debate strategy—criticize your opponent and never affirm what you believe to avoid criticism. It is next to impossible to get creationists to offer an explanation for life (other than did it?). Intelligent Design (ID) creationists have done no better, picking away at weaknesses in scientific explanations for difficult problems and offering in their stead. "ID did it." This stratagem is unacceptable in science.

9. If the claimant proffers a new explanation, does it account for as many phenomena as the old explanation did?

Many HIV/AIDS skeptics argue that lifestyle causes AIDS. Yet their alternative theory does not explain nearly as much of the data as the HIV theory does. To make their argument, they must ignore the diverse evidence in support of HIV as the causal vector in AIDS while ignoring the significant correlation between the rise in AIDS among hemophiliacs shortly after HIV was inadvertently introduced into the blood supply.

10. Do the claimant's personal beliefs and biases drive the conclusions, or vice versa?

All scientists hold social, political and ideological beliefs that could potentially slant their interpretations of the data, but how do those biases and beliefs affect their research in practice? Usually during the peer review system, such biases and beliefs are rooted out, or the paper or book is rejected.
Effects of social distancing on 1918 flu deaths

As the first cases of the 1918 flu were reported in Philadelphia in September 1918, authorities played down the significance and allowed public gatherings to continue. Closures in Philadelphia were only enacted once the virus had spread. The first cases in St. Louis were reported in early October, with measures to contain the spread enacted two days later. This resulted in a slower spread and lower mortality rate.

On 5 June, researchers in the United Kingdom announced the results from the largest trial yet. In a group of 1542 hospitalized patients treated with hydroxychloroquine, 25.7% had died after 28 days, compared with 23.5% in a group of 3132 patients who had only received standard care.
Oklahoma Wants To Return Its $2 Million Stockpile Of Hydroxychloroquine

Dominique Mosbergen · Senior Reporter, HuffPost
Tue, January 26, 2021, 8:54 PM

Oklahoma is trying to return its $2 million stockpile of hydroxychloroquine, an anti-malaria drug once touted by former President Donald Trump — despite limited medical evidence — as a promising treatment for COVID-19.

A spokesman for Oklahoma Attorney General Mike Hunter confirmed to HuffPost on Tuesday that Hunter’s office had been asked by the state’s Department of Health to help them offload the hydroxychloroquine stash. Oklahoma’s The Frontier was the first to report the news.

Dylan Goforth
@DGoforth918

The Oklahoma Attorney General’s Office has been tasked with attempting to return a $2 million stockpile of a malaria drug once touted by former President Donald Trump as a way to treat the coronavirus.
What Is Botany?

Botany is a science

Science is an activity that tries to discover how the world works

Science is an INVESTIGATIVE process
Botany as science

Assumes there are natural laws in play, e.g., gravity

Supernatural--- outside natural laws

Scientists look for events that are correlated

Chance or cause/effect?

Can determine whether by chance or cause/effect by evidence (data)

Science is evidence-based, not belief-based

Scientists use evidence to eliminate alternative explanations

 Appropriately obtained data are the evidence scientists want and need to support their claim
**Children who eat fries raise breast cancer risk**

Frequent servings at ages 3-5 increased later chance of disease in study

By Sandee LaMotte, CNN

Children who eat fries raise breast cancer risk -- MSNBC.com

WASHINGTON - Very young children who eat French fries frequently have a much higher risk of breast cancer as adults, U.S. researchers reported.

A study of American nurses found that one additional serving of fries per week at ages three to five increased breast cancer risk by 27 percent.

"Researchers are finding more evidence that diet early in life could play a role in the development of diseases in women later in life," said Dr. Karin Michels, of Brigham and Women's Hospital in Boston and Harvard Medical School, who led the study.

**Smoking marijuana linked to testicular cancer - Health - Men's health | NBC News**

Dude, it's your junk! Pot linked to testicular cancer

By Bill Briggs NBC News
9/10/2012 2:08 AM ET

Some blunt advice for the young, male fans of marijuana: You may want to kill that joint and clutch your crotch -- self-check style, that is.

Scientists at the University of Southern California say they've detected a link between recreational marijuana use and a greater chance among males in their early teens through their mid-30s of contracting a particularly dangerous form of testicular cancer -- non-seminoma tumors, according to a small study published today online in CANCER, a peer-reviewed journal of the American Cancer Society.

**Cancer expert warns employees on cell phones**

PITTSBURGH, Pennsylvania (AP) - The head of a prominent cancer research institute issued an unprecedented warning to his faculty and staff Wednesday: Limit cell phone use because of the possible risk of cancer.

The warning from Dr. Ronald B. Herberman, director of the University of Pittsburgh Cancer Institute, is contrary to numerous studies that don't find a link between cancer and cell phone use, and a public lack of worry by the U.S. Food and Drug Administration.

Herberman is basing his alarm on early unpublished data. He says it takes too long to get answers from science, and he believes that people should take action now, especially when it comes to children.

"Really at the heart of my concern is that we should not wait for a definitive study to come out but err on the side of being safe rather than sorry later," Herberman said.

No other major academic cancer research institutions have sounded such an alarm about cell phone use. But Herberman's advice could raise concern among cell phone users and especially parents.

In the memo he sent to about 3,000 faculty and staff Wednesday, he says children should use cell phones only for emergencies because their brains are still developing.

Adults should keep the phone away from the head and use the speakerphone or a wireless headset, he says. He even warns against using cell phones in public places such as a bus, because it exposes others to the phone's electromagnetic fields.

The issue that concerns some scientists -- though nowhere near a consensus -- is electromagnetic radiation, especially its possible effects on developing brain cells.
Heavy cell phone use tied to poor sperm quality

Men who talked more than 4 hours a day had lowest counts, study says

Reuters
Updated 9:04 AM CT, Sat, Oct 4, 2008

NEW YORK - Spending hours on a cell phone each day may affect the quality of a man's sperm, preliminary research suggests.

In a study of 336 men age at their infertility clinic, researchers at the Cleveland Clinic found an association between the patients' cell phone use and their sperm quality.

On average, the more hours the man spent on their cell phones each day, the lower their sperm count and the greater their percentage of abnormal sperm.

The findings, published in the Journal of Andrology, were to questions about the potential health effects of cell phone and other wireless devices. Some studies, for example, have linked long-term cell phone use to a higher risk of brain tumors.

The concern is that, over time, the electromagnetic energy emitted from mobile phones could theoretically harm body tissue by causing DNA damage, for example.


**BODY & BRAIN**

Heavy milk drinking may double women's mortality rates

Consumption of the drink coincided with higher chances of death due to cancer, heart disease

BY NATHAN SEPPA

Women drinking milk and cheese.

participants had provided information on their diet and other lifestyle factors through questionnaires at the outset and later in the study.

Urine samples from hundreds of the men and women in the study. People who consumed lots of milk had higher concentrations of a telltale oxidative


Cancer expert warns employees on cell phones

- Story Highlights
- Cancer institute chief urges employees to limit cell phone use, dicing cancer risk
- Warning contrary to numerous studies that didn't link cancer, cell phone use
- Expert issues alarm on early unpublished data
- FDA: If risk exists – note is yet confirmed – it is probably very small

PITTSBURGH, Pennsylvania (AP) - The head of a prominent cancer research institute issued an unprecedented warning to his faculty and staff Wednesday. Limit cell phone use because of the possible risk of cancer.

The warning from Dr. Ronald B. Herberman, director of the University of Pittsburgh Cancer Institute, is contrary to numerous studies that didn't find a link between cancer and cell phone use, and a public lack of worry by the U.S. Food and Drug Administration.

Herberman is basing his alarm on early unpublished data. He says it takes too long to get answers from science, and he believes that people should take action now, especially when it comes to children.

"Really at the heart of my concern is that we shouldn't wait for a definitive study to come out but err on the side of being safe rather than sorry later," Herberman said.

No other major academic cancer research institutions have sounded such an alarm about cell phone use. But Herberman's advice could raise concern among many cell phone users and especially parents.

In the memo he sent to about 3,000 faculty and staff Wednesday, he says children should use cell phones only for emergencies because their brains are still developing.

Adults should keep the phone away from the head and use the speakerphone or a wireless headset, he says. His even warns against using cell phones in public places such as a bus, because it exposes others to the phone's electromagnetic fields.

The issue that concerns some scientists - though nowhere near a consensus - is electromagnetic radiation, especially its possible effects on children. It is not a major topic in conferences of brain specialists.

A 2008 University of Utah analysis looked at nine studies, including some Herberman cites, with thousands of brain tumor patients and concludes that "we found no overall increased risk of brain tumors among cellular phone users. The potential elevated risk of brain tumors after long-term cellular phone use awaits confirmation by future studies."
CORRELATION DOES NOT EQUAL CAUSE AND EFFECT

BUT IF YOU SEE A CORRELATION, IT’S A GOOD PLACE TO START YOUR STUDY
Botany as science

Evidence (data) obtained through:
controlled experiments or major observational studies

Experiments are:
controlled, repeatable, verifiable, reviewed, and reported for public scrutiny

Obtain data by:
asking good questions, making good observations, designing good experiments

Supported by evidence from other experiments and science disciplines (converging on same conclusion)

Science is self-correcting!

Science changes with new information!

Science is about gaining consensus understanding
DIFFERENCE BETWEEN EXPERIMENT AND OBSERVATIONAL STUDY

CONTROLLED EXPERIMENT—assign similar/identical organisms to different groups and then apply a treatment to one group while the other group does not receive the treatment.

OBSERVATIONAL STUDY—measure or survey subjects of a group without trying to affect them or applying treatments to the subjects. May have a controlled observational study.
Is Your Cell Really Safe?

Worries about a link between cell-phone radiation and brain cancer still can’t be dismissed, says a new study

By Claudia Kalb and Karen Springen

Shari Welsh can’t imagine life without her cell. She brings it everywhere—biking through the hills, driving in the city. "I feel so much safer," she says. But at the same time, Welsh, 32, can’t stop thinking about whether she’s really protecting herself at all. "A lot of times when I’m using my cell phone," she says, "I wonder if I’m going to get brain cancer." And so do a lot of other people. A whopping 100 million Americans now use mobile phones, and tens of thousands of new customers wire up every day. Health concerns first made major headlines in 1993, when a man alleged that his wife had died of brain cancer from cell-phone use, sued the manufacturer and appeared on "Larry King Live." (The case was dismissed.) This week Medscape’s online journal, MedGenMed, raises new questions with a controversial article surveying the current wireless medical research. Its conclusion: Industry claims that cell phones are absolutely safe are "no longer supportable." George Carlo, the paper’s lead author, says he was shocked by the data. "We’re beginning to see a momentum of scientific and medical studies," he says, "that are now pointing in the direction of potential problems.

Safety concerns are clearly worth investigating. It has long been known that intense exposure to electromagnetic radiation can harm human tissue. The question is, can the tiny amounts emitted by cell-phone antennas do serious damage? Carlo, the former head of the industry-funded Wireless Technology Research program (set up in 1993 to study cell-phone safety), surveyed more than 50 studies, many of them still unpublished. Most showed no link. The "red flags" he cites come from recent work—much of it preliminary and in no way conclusive. In one experiment researchers at Integrated Laboratory Systems in Research Triangle Park, N.C., found that high levels of cell-phone radiation (two and a half to five times greater than legal cell-phone limits) can cause chromosomal abnormalities in human blood cells. In a Swedish study of brain-tumor patients published last year, majority, but in a subgroup of 35 there was some correlation between cell-phone use and a rare type of brain cancer.

Carlo’s review of the science, much of which he has already presented publicly, has drawn fire from industry officials, who say he is exaggerating the findings. Based on the science so far, says Jo-Anne Basile of the Cellular Telephone Industry Association, "there are no adverse health effects from the use of wireless phones." And some of the very researchers Carlo cites object to the way he has presented or interpreted their data and say it requires far more analysis. Carlo, who has a law degree and a Ph.D. in pathology, has spent years doing industry-funded research (he also worked for breast-implant manufacturers) and has been a controversial figure in the health field. He says he’s just doing his job. Initially, he thought the data would turn up empty; now, he says, there are questions.

Some of these questions will be more fully addressed over the next few years. This week the Food and Drug Administration and the CTIA meet in Washington to collaborate on safety research. The National Cancer Institute is now analyzing data from a major survey on the causes of brain cancer, which includes an analysis of cell phones. And the World Health Organization, noting that there will be as many as 1.6 billion cell-phone users worldwide by 2005, is planning a study in at least 10 countries to examine links to head and neck cancer.

In the meantime, if you’re worried about cell-phone safety, you can take some precautions. Start with an earpiece. Get an old-fashioned cell phone for your car, so that the antenna is outside the vehicle. Hang up when signal strength is bad. Dr. John Moskler, a radiation oncologist at the Medical College of Wisconsin—that means the phone has to work harder and emit more radiation. Use digital phones (less radiation) rather than analog. And beware of devices that claim to shield radiation, since anything that blocks transmission keeps the phone from working properly. Finally, put it down when you get behind the wheel. You might enjoy the quiet.

Get an earpiece. Make sure the antenna is outside your car. Hang up when signal strength is bad.
DESIGN AN EXPERIMENT TO TEST WHETHER PHONE USE CAUSES BRAIN CANCER
In Spain’s Las Pesteja Cave, a set of lines (center) painted by Neandertals was embellished by later artists.

Cave art across Italy, France, Portugal, and Spain. Most of the dates fell within the European reign of modern humans, which began 40,000 to 45,000 years ago. But in the three cases described in Science, the paintings are far too old to have been made by them.

"To me the biggest question is how good is the dating," says Harold Dibble of the University of Pennsylvania, who has long challenged claims of sophisticated Neandertal behavior. But others see little reason for doubt. Multiple samples from each painting yielded consistent results, and in several cases Hoffmann and his colleagues analyzed scrapings from increasing depths in the calcite layer. The dates grew older as they approached the pigment, adding credibility. "I am confident that the [uranium-thorium] dates are correct," says Rainer Grün, an expert in the technique at Griffith University in Nathan, Australia, who did not take part in the work.

Zilhão predicts that other cave paintings will prove equally ancient, if not more so. "This is just scratching the surface of an entirely new world." He cites two other finds as evidence of a long Neandertal tradition of art and ritual. One is a pair of coralline-shaped structures, the larger one more than 6 meters across, assembled from broken stalagmites and scorched by fire, found by cavemen more than 300 meters deep in Bruniquel Cave in France. In 2016, a French-led team reported in Nature that the structures were built some 175,000 years ago—presumably by Neandertals, perhaps for ritual purposes. And then there are the colored shells from Cueva de los Aviones, a sea cave in southern Spain, where Hoffmann’s uranium-thorium dating of a calcite crust covering the objects has just yielded an age of more than 335,000 years.

But was this Neandertal artistic creativity equivalent to the art and symbolism practiced by modern humans? At sites across Africa, our direct ancestors were making shell beads and etching abstract designs into egg shells and minerals 80,000 years ago and more. Neandertal achievements were fully comparable, Zilhão insists, and to suggest otherwise implies a double standard.

Hublin disagrees. The startling new dates for the paintings "show that Neandertals had the same potential as modern humans in a number of domains," he acknowledges. But he and others see differences in cognition and culture that even the new research does not fully explain.

Infectious Diseases

Worms living in your veins?
Seventeen volunteers said ‘OK’

A controversial study infects people with schistosomiasis to speed up drug and vaccine development

By Kai Kupferschmidt, in Leiden, the Netherlands

At 12:05 p.m. on a Thursday in February, a lab technician takes a six-well plate containing a solitary red snail and places it in a heated water bath under a strong light. The light and warmth signal hundreds of tiny larval parasites to stream out of the mollusk. Now, the clock starts ticking for Meta Roestenberg, an infectious disease physician here at Leiden University Medical Center. She has about 4 hours to launch a unique, controversial experiment in which she will let the parasites burrow into the arms of four healthy volunteers. If she waits too long, the larvae start to die.

Roestenberg and her colleagues are infecting people with Schistosoma mansoni, one of five tiny waterborne worm species that cause schistosomiasis, a disease that sickens millions of people in Africa, the Middle East, and Latin America and kills thousands each year. There is no schistosomiasis vaccine and only one old, inadequate drug, praziquantel, to treat it.

Infecting humans could help speed up the development of new interventions. Roestenberg has designed the experiment to prevent the parasites from reproducing, and she says the risk to volunteers is extremely low.

But not low enough, some scientists argue, because there is no guarantee that subjects will get rid of their parasites when the study is over. "I would not volunteer for this study and if I had a son or daughter who wanted to volunteer, I would recommend against it," says Daniel Colley, a schistosomiasis researcher at the University of Georgia in Athens.

At 1:05 p.m., the technician takes the plate out of the bath. The larvae are ready to be harvested. Viewed under a microscope, they move around frantically, like mispropellers. Another technician removes one drop, dilutes it, adds iodine to kill the parasites, and counts them. That allows the researchers to calculate how many are left in the well: 574. They need only 80 today, 20 per volunteer.

A small population in an African lake could shed millions of these larvae into the water on a single day, each equipped with a chemical sensor that lets it home in on humans entering the water. After penetrating the skin, they migrate to the liver, where they mature and mate. Male-female couples stay together and move to blood vessels in the bowel, where they reside for years, shedding hundreds of eggs a day. Most eggs end up in urine and feces, and if they make their way back into the lake they may infect fresh snails. But some get trapped in the liver, kidneys, or spleen, causing disease and leading to pain.

Parasites to the people

Researchers have long grown Schistosoma mansoni in the lab, using hamsters. Now, they are also infecting humans with the parasitic worms.
CANCER EXPERIMENT

1. Recruit 50 participants. Divide into two groups. Instruct one group to use cellphone for 6+ hours per day and have it with them at all times. Instruct the other group to not use any cell phone at all. Test all patients for brain cancer every six months.

2. Have a group of 50 people with no genetic predisposition to brain cancer use their cell phone for eight hours a day over the course of a month. Take a brain scan before and after to see if there are any visible effects.

3. Compare one group of 25 healthy people who do not use cell phones and one group of 25 people who use a cell phone daily. Observe these two groups over the course of 10 years and track their health.

Choose the one that is the best experiment to test whether or not cell phone use causes brain cancer.
Bloom's Taxonomy

- **Remember**
  - Recall facts and basic concepts
  - define, duplicate, list, memorize, repeat, state

- **Understand**
  - Explain ideas or concepts
  - classify, describe, discuss, explain, identify, locate, recognize, report, select, translate

- **Apply**
  - Use information in new situations
  - execute, implement, solve, use, demonstrate, interpret, operate, schedule, sketch

- **Analyze**
  - Draw connections among ideas
  - differentiate, organize, relate, compare, contrast, distinguish, examine, experiment, question, test

- **Evaluate**
  - Justify a stand or decision
  - appraise, argue, defend, judge, select, support, value, critique, weigh

- **Create**
  - Produce new or original work
  - design, assemble, construct, conjecture, develop, formulate, author, investigate

Vanderbilt University Center for Teaching
HOW ARE YOU GOING TO SAVE THE WORLD?
(At least part of it)  15 points possible

This assignment is about human interactions with the environment.

DUE SUNDAY, APRIL 30
Upload to Assignments on Canvas

CREATE A CONCEPT MAP AND WRITE A ONE-PARAGRAPH PLAN

Related to:  THE PROBLEM OF PLASTICWARE (knives, forks, and spoons) PROVIDED FROM FAST FOOD RESTAURANTS (local or national)
Your concept map should begin with the WORDS IN RED. Then, expand from there.

**MY PLAN**

YOUR PLAN (Description of your plan is not included on your concept map.)

How would you reduce or eliminate the distribution of plasticware from fast food restaurants? (You can think locally or nationally). Be realistic and describe specific steps you would take.
YOUR CONCEPT MAP SHOULD ADDRESS 2 QUESTIONS:

1. WHAT IS THE PROBLEM WITH RESTAURANTS PROVIDING PLASTICWARE? (Provide some data about the issue)
2. WHAT IS THE POTENTIAL IMPACT OF YOUR PLAN?
   
   What are potential benefits of your plan?
   
   Who/what is affected positively? How are they affected?
   
   What might be the negative consequences of your plan?
   
   Who/what is affected negatively? How are they affected?

YOUR PARAGRAPH SHOULD DESCRIBE YOUR PLAN

HOW DO YOU ELIMINATE/REDUCE THE PROBLEM?

WHAT IS YOUR PLAN? PROVIDE SPECIFIC STEPS.
DISTRIBUTING PLASTICWARE  \[\rightarrow\]  REDUCING/ELIMINATING PLASTICWARE

YOUR PLAN
Bloom's Taxonomy

- **Remember**
  - Recall facts and basic concepts
  - define, duplicate, list, memorize, repeat, state

- **Understand**
  - Explain ideas or concepts
  - classify, describe, discuss, explain, identify, locate, recognize, report, select, translate

- **Apply**
  - Use information in new situations
  - execute, implement, solve, use, demonstrate, interpret, operate, schedule, sketch

- **Analyze**
  - Draw connections among ideas
  - differentiate, organize, relate, compare, contrast, distinguish, examine, experiment, question, test

- **Evaluate**
  - Justify a stand or decision
  - appraise, argue, defend, judge, select, support, value, critique, weigh

- **Create**
  - Produce new or original work
  - design, assemble, construct, conjecture, develop, formulate, author, investigate

Vanderbilt University Center for Teaching
WHAT TO DO

USE THE TEXTBOOK AS A REFERENCE, NOT A PRIMARY RESOURCE

“ENGAGE STUDENTS” IN ACTIVE LEARNING, UNDERSTANDING, DISCOVERING, PREDICTING, DOING SCIENCE, THINKING SCIENTIFICALLY
WHAT TO DO

TEACH “STREET-SMART” SCIENCE

DEVELOP SOCIALLY CONSCIOUS STUDENTS

“ENGAGE” STUDENTS IN ACTIVITIES AND THINKING ABOUT SCIENCE
BUZZ FOOD

Feeding insect meal to livestock could help the planet, but will it be good for people? By Kai Kupferschmidt

ick Grant is a farmer in Roos, U.K., a burly fellow with strong hands and a quick smile. His great-grandfather started out with a shop and two cows. Out of that grew Elm Farm, a 450-hectare estate on which Grant is raising pigs and growing wheat, peas, and oilseed rape. Recently, Grant has added a new species of livestock: housefly larvae, also known as maggots.

In two blue shipping containers a short drive from the farmhouse, Grant is raising them by the tens of thousands. They grow on manure from a nearby chicken farm—the fresher the better, Grant says: “As it gets older it crusts and gets fungus in it.” Maggots from old manure, he says, “are not as good a maggot as they are at the beginning.”

Grant has produced hundreds of kilos of dried maggots in the last few months as part of an EU-funded research project called PROteINSECT. They are now being fed to fish, pigs, and chickens in large trials designed to answer an increasingly urgent question: Are insects the animal feed of the future?

Some scientists are convinced the answer is yes. The world’s appetite for meat is growing, and the production of animal feed is an increasing strain on land and water. Insects could provide much of the protein animals need at a much lower environmental cost; many insect species can feed on manure, like Grant’s maggots, or other types of organic waste, such as leftover food, offal, and grains discarded by breweries.

Regulatory agencies are beginning to weigh the benefits against potential safety risks, including the possibility that insects might accumulate environmental toxins or even transmit diseases to the farm animals that eat them. On 8 October, the European Food Safety Authority (EFSA) in Parma, Italy, released its first report on the risks of using insects as food and animal feed. It concluded that the risks depend on the insect species used—and that more studies like PROteINSECT are needed before livestock or fish are switched to this new diet.

But in other countries the brave new world of industrial-scale insect farming is already on view.

THE BEST WAY TO TURN INSECTS INTO food is simply to eat them—and in many countries people already do. More than 2 billion people occasionally cook caterpillars, boil beetles, or marinate maggots as part of their traditional diet. In Southern Africa, 9.5 billion mopane caterpillars—named for their favorite tree—are harvested every year for human consumption, and in Uganda, a kilogram of grasshoppers is more expensive than a kilogram of beef.

Environmentally speaking, it’s a great choice, says Arnold van Huis, an entomologist at Wageningen University in the Netherlands who co-authored an insect cookbook. Insects produce body mass at an astonishing rate, in part because as cold-blooded animals they don’t need to expend energy on regulating their body temperature. Crickets need only 1.7 kilograms of feed
to gain a kilogram of body weight; a typical U.S. chicken consumes 2.5 kilograms, pigs 5 kilograms, and cattle 10 kilograms. Another advantage: Most insects can be eaten whole. Only about half of a chicken or a pig is edible; for a cow the fraction is even less. As a result, raising a kilogram of insect protein produces less CO₂ than rearing pigs or cattle, Van Huis says, and takes up only one-tenth the land.

Edible species of which there are some 2000, are high in protein and rich in micronutrients such as iron and vitamins; several studies have found. A 2012 report by the Food and Agriculture Organization of the United Nations (FAO), co-authored by Van Huis, noted "the huge potential that insects offer for enhancing food security."

But beyond the safety unknowns, putting insects on the menu faces a bigger obstacle, Van Huis says: "Most people are simply disgusted by the idea of eating insects." Feeding insects to livestock may have a lower environmental payoff but could be easier to sell to the public, and it makes the safety concerns less acute. (And, who knows, insect enthusiasts say, once farm animals start eating insects, humans might begin to find the idea less repulsive.)

Studies suggest that many animals do just fine on insects—which after all are a natural staple for creatures from chickens to trout. A 2014 review by FAO scientists of feeding trials conducted on catfish, tilapia, rainbow trout, and several other fish species, as well as crustaceans, chickens, and pigs, concluded that insect meal could replace between 20% and 80% of soybean or fishmeal in the animals' diets with no adverse effects. Most insect meals were deficient in calcium and the amino acids methionine and lysine, but those can be added cheaply. The authors noted that the aroma and texture of fish did not change when they were fed on black soldier fly larvae.

EUROPEAN FARMERS have little experience raising insects, but Grant didn’t have to start from scratch. Elm Farm has produced bluebottle larvae for decades, as bait for recreational fishers. They grow on abattoir waste—kidneys, livers, and hearts, glutens

From spare food to spare ribs

Researchers are studying how to use insects raised on waste to feed farm animals and fish.

Waste
Insects can feed on leftover food, grains discarded by distilleries, or even manure.

Flies
Adult flies are kept in a room; their eggs are collected.

Larvae
The eggs develop into larvae. Some of them are allowed to grow into flies to lay more eggs.

Pressing

Drying

Oil
Insect oil could replace fish oil or soy oil in animal feed.

Meal
Insect meal could replace fish meal or soy meal.

Livestock and fish
Feeding trials are ongoing; regulators are studying the risks of allowing insect-fed animals into the human food chain.

sands of flies buzz in a huge wooden compartment. Early in the morning, a farmhand places trays of fresh chicken manure on the floor of the container. For 2 hours, the flies are allowed to lay their eggs on the manure. Then, the trays are put inside the other container to hatch.

Larvae start hatching from the eggs within hours. They feed on the manure, which is kept moist, and slowly burrow into it. After a few days they move toward the sides of the tray, that means they are ready to harvest. Some of the maggots get a little extra nutrition: fish scraps. Grant uses these maggots to replenish the stock of flies next door. "The fish just give the flies a certain va-va-voom," he says. "They are just fitter and lay more eggs." But most of the maggots are destined to be animal feed. They are sieved from the manure, then dumped into a cement mixer where they are dried and left to fall apart, resulting in a fine insect powder.

For now, it's all for research purposes. But Grant likes to imagine a building where all of this is automated so that he can churn out tons of animal feed. "The potential is huge," Van Huis says. In 2014, the world produced about 900 million tons of feed, worth about $450 billion. With meat consumption growing, those numbers will only rise. Already, more than 80% of the world's soybeans are used as feed; their cultivation takes up huge amounts of land and water. Insect meal could never replace soy feed entirely, but it could take some pressure off, says PROInsect coordinator Elaine Fitches, a researcher at the Food and Environment Research Agency (FERA), a partly privatized U.K. government institute in York. It takes about a hectare of land to produce a ton of soy per year; the same area could produce up to 150 tons of insect protein, she estimates.

Insect protein could make an even bigger impact in aquaculture, which consumes 10% of the world's fish production as feed for other fish.

The availability of fishmeal has been erratic and its prices are rising rapidly, says Jason Drew, a U.K. entrepreneur—from about $500 per ton in the 1990s to $1300 to $2500 in recent years. "Companies are looking for solutions to the looming protein crisis, Drew says. "I think insect protein will replace fishmeal. We can then leave this food source at the bottom of the food chain, where it should be—in our seas."

Drew is one of the founders of AgriProtein Technologies, a company in Cape Town, South Africa, that many observers agree is furthest along in rearing insects at an indust
Many people find the idea of eating mealworms repulsive. Feeding them to animals avoids that problem.

trial scale. With $31 million from the Bill & Melinda Gates Foundation and private investors, the company has built a huge factory next to Cape Town's International Airport that is now ramping up production. Once it reaches capacity, soldier fly larvae will consume 110 tons of organic waste daily to produce 24 tons of maggots. Dried and ground to a powder, they will be sold to South African farmers as feed at a lower price than fish meal, Drew says. Nothing prevents him from taking his product to the market, and he already has plans for a second factory. Drew thinks maggots will make him a millionaire.

No one thought of insects at the time, but today, the regulation is holding back development, complains Antoine Hubert, a French scientist who co-founded Insecta, a company that aims to rear insects for feed and other applications. Because insects and mammals are so distantly related, the risk of retransmitting diseases or other pathogens making the jump is much smaller than it is between mammals, Hubert argues.

In 2013, the European Union relaxed the rules a bit to allow the use of animal proteins in aquaculture. But there is one problem: Animals used as fish feed have to be killed in a certified slaughterhouse with a welfare officer present, a rule clearly not written with maggots in mind. As a result, fish farmers can now feed their animals chicken offal but not insects—even though many fish species eat insects in nature but not chickens. "That's just absurd," Hubert says.

Hubert is now lobbying for changes in the regulations through the International Plant Protection Convention of Insects for Food and Feed, which he founded in April together with representatives of AgriProtein and companies from France, Germany, and the Netherlands. The European Commission is paying attention: Also in April, it asked EFSA, its food watchdog, to look into the risks posed by the use of insects in food and feed. The resulting report, issued last week, mentions the buildup of chemicals such as heavy metals or arsenic as one possible risk. It also discusses infectious diseases, but finds that the risks aren't higher than with other sources of animal protein.

Insects aren't even known to develop prion diseases, the report notes, and it agrees with Hubert that any bacteria or viruses that harm insects are most likely harmless to humans. Insects could conceivably pick up pathogens of fish, birds, or mammals through their diet and passively spread them, but there are ways to mitigate those risks, the report says, such as carefully choosing the insects' food source.

On many issues, however, there's simply not enough information. There are reports of allergic reactions in humans after eating insects, for instance, and even a case of anaphylactic shock. But such allergic reactions have never been reported in farm animals, although they should be monitored for that, the authors write.

MICK GRANT'S MAGGOTS could help provide more answers. At FEERA, scientists have purebred the maggots and investigated them for pesticides, heavy metals, and traces of antibiotics and growth hormones. "Anything that we find on a farm could find its way into the maggots and in our food chain," says Michael Dickinson, a scientist at the institute. "But we have not found any red flags so far." The maggots are now being fed to pigs and chickens in Belgium. The growth of the animals as well as their health and the meat quality is compared with animals on a standard diet. By the end of the year, results from these trials should be available for EFSA to take into account.

Whether maggot-fed meat eventually makes its way to the table will depend in part on public acceptance—and Hubert worries that PROINSECT's use of manure as a food source will not help. "The public won't accept feeding insects on manure," Hubert says. (Insect, his own company, only uses food industry byproducts that are allowed as feed.)

Mick Grant, for his part, sees no problem. For him, insects are all about efficiency. "If you can use waste to make something, it makes more sense than anything, doesn't it?"
QUESTION FOR THE FINAL
BASED ON BUZZ FOOD, BE ABLE TO
CONNECT THE FOLLOWING TERMS (AS IN A
CONCEPT MAP):

GRAINS
SOYBEANS
FISH MEAL
FISH
HOUSEFLIES
MAGGOTS
PIGS
CARBON DIOXIDE (CO2)
MANURE
GLOBAL WARMING
HUMAN FOOD CHOICES
The Distracted Classroom: Is It Getting Worse?

By James M. Lang | April 17, 2017

The inexorable spread of new technologies has spurred a cottage industry of intellectual hand-wringing about their adverse effects on our lives. Books like Nicholas Carr’s *The Shallows: What the Internet Is Doing to Our Brains* or Sherry Turkle’s *Alone Together: Why We Expect More From Technology and Less From Each Other* offer research from neuroscience and psychology to analyze the deleterious influence of our omnipresent devices.

I find the work of one astute thinker in this area especially compelling: "For a multitude of causes, unknown to former times, are now acting with a combined force to blunt the discriminating powers of the mind, and, unfitting it for all voluntary exertion, to reduce it to a state of almost savage torpor. The most effective of these causes are the great national events which are daily taking place, and the increasing accumulation of men in cities, where the uniformity of their occupations produces a craving for extraordinary incident, which the rapid communication of intelligence hourly gratifies."
Students who use digital devices in class 'perform worse in exams'

Study finds use of computers by students in lectures and seminars has 'substantial negative effect' on performance

Richard Adams Education editor
Wed 11 May 2016 14.58 EDT

Allowing students to use computers and the internet in classrooms substantially harms their results, a study has found.

The paper published by the Massachusetts Institute of Technology found that students barred from using laptops or digital devices in lectures and seminars did better in their exams than those allowed to use computers and access the internet.

The researchers suggested that removing laptops and iPads from classes was the
For incoming college freshmen, one of the biggest academic challenges is learning ... well, learning how to learn. And experts say that using a laptop to take notes in class is a step in the wrong direction.

The research is clear: Typing out your notes results in decreased comprehension of lecture material.

For one, we're not paying as much attention to the actual words we're typing. Last year, a study out of Princeton and UCLA found that when students take notes on laptops, their "tendency to transcribe lectures verbatim rather than processing information and reframing it in their own words is detrimental to learning."

And the Internet is just so much more fun than a lecture. In 2003, Cornell researchers let half of students browse the Web during a lecture while the other half had to keep their laptops closed. Not surprisingly, the ones who weren't online did better on a post-class quiz.

"The act of typing effectively turns the note-taker into a transcription zombie."

Worst of all, laptop note-takers may be hurting the learning of their classmates. A 2013 study found that those who could even catch a glimpse of a "multi-tasking" peer's laptop performed 17 percent worse on a comprehension test after the lecture.

Get more tips and advice on college at The Freshman Year Experience on NBCNews.com

As a result, professors are practically pleading with students to ditch the Macbooks and pick up a pen.

Dartmouth College professor Dan Rockmore, who made headlines by banning laptops in his classroom, wrote in the New Yorker that "the act of typing effectively turns the note-taker into a transcription zombie."

And while there's an argument to be made that if students are so easily distracted these days, maybe lectures should be more interesting (as one NYU student argued in a 2012 article), even educators who are working towards a more dynamic lecture experience make the case for pen and paper.

At the University of North Carolina, professors in the sciences are experimenting with intro classes, using "high-structure, active learning" to change up lecture formats and testing the results on students' engagement.
Don’t try to multitask!!!
I know it’s hard to do, but put away your phone during class!
We will take a break in the middle of each class, and you can check your phone then.

KEEP ON TOP OF ACTIVITIES, NOTES, AND ASSIGNMENTS!
GET ORGANIZED!
PEOPLE TALK ABOUT ACTIVE LEARNING

BUT TO WHAT END---

FOR WHAT IS YOUR ACTIVITY PREPARING YOUR STUDENTS?