LESSON PLAN

Level:	Grades 9 to 12
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Duration:	1 to 1 ½ hours, plus time for the assessment/ evaluation activity

This lesson is part of the *Reality Check* lesson series.

Reality Check: Getting the Goods on Science and Health

This lesson is part of USE, UNDERSTAND & CREATE: A Digital Literacy Framework for Canadian Schools: http://mediasmarts.ca/teacher-resources/digital-literacy-framework.

Overview

In this lesson, students start by considering the wide range of science and health information they are likely to encounter in news or through social media. They read an article on a scientific topic to help them understand the particular challenges of verifying science and health information and then use an educational computer game to practice skills in critically reading health and science stories. Finally, students compile a list of reliable sources they can turn to for verifying health and science stories.

Learning Outcomes

Students will:

- Understand the particular challenges of verifying health and science topics
- Reflect on how health and science information may be misrepresented in news or online sources
- Practice critical reading of health and science news
- Evaluate verification resources on health and science topics
- Contribute to a shared resource on verifying health and science topics

Preparation and Materials

- Photocopy the handouts *Octopus from Outer Space?* and *5 for 5: Five Things You Can Do to Get Good Info (in Under Five Minutes)*
- Photocopy the assignment sheet *Reliable Sources*
- Prepare to read or project the overhead *Weird Science*
- Ensure that students have internet access and are able to access *Reality Check Mission Three: Getting the Goods on Science and Health* (http://mediasmarts.ca/sites/mediasmarts/files/games/reality-check/index.html#/)

Procedure

Weird Science

Start by projecting or reading aloud the headlines on the overhead *Weird Science* and ask students to guess which ones are real (not necessarily which stories are *true*, just which ones are stories that really appeared in newspapers, magazines or websites)*:*

- Bees can count to four, understand zero
- Matter sucked into black holes may travel into the future
- Billionaire launches car into space
- Hawaiian seals have a new bad habit: sticking eels up their noses
- Flat-earther builds, launches home-made rocket to prove his theory
- After 130 years, the original kilogram has been retired
- Your politics can change how you smell
- Celebrities die earlier than non-famous people
- Skip the sunblock and stop shaving: beards stop UV rays
- Scientists didn't find this human organ until 2017

After you've gone through the list, tell students that *all* of these are actual news stories.

Reading Like a Scientist

Tell students that health and science stories – for example, a news story about a scientific discovery or a post about something that's supposed to be good or bad for you – are some of the most common stories we read, watch and share: a quarter of social media users follow science-related accounts, and "weird science" stories like these are the most common content.

Now point out that just because these are all real news stories, it doesn't mean they are all *true*: while some are really news stories *about* science (such as the car being launched into space, or the kilogram being retired) and can be verified in the same way we verify other news or information online, when we read stories about scientific discoveries we also have to consider:

- Whether the writer of the piece *understands the finding* they're reporting on
- Whether the writer *knows the field* well enough to put the finding in context
- Whether the writer is *misrepresenting the finding for political or commercial reasons*
- Whether the *headline* (which is often not written by the same person who wrote the article) misrepresents the finding

Now point out that those questions only tell you if the *article* on the finding is reliable, not whether the finding itself is *well-founded* (did the scientists follow proper procedure and interpret their results accurately?) or *replicable* (will other scientists consistently find the same thing?).

Project or distribute the article Octopuses from Outer Space and either have students read it or read through it with the class. Have students answer the questions on the article and then take them up in class:

- What is the *finding* that the story is reporting on?

  Scientists claim that octopuses are evidence that alien viruses brought to Earth by comets have influenced evolution.

- What is the original source for the finding?

  A paper in a journal called Progress in Biophysics and Molecular Biology.

- Why might the writer of the article or headline misrepresent this finding?

  It's a very sensational claim, which makes you more likely to read and share the article. It's also possible that the writer might already believe in the theory and want to promote it. Finally, there's always a bias in news towards what's news-worthy: "octopuses probably aren't aliens" isn't really a news story.

- How do the article and headline represent the finding?

  The writer gives more weight to arguments in favour of the finding by putting them at the beginning of the article, waiting until near the end to give arguments against (and going into much less detail on those) and barely mentioning the key fact that none of the authors of the original study is a zoologist. The headline misrepresents the finding by presenting the finding as basically fact, with just a question mark to show that it's not actually widely accepted.

- How could you find out how the finding fits in the context of the *scientific consensus* on the topic?

  A search for "octopus" and "aliens" might tell you, but you'd need to be careful to look for more critical articles on this study. More useful might be to consult a general reference work like Wikipedia or Britannica Online: if this theory is at all accepted by other scientists it would at least be mentioned there (it isn't).

Tell students this article is a good example of health and science misinformation because it isn't exactly *wrong*: it's based on an article from a legitimate journal, written by actual scientists, putting forth evidence for a theory that is held by some scientists – but the article misrepresents the issue by making the evidence for the theory more prominent than the evidence against it.

Getting the Goods

Tell students that you don't necessarily have to do a huge amount of work to verify each health or science story you see, but you do have to make a habit of doing it every time. Distribute the handout 5 *for 5: Five Things You Can Do to Get Good Info (in Under Five Minutes)* and go through it with the class, highlighting points that have already come up in class discussion.

Have students use the handout to help them complete *Reality Check Mission Three: Getting the Goods on Science and Health*.

Students may do this alone, in pairs, or as a whole class, at your discretion.

When students have completed the mission, ask them how close their judgment of the story's reliability was. *(This story is rated a 2, "Probably False," with the corresponding action "Tell Daphne not to buy Doctor LaCrosse's cat food.")*

What were the most important clues, and how did they find them? *(Tracking the story to its original source led to Blorp, a website with no particular authority, and Doctor Bob LaCrosse. The fact that the site was selling a remedy for the condition it was warning about should have been a major red flag.)*

What might have been some misleading clues? (*A search on toxoplasmosis showed that it is a real condition, and Doctor LaCrosse was a real doctor – but a cardiologist, not a vet. Doing research on him and using a specialist search engine found the key info.)*

Assessment/Evaluation Activity: Reliable Sources

Point out to students that one of the best "short cuts" for verifying health and science news is to have sources that you already know are reliable. Distribute the assignment sheet *Reliable Sources* and explain that they are going to assemble a collection of reliable sources on different health and science topics that they can use and share with friends and family. (You may allow up to three students to do the same topic, to make sure there is at least one successful assignment on each topic.)

When students have completed the assignment, collect the successful assignments into a single document (print or online). (If students working on the same topic came up with different reliable sources, you may include more than one on each topic.) Make the collected resource available to students to use and share.

Remind students that if they have concerns about their own physical, mental or sexual health they should not rely on online sources but should consult a health professional.

Octopus from Outer Space?

Are octopuses actually space aliens? Scientists now believe that some of their DNA originated… out there.

Octopuses are well-known as one of the smartest animals in the world, especially considering that relatives like snails and mussels are among the dumbest. A paper titled *Cause of Cambrian Explosion – Terrestrial or Cosmic?* authored by 33 scientists from around the world argues that the octopus's intelligence and the flourishing of life on Earth during the Cambrian period – called the Cambrian Explosion – are the result not of normal evolution but of freeze-dried viruses brought from outer space in comets.

This isn't as out-there as it sounds: the theory behind it was suggested by Fred Hoyle, one of the originators of the Big Bang theory of the origin of the universe, and some kinds of viruses can actually change their hosts' DNA.

The paper does not include any new research, but is a collection of evidence for the theory. The authors chose the octopus as one of the examples because "the genetic divergence of Octopus from its ancestral coleoid sub-class is very great … Its large brain and sophisticated nervous system, camera-like eyes, flexible bodies, instantaneous camouflage via the ability to switch color and shape are just a few of the striking features that appear suddenly on the evolutionary scene… it is plausible then to suggest [these traits] seem to be borrowed from a far distant 'future' in terms of terrestrial evolution, or more realistically from the cosmos at large."

None of the study's authors, though, is a zoologist, and when scientists decoded octopus DNA in 2015 they found the species evolved from squid just 250 million years *after* the Cambrian Explosion. Other scientists have pointed out that while some animals, like tardigrades, can survive the conditions they'd endure inside a comet (frozen and blasted by cosmic rays), viruses co-evolve with their hosts, so the chances that a virus from another planet could infect an animal from Earth are very small.

So are octopuses aliens? The jury is still out. Next time you go to the aquarium, try flashing the Vulcan salute and see what happens.

Questions

1. What is the finding that the story is reporting on?
2. What is the original source for the finding?
3. Why might the writer of the article or headline misrepresent this finding?
4. How do the article and headline represent the finding?
5. How could you find out how the finding fits in the context of the scientific consensus on the topic?

Weird Science!

Which of the following stories about health and science actually appeared in newspapers, magazines or news websites?

1. Bees can count to four, understand zero
2. Matter sucked into black holes comes back out – in the future
3. Billionaire launches his car into space
4. Celebrities die earlier than non-famous people
5. Hawaiian seals have a new bad habit: sticking eels up their noses
6. Man builds, launches home-made rocket to prove the Earth is flat
7. Skip the sunblock and stop shaving: beards stop UV rays
8. After 130 years, the original kilogram – a metal bar that weighs exactly one thousand grams – has been retired
9. Your politics can change how you smell
10. This organ is in your body, but scientists didn't find it until 2017

5 for 5: Five Things You Can Do to Get Good Info (in Under Five Minutes)

Checking online info doesn't have to be hard, and it doesn't have to take a long time – but you do have to do it every time you want to share something, or you might make a decision based on it.

It's good to be skeptical, but it doesn't do you any good to doubt *every*thing. Instead, you need to find sources you can trust. Here are five things you can do in less than five minutes to get good info on specialist topics like health and science. (Most will take you less than two minutes!)

1. Read like a scientist. Science writer Emily Willingham gives five tips for reading science news:

    - Skip the headline: Headlines, which are often written by people other than the person who wrote the article, simplify issues and emphasize the most sensational aspects of a story – which may not be the most important.
    - Look for the basis of the article. Is it about new research, or connecting existing research to a new story? Read through the story to find out what it's based on, and watch out for words like "review," "perspective," or "commentary" -- these usually mean no original research has been done.
    - Watch out for vague words like "natural" or "energy" or scientific terms used out of context like "quantum" or "toxins."
    - Keep commercial considerations in mind. News outlets want readers; researchers need funding; the institutions that fund them often want publicity. Even when a science story is entirely legitimate, and not someone trying to scare you into buying a book or some nutritional supplements, there are lots of reasons why the importance or implications of new research might be exaggerated by anyone in that chain.

2. Find the consensus. In any part of science or medicine, there is usually a *consensus,* a theory or model that *most* experts in that field agree is *probably* true. That consensus can change: in fact, what makes science work is that claims have to be *falsifiable* – if there's no conceivable way something *could* be disproved, it has no scientific value. But that doesn't mean that everything that's consensus now will be overturned, or that consensus can be overturned by a single piece of evidence.

    One of the best ways to find consensus is to look at an online or offline encyclopedia. Wikipedia articles generally do a good job of telling you what the consensus on a topic is and whether there are any major challenges to it. (Make sure to click on the "Talk" tab to see how an article is rated and whether there are any debates going on about the content.)

3. Use specialized sources. Regular search engines treat all sources as equally reliable, but with health and science topics it's important to know that your source is an authority.

    - You can use specialized search tools like HonSearch (https://www.hon.ch/HONsearch/Patients/index.html) and WorldWideScience (https://worldwidescience.org/) to limit your search to sources that are known authorities.

- You can also double-check claims and sources at debunking sites like Quackwatch (https://www.quackwatch.org/), the McGill University Office for Science and Society (https://www.mcgill.ca/oss/) and Snopes, which has specific sections on health (https://www.snopes.com/tag/health/), science (https://www.snopes.com/fact-check/category/science/) and medicine (https://www.snopes.com/fact-check/category/medical/). Remember that just because a claim hasn't been debunked doesn't mean it's true – these sources may just not have gotten around to it yet.

4. Make sure you've found the original source of a claim. People who promote fringe views on science and health will often seize on one legitimate finding or bit of data that *seems* to support their claim when it's taken out of context. Be careful to track these back to the original source to be sure you're getting the whole story.

5. Evaluate a source's authority before believing any of its claims. While it's not always possible to judge the reliability of a specific scientific or medical claim, it's usually possible to judge the authority of the person making it.

   - Being an expert gives a source authority online in a particular *subject*, so your first step is to make sure an expert's credentials are actually in the relevant area. If the claim is about climate, for example, make sure the source is an expert in that field.
   - You can find out a person's standing in the field by doing a search for their name on Google Scholar (https://scholar.google.ca/). Make sure they have publications on that topic.
   - You can also use Google Scholar to see if the article has been cited by other researchers. A recent article might not have been yet, but if an older article has very few citations – especially if it's making a strong claim – it suggests other scientists haven't accepted it.
   - If the research was published in a scientific journal, do a Google search for the journal's name plus the words "impact factor" to see if other scientists draw on it (anything above a 1 shows that the source is a part of the scientific community; if the search doesn't show an impact factor at all, that means the source isn't considered an academic journal.)
   - Consider whether the source might be *compromised*. Will they make money if you believe them? Are they being funded by someone who will make money if you believe them?
   - If the source is an organization, do a general search on them or look for a Wikipedia article. It's easy for a fringe group or "astroturf" (an organization that isn't open about its funding so it can look more neutral) to call itself a "Centre" or "Institute" and give its website a dot-org address, or to give itself a name very similar to a more legitimate source. If you're not 100% sure you recognize a source as an authority, double-check.

Reliable Sources

For this assignment, you will be choosing a health or science topic and finding a *reliable source* that you can use to fact-check information on that topic.

You may not use the sources listed in the *5 for 5: Five Things You Can Do to Get Good Info (in Under Five Minutes)* handout, but you may use those to *find* your source.

Use the steps in that handout to verify that the source you have found is a reliable source of information on your topic.

If you are unable to find a reliable source on your topic, you may consult me about changing topics.

If you would like to investigate a topic not on this list, consult with me.

When you have found and verified the source, write down the following information:

- The name of the source and how to find it
- The health or science topic for which it's a reliable source
- How you know it's a reliable source
- What steps you took to make sure it's a reliable source

Here are some possible topics. (Note that some stories will fit in more than one topic: for example, the octopus story would fit in both animals and astronomy, while a story about taking vitamins to prevent colds might fit both in diet and general health.)

- Alcohol, tobacco and other drugs
- Animal science, biology, genetics
- Archaeology
- Artificial intelligence and algorithms
- Astronomy, physics and outer space
- Child rearing and general parent advice
- Cybersecurity
- Diet and nutrition
- Energy
- Engineering and technology
- Environment (other than climate)
- Exercise
- Fringe science or science denial
- Gender and sex
- General health (wellness, disease prevention, vaccines, etc.)

- New treatments for disease or injury
- Psychology, sociology, neurology and behavioral sciences
- Public health (sanitation, food safety, etc.)
- Robotics
- Weather and climate

If you have concerns about your own physical or mental health, do not rely on online sources. If you don't feel comfortable talking to a health professional in person, contact your province or territory's telehealth line. You can see a list of these here: http://www.cwhn.ca/en/yourhealth/provincialhealthlines

You can also call Kids Help Phone at 1-800-668-6868, connect with their Crisis Text Line by texting CONNECT to 686868 or live chat at https://kidshelpphone.ca if you'd like to talk to a counselor.

Assessment Task Rubric

	Learning Expectations	***Achievement***
Use Skills and competencies that fall under "use" range from basic technical know-how – using computer programs such as word processors, web browsers, email and other communication tools – to the more sophisticated abilities for accessing and using knowledge resources, such as search engines and online databases and emerging technologies such as cloud computing.	*Finding and Verifying:* applies digital tools to gather, evaluate and use information locates, organizes, analyzes, evaluates, synthesizes and ethically uses information from a variety of sources and media *Community Engagement:* uses digital media to be part of a community exhibits leadership as a digital citizen	Insufficient (R) Beginning (1) Developing (2) Competent (3) Confident (4)
Understand "Understand" includes recognizing how networked technology affects our behaviour and our perceptions, beliefs and feelings about the world around us. "Understand" also prepares us for a knowledge economy as we develop information management skills for finding, evaluating and effectively using information to communicate, collaborate and solve problems.	*Finding and Verifying:* compares, contrasts and synthesizes information from diverse sources (triangulates information) before it is used in a knowledge-making process *Community Engagement:* understands how meaning is produced through multimedia (text, images, audio, video) and how culture is produced through the Internet and social media in particular	Insufficient (R) Beginning (1) Developing (2) Competent (3) Confident (4)
Create "Create" is the ability to produce content and effectively communicate through a variety of digital media tools. It includes being able to adapt what we produce for various contexts and audiences; to create and communicate using rich media such as images, video, and sound; and to effectively and responsibly engage with user-generated content such as blogs and discussion forums, video and photo sharing, social gaming, and other forms of social media. The ability to create using digital media ensures that Canadians are active contributors to digital society.	*Finding and Verifying:* uses digital technology to identify and define authentic problems and significant questions for investigation understands how meaning is produced through the news media (text, images, audio, video) and how culture is produced through the news creates new critical or analytical worlds *Community Engagement:* makes valuable contributions to the public knowledge domain (e.g. wikis, public forums, reviews)	Insufficient (R) Beginning (1) Developing (2) Competent (3) Confident (4)