Puttin' On the Ritz: How to Put Science Into Cases

By Clyde Freeman Herreid

Puttin' on the Ritz, a syncopated rhythm about dressing fashionably was composed by Irving Berlin in 1927. The song played a pivotal role in several motion pictures, earning a place in the hearts of Fred Astaire fans when it was most notably danced by Astaire in the 1946 film *Blue Skies*. Before that it debuted as an independent Tin Pan Alley hit and then was spliced into the 1930 eponymous movie *Puttin' on the Ritz*. It was burlesqued in the 1974 film *Young Frankenstein*, warbled in a 1984 episode of *Alvin and the Chipmunks,* and even today it can be found in the 2016 "Boop-A-Doo" album by the Swing revivalists, the Cherry Poppin' Daddies. Along the way the lyrics were changed to fit the times and fashions. Great tunes are like that; the themes are used over and over again, morphed and manipulated to fit into a story line. Producers always know they want the melody, but just how to plug it into a script is often the challenge. So too we find when a teacher writes a case study and covets a familiar chunk of science, she may struggle with how to mold it and insert it into the plot. This often is the hardest nut that the author needs to crack.

But not all STEM cases are chock-filled with science. That isn't their main purpose. *Trigger cases* are meant to stimulate interest in the topic (Herreid, 2009). They are given to arouse the emotions, to provoke curiosity, and to raise questions. They are presented to students at the beginning of a course module when they have limited information. Trigger cases set the scene for material to come later in the course. An example is the case dealing with genetically modified crops called "Torn at the Genes" (http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case_id=423&id=423), where a family is debating the merits and dangers of GMOs—not much information, but a lot of opinions. *Capstone cases* are another example; they are meant to summarize and coalesce knowledge, not deliver new information (Herreid, 2009). These cases come at the end of a unit, when students have a large amount of data at their command and thus can grapple with questions that are raised in the case in a new way. Surprisingly, the "Torn at the Genes" case is an excellent capstone case as well; if students encounter this case at the end of a biology course, they will have a deep knowledge of how genes are recombined. They will be much more able to deal with the health, environmental, and ethical problems the case presents.

It is only in *content cases* that we are primarily concerned about introducing science facts and principles. We can do this in a number of ways. We can present the science before, after, or during the case. Any of these practices can be effective, and there is no reason to believe that one method is better than the others.

1. Ahead of the case: This approach has a familiar ring to it. Oh, if we could only get students to read a chapter, listen to a lecture, watch a video, answer questions, or do homework before they come to class, then what wonders we could accomplish. Here is an example of how a case author has attempted to deliver the necessary science ahead of the case by providing a written summary of the devastating effects of cholera in Haiti. This furnishes the necessary background so that students can then participate in an active learning game in class that simulates the transference of the disease. See "Disease Along the River" (http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case_id=766&id=766).

Here is another sample capitalizing on the newest teaching fad, flipping the classroom: "A Decision to Branch Out: Evolution and the Domestication of Maize" (http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case_id=845&id=845). In this instance and in other flipped cases, the faculty tries to capitalize on the students' technological fancies by asking the students to watch a couple of short videos before class. To find out if the students have actually done their homework, they are given test questions that may be asked prior to class. The idea that students should prepare before class certainly isn't new, but development of the internet and YouTube videos has made the preclass assignment much more

practical. Recently, with the support of the National Science Foundation, the National Center for Case Study Teaching in Science has begun publishing cases such as flipped cases (Herreid & Schiller, 2013; Herreid, Schiller, Herreid, & Wright, 2014; Prud'homme-Généreux, Schiller, Wild, & Herreid, 2017).

2. After the case: Most case studies don't end at the end of the class period, especially if the topic is important. There are follow-up assignments and reflection pieces. Here is an example where we see science topics introduced both before the case and afterward: "Threats to Biodiversity: A Case Study of Hawaiian Birds" **(**http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case_id=449&id=449).

3. During the case: With few exceptions, case studies are not short stories. One primary difference is that the skill of the writer is seldom up to the job. Another is that some cases are not narratives involving people and their problems, with a beginning, middle, and end; they are simply spelling out an environmental or health problem that is described in an impersonal way. Even if there is a story, the students are likely aware of the author's heavy hand intruding into the tale by asking questions that jerk the reader back to reality. Here are a couple of examples of where the case sidesteps those pitfalls. In the first approach, science is delivered before the story actually gets into gear. In the second approach, if the skill of the author is up to the task, the science can be so subtly integrated into the story that the reader is not distracted but may absolutely plead for the facts.

(a) ***Deliver science in the first paragraphs*** as an impersonal narrative introduction giving the science background. The students are then challenged to develop a plan to deal with the problem. Look at "Restoring Resilience: Changing the Landscape Legacy in Patagonia" to see how it is done with a PowerPoint (http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case_id=765&id=765).

(b) ***Weave the science into the story line throughout the narrative***. This is perhaps the most seamless way to deliver the science—just blend it into the story. It is the most like a short story when all of the information is delivered at once. There are no interruptions to the narrative. This usually means that the teacher will hand out the case and then run a whole class discussion rather than use small groups. See "And What Now Ms. Ranger? The Search for an Intelligent Designer" (http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case_id=332&id=332). But here is a warning: Beware of having characters give long-winded speeches spewing endless scientific facts that the reader needs to know. Try not to have more than three sentences of lecturing before another character speaks, a dog barks, or a baby cries.

In contrast to these methods, in the following examples any chance for a sustained story is gone; the narrative is broken either with questions to the students or there is an abrupt stop when the author introduces ala *deus ex machina* a lecture, video, or essay with information that the students need to solve the problem. There is little hope that the power of a short story can be emulated—there are too many interruptions.

(c) ***Use questions throughout the case*** to draw attention to the science and force students to deal with them either verbally or by written reports. The technique called the Interrupted Case Method, the case method most favored among teachers, is used in the case called "Aliens on Earth? The Arsenic Life Affair" (http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case_id=708&id=708). Chunks of the story with science are delivered in bite-sized pieces with guiding questions.

"Breeding Belyaev's Pets: Domestication, Evolution, and the Farm-Fox Experiment" (http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case_id=733&id=733) does it another way. Again the case is delivered in sections using progressive disclosure of science, but this time it is done via a clicker case. The story line is conveyed by PowerPoint with questions interspersed throughout. Students are expected to answer the questions via personal response systems such as clickers or via cell phone connections, with the results displayed on a classroom projection screen. Obviously, with all of the technological intervention any semblance of the story is suppressed in deference to the classroom exercise.

(d) ***Deus ex Machina*****:** The Greeks originated this technique. Suddenly in the middle of a play when an insolvable problem loomed and all hope was lost, literally a trap door would open and dragon-drawn chariot sent by the sun god would careen on stage to carry Medina away to safety or a crane would deliver Hercules from the sky into a melee to save the day. So too, case writers sometimes need a quasi-miracle to solve a case dilemma. The action stops and suddenly the author supplies impersonal narratives interrupting the story line scenario to introduce additional information to help the students understand or solve a problem. This could be as a lecture, PowerPoint, or video, or as an essay. The case "Of Silt and Ancient Voices: Water and the Zuni

Land and People" (http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case_id=746&id=746) has numerous such interruptions with side bars and questions.

(e) ***Lab measurements provide the data.*** Some cases involve scientific lab work by the students. Here is one involving cocaine-contaminated money ($9,000) found in a bag carried by Willie Jones as he was boarding a plane. U.S. Drug Enforcement Administration agents confiscated the money under the federal Racketeer Influenced and Corrupt Organizations (RICO) Act. RICO allows the government to seize assets, such as money, that are suspected of having been used to commit crimes. Mr. Jones sued the government to return his funds, arguing that cocaine-contaminated money is common and that this finding does not constitute sufficient evidence to prove his culpability. In "Filthy Lucre: A Case Involving the Chemical Detection of Cocaine-Contaminated Currency" (http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case_id=298&id=298), students look for cocaine residues on their own currency using gas chromatograph/mass spectrometer measurements and then come to a conclusion about the guilt or innocence of Willie Jones, a man accused of the commission of crime.

(f) ***Problem-based learning (PBL)*** is a method where small groups of students, usually working with a facilitator, receive a written problem, learning about a patient with an unknown illness. They work together over several class periods to diagnosis the malady. They ask themselves: What do we know? What don't we know? What do we need to find out? They then disperse to find out the information and return another day to share their findings. At that time, they often receive additional data, and once more they ask what they know and don't know and again divide up the work to seek the answers. Usually at the end of the third session, they render a verdict. Obviously, in this PBL case method, the science is delivered both by the data the case author provides and (primarily) by the multiple sources from the literature that the students cull.

See "A Green Light for CFLs" (http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case_id=674&id=674). The case abstract reads: "In this problem-based learning case, three housemates in an environmentally themed college house debate the pros and cons of compact fluorescent lamps (CFLs) over incandescent lamps. The students raise issues of the cost difference between the lamps (both in the short and long term), energy use and greenhouse gas production in the manufacture and use of the lamps, and the mercury content in CFLs and the risks that poses to people and the environment."

A final example is another environmental case using PBL, "Corn Ethanol: Using Corn to Make Fuel?" (http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case_id=739&id=739). Complex cases in health and the environment are ideal to use with this method because large amounts of data must be packed into the case lasting over several days. The technique is particularly useful to develop library skills and to develop independent learners—students who know how to locate and evaluate information.

In short, there are multiple ways to put science into a case. Most disrupt the story line, but a fascinating compelling story line isn't the primary motive for using cases. The real purpose is to deliver a credible message, and that is best done in the context of a credible story. If it is memorable, so much the better, but the critical point is not that the story is real but that it *feels* real. And we should add that it teach some science. ■

Acknowledgments

This material is based on work supported by the NSF under Grant Nos. DUE-0341279, DUE-0618570, DUE- 0920264, DUE-1323355 and a Higher Education Reform Grant from the PEW Charitable Trusts. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the NSF and PEW Charitable Trusts.

References

Herreid, C. F. (2009). Trigger cases versus capstone cases. *Journal of College Science Teaching, 38*(2), 68–71.

Herreid, C. F., & Schiller, N. A. (2013). Case studies and the flipped classroom. *Journal of College Science Teaching, 42*(5), 62–66.

Herreid, C. F., Schiller, N. A., Herreid, K. F., & Wright, C. B. (2014). A chat with the Survey Monkey: Case studies and the flipped classroom. *Journal of College Science Teaching, 44*(1) 75–80.

Prud'homme-Généreux, A., Schiller, N. A., Wild, J. H., & Herreid, C. F. (2017). Guidelines for producing videos to accompany flipped cases. *Journal of College Science Teaching 46*(5), 40–48.

Clyde Freeman Herreid (herreid@buffalo.edu) *is a Distinguished Teaching Professor in the Department of Biological Sciences at the University of Buffalo, State University of New York. He is also the director of the National Center for Case Study Teaching in Science (NCCSTS; http://sciencecases.lib.buffalo.edu) and editor of the Case Study column in the* Journal of College Science Teaching.