CREATIVE VISUAL REPRESENTATION
Using science infographics to jump-start creativity in the classroom

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Constructing infographics, or visual displays of information, encourages student creativity in selecting a topic, strategically and visually organizing the topic, and sharing it with a public audience. The STEM Literacy through Infographics (SLI) project has partnered with secondary teachers to explore infographics in science classrooms and has found that student creativity is tied to their level of engagement, authenticity of work, and ultimately pride in their final product. We interviewed 15 teachers about their experiences with infographics and report here on their accomplishments—and on a few of their challenges.

Infographics present information or data in an easily accessible and concise manner to help a viewer understand a phenomenon. Creating infographics requires students to make sense of multiple sources of data and synthesize these data into a compelling visual form to make a central claim. Unlike posters, which tend to be purely informational with disjointed facts, news infographics are journalistic, make an argument, and have an overarching message.

In general, parts of a poster need not relate to one another, but the parts of a good infographic (e.g., graphs, data representations, and visual and textual elements) tell a bigger story that is important to its intended audience. Additionally, infographics allow for multiple cycles of revisions not available with posters, so students can fine-tune their message. As students try to reason with a broader audience, they make decisions about clarity of concepts, visualizations of data, and even emotive elements of design that deepen their comprehension of their topic. Infographics fit nicely into student-driven project-based learning (Krajcik 2015) and problem-based learning frameworks (Strobel and van Barneveld 2009). Research in science classrooms has shown infographics support students’ data literacy and representational competence (Gebre and Polman, 2016).

SLI investigated how infographics-based journalism encourages young people to use mathematical reasoning and visual representation to make sense of and communicate science data and ideas. We provided professional development on classroom infographics implementation to 17 secondary teachers. We researched their classroom practices related to infographics to help create additional resources to support infographics instruction. At the end of the academic year, we interviewed 15 of the teachers regarding their thoughts related to the process. Figure 1 provides a list of the different science disciplines taught by the teachers interviewed for this article.

The majority of teachers interviewed for our project chose to incorporate infographics into their classrooms because they were looking for innovative and creative ways for students to demonstrate their knowledge of new concepts and events. Not only do infographics bring a new activity into the classroom to inspire students, but they also encourage numerous practices that are part of the Next Generation Science Standards (NGSS Lead States 2013), including Analyzing and Interpreting Data, Using Mathematics and Computational Thinking, and Obtaining, Evaluating, and Communicating Information.

Getting started: Picking a topic
The first step in implementing infographics in your classroom is deciding the purpose of the infographic and whether the activity will be in addition to your other activities or if it will replace an assignment. Some teachers in our project assigned infographics instead of research papers, others used them instead of traditional science fair posters, and some saw them as tools to reinforce particular content. The purpose of the infographic will influence how creative students can be in selecting a topic.

An open-ended assignment, such as one that would replace a traditional research paper, allows students to pick a topic meaningful to their lives, and is limited only by students’ imagination. In one example from a chemistry teacher who encouraged her students to investigate the chemistry of everyday objects, students submitted infographics on the chemical composition of Silly Putty, gummy bears, and substances that influence sleep such as melatonin and caffeine. A forensic science teacher used infographics in lieu of a final paper, and students explored a mixture of topics, such as the difference between psychopaths and sociopaths and the history of a known serial killer. Infographics have the potential to

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**FIGURE 1**
Different science disciplines in STEM literacy through infographics.

<table>
<thead>
<tr>
<th>Anatomy</th>
<th>Ecology</th>
<th>Physical Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology</td>
<td>Environmental Studies</td>
<td>Physics</td>
</tr>
<tr>
<td>Chemistry</td>
<td>Forensic Science</td>
<td>Physiology</td>
</tr>
<tr>
<td>Data Analysis</td>
<td>Genetics</td>
<td>Statistics</td>
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<tr>
<td>Earth Science</td>
<td>Nutrition</td>
<td>Zoology</td>
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</tbody>
</table>
support a wide array of topics, including how science relates to broader social and cultural concerns.

Teachers also instruct students to create particular types of infographics. Examples include: a zoology teacher who required her students to create infographics to encourage the public to visit the newly built aquarium in their city; an anatomy teacher who had students create an infographic about a disease’s effect on the human body; and a chemistry teacher who had students select an element from the periodic table and tell a story about it. Our teachers report being amazed at students’ creativity even when given the same topic.

One teacher reported, “My favorite aspect was seeing how creative the students were. How even students who took the same subject came up with three different ways to visualize it and to represent the data.” Even in classes where topic selection is restricted, infographics allow students to express themselves in unique ways because they go through iterative processes of synthesizing data and designing the final infographic.

It is important to be aware that different schools have different policies regarding cybersafety; when students are researching topics, internet safety issues should be addressed alongside issues of data credibility.

**Iterating on data and design**

A powerful infographic can convince an audience of an argument or can evoke a new response to a phenomenon. One way students build strong arguments is by taking multiple sources of data and finding interrelationships that are not apparent from one source alone. As a genetics teacher said, “my favorite part was seeing how students could create something unique by taking data and portraying it in a way I hadn’t seen before.”

One student infographic examined sleep deprivation in teens (Figure 2). The student originally wanted to know if sleep affects grades and why teens don’t get enough sleep. Her data and final infographic showed that only 1% of teens come close to getting the recommended amount of sleep, and that increased sleep correlates with higher grades. Sleep deprivation is also correlated with increased suicide risk. Given time spent at school, extracurricular activities, and homework, teens would have no more than 45 minutes of free time were they to get the recommended amount of sleep. Her infographic became more than just a statement about sleep—it also showed how scheduled and stressful teen lives are.

Data collection and exploration provide instructional opportunities to help students evaluate whether data are reliable, unbiased, and trustworthy, as well as what data are needed to answer a research question. For example, the student who researched tired teens told her instructor that only about 10% of her research made it into the infographic. With guidance from facilitators, she cited reputable sources, such as peer-reviewed articles, and all of her data was easily verifiable. However, the student also pointed out that the research she cited was conducted at different times between 2006–2016, leading her to question whether you can generalize about all teens: are teens in 2018 the same as teens from 2007? Learning to recognize reputable data and the ways in which data are used...
to make arguments lead students to be more critically aware of how information is presented in their daily lives.

We encourage teachers to allow for iteration in the infographic design and provide students the opportunity to get feedback from peers, instructors, and external experts or editors if possible. Feedback helps students recognize and improve upon their own thinking from a metacognitive perspective. As one teacher said, “my favorite part would be either me talking to kids, or kids talking to each other, about their work as they were doing it. Why are you doing this, and how is this going to work? What’s missing here? I don’t understand what you’re trying to say.” Students then refine their data and/or rethink how it is displayed.

Printing out the infographic full-scale and in color is a fun way to help students see their argument from a new perspective. Although printing is not available for all teachers, we include ways to share infographics on our website, where you can also find additional tips on how to guide students through the entire creation process (see “On the web”). If you can print in color, it helps students decide if they chose the right color or placed a data visualization prominently to make their argument.

Allowing for multiple cycles of revision provides students the opportunity to do their best and learn from each iteration. In particular, when students submit their work to an external editor or expert, they get challenged in unexpected ways; outsiders see things teachers and peers do not. For example, an outsider with graphic design expertise (such as a media arts teacher at your school) might encourage an extra graphic over text or a different layout, whereas an outsider with science expertise (such as an interested scholar from a nearby university) might suggest another useful source.

One student was encouraged to change her title from “The Rise of Anxiety in Students” to “The Hidden Suffering of Students with Anxiety” (Figure 3) because her infographic explained more than the fact that anxiety was on the rise. In our experience, students generally respond well to the feedback they receive. One teacher said that the final infographic product represents “several divergent lines of student thinking” and when a student is satisfied with his or her final product, “they take a lot of pride in it.” Many teachers we interviewed discussed how students were proud and took ownership of their work. We believe this is due in part to encouraging infographics to be public-facing and not just between the teacher and student.

Making it public

Students are encouraged to share their infographics with each other while they are creating them to get feedback. We also encourage teachers to give students the opportunity to display their infographics publicly. There are a variety of creative methods to do this, including publishing in the student
newspaper, organizing a “gallery walk” for other classes and/or parents, submitting to an online infographics contest, and publishing online. All of these options bring authenticity to the student work that might not be present when they turn in a final project only to be seen by the teacher.

We have seen infographics used as public service announcements for student communities. One teacher challenged her students to make infographics on how STEM can help end poverty. Students see infographics as an opportunity to teach their peers about issues they may be unaware of. One student wanted her peers to know that teens should think about fertility preservation if they have to undergo cancer treatment; another student demonstrated that concussion rates are higher for females across sports other than football. In each of these examples, student creativity is extending beyond the classroom to contribute to larger societal conversations, and students like to be recognized for their contribution.

A gallery walk is one way for students to get recognition. In this activity, some teachers print and display final infographics, while others have each student open their infographic on a computer monitor. In both cases, other students or visitors from outside the class read and provide comments to the student author, who is generally standing next to his or her infographic. One teacher commented that this activity was a great conversation starter between parents and students on controversial topics that teens are interested in, ranging from climate change to sex education in health class. Another teacher said this activity let students share their “personal feelings” and connect to their topic. Again, teachers reported that students were proud to share their work beyond the classroom.

Other considerations and potential challenges

The teachers in our project all reported success implementing infographics in their classes, but, as with all project-based learning, there are challenges teachers face. When we asked specifically about challenges, we heard many of the usual answers, including not having enough time to do all the things teachers had planned, as well as worrying about covering all the grade-level content. Aside from general instructional challenges, three categories of challenges are worthy of mention: data, software, and design expertise.

Teachers want students to have access to data that is readily available, up-to-date, and from a reliable source. To ensure this, one health sciences teacher had students track their own eating habits for macronutrients and calories. Reported anonymously to ensure privacy, these became the data set for the whole class. For teachers who do not want students to generate their own data, we provide a list of possible data sources that include government websites such as the Centers for Disease Control and Prevention, as well as discipline-specific sites such as the U.S. Geological Survey’s water quality data (see “On the web). Some credible data sources on the web will require processing and structuring data for analysis, and although this is a new skill for many high school students, it is increasingly relevant to the many fields in the data sciences and other data-rich STEM endeavors.

Information to help with other challenges can be found at the project’s website as well. Some teachers expressed having a
Connecting to the Next Generation Science Standards (NGSS Lead States 2013)

Standard
Varies by Infographic Project

Performance Expectations

- The chart below makes one set of connections between the instruction outlined in this article and the NGSS. Other valid connections are likely; however, space restrictions prevent us from listing all possibilities.
- The materials, lessons, and activities outlined in the article are just one step toward reaching the performance expectation listed below. Since infographics as described in this article are open-ended creative representations, they can be used to address and support many different standards and performance expectations. In the chart below, we stress the science and engineering practices and crosscutting concepts most frequently addressed, but since the disciplinary core ideas can vary so greatly, we do not specify those or any particular performance expectations.

<table>
<thead>
<tr>
<th>DIMENSIONS</th>
<th>CLASSROOM CONNECTIONS</th>
</tr>
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<tbody>
<tr>
<td>Science and Engineering Practices</td>
<td>Students are expected to gather, analyze, and interpret data to understand the issues and questions they are examining in their infographic.</td>
</tr>
<tr>
<td>Analyzing and Interpreting data</td>
<td>Students use mathematics such as descriptive statistics to make sense of and/or summarize quantitative data, to understand trends and patterns.</td>
</tr>
<tr>
<td>Using Mathematics and Computational Thinking</td>
<td>Students gather information and data, and design visualizations of that information and data, in order to communicate to an audience.</td>
</tr>
<tr>
<td>Obtaining, Evaluating, and Communicating Information</td>
<td>Teacher assists students in making connections to various disciplinary core ideas, depending on the topics chosen.</td>
</tr>
</tbody>
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Disciplinary Core Idea
Varies by Project

Crosscutting Concepts

Patterns
Students analyze and visualize data to understand and convey patterns.

Scale, Proportion, and Quantity
Students make use of scale, proportion and quantity to understand and convey the scope of a phenomenon, costs, or risks to populations.

Systems and System Models
Students create and test qualitative visual models that describe system properties, and inform the narrative and messages they convey.

Connecting to the Common Core State Standards (NGAC and CCSSO 2010)

ELA/Literacy
RST.11–12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
RST.11–12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
RST.11–12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
learning curve using infographic-creation software. There is a growing array of free and “freemium” (free with additional features available for a subscription, sometimes with educator discounts) web-based infographics authoring tools, such as Venngage, Piktochart, Easel.ly, Canva, or Infograph; our website provides a Consumer Reports–style guide to these software programs.

In addition, infographics can be made in software readily available at most schools, such as Microsoft PowerPoint or Google Slides. Likewise, teachers reported feeling challenged providing design advice, but in addition to tips on our website, it is important to remember that students are getting a chance to show their creativity while learning and communicating science, and teachers can take a step back and let them. It’s okay to fail forward. Infographics support being active and reflective on the process, which is a skill all students should have.

Conclusion

Through the activity of constructing infographics, students engage in the creative pursuit of becoming scientifically literate, but not creativity for creativity’s sake. Rather, infographics serve as a novel way to make students’ thinking visible that also inspires students to be proud of their thinking. Infographics are a great option for all science teachers seeking more creativity in their classroom.■

ON THE WEB

Project website: http://science-infographics.org/
CDC Wonder: https://wonder.cdc.gov/

REFERENCES


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