



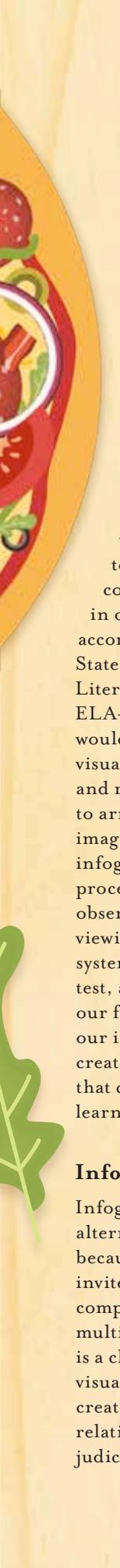
Recipe for an *Infographic*

“A creative process may begin with a flash of a new idea or with a hunch. It may just start as noodling around with a problem, getting some fresh ideas along the way. It’s a process, not a single event, and genuine creative processes involve critical thinking as well as imaginative insights and fresh ideas.”

—Sir Ken Robinson (2009)

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America's Test Kitchen, located just outside of Boston, strives to develop absolutely the best recipes for popular dishes. Staff members test each recipe "30, 40, sometimes as many as 70 times, until we arrive at the combination of ingredients, technique, temperature, cooking time, and equipment that yields the best, most-foolproof recipe" (America's Test Kitchen 2014). Inspired by their patience and precision, we decided to develop a teaching recipe that would consistently engage students in open-minded inquiry. In accordance with Common Core State Standards CCSS.ELA-Literacy.CCRA.R.7 and CCSS.ELA-Literacy.CCRA.R.8, students would select and weigh textual, visual, and quantitative evidence and reason dispassionately in order to arrive at a unique synthesis imaginatively presented in an infographic. We have begun the process: testing many ideas, observing lessons in action, and viewing student products. As systematic "bakers," we expect to test, adapt, review, and learn from our failures. We invite you into our infographic kitchen to help us create an instructional sequence that consistently yields high-quality learning for students.

Infographics, Not Posters

Infographics can be engaging alternative products of research because the multimodal format invites students to make sense of complex information by applying multiple literacies. An infographic is a claim expressed through visual metaphor, conveying the creator's fresh understanding of relationships, expressed through a judicious selection and arrangement

of visuals, evidence, and text acquired during inquiry research within a discipline.

However, as we looked into classrooms, searched the Web, and spoke with classroom teachers, we learned that most infographic assignments resulted in what we would label as posters. Essentially, these products were the equivalent of David Loertscher's "bird reports"—representations of loosely related facts and numbers, sometimes verified and paraphrased, displayed visually. We hypothesized that the student engagement enthusiastically reported by teachers came primarily from using novel technology, not from inquiry learning. If we were to devote time to teaching infographics, the product must be more than an attractive visual collage of statistics and facts; it should demonstrate understanding (per CCSS.ELA-Literacy.CCRA.W.7).

Inquiry, Not Advertising

For guidance we looked first to applications outside school settings. We observed that many popular infographics were advertisements that, subtly or not so subtly, cherry-picked evidence to persuade a target audience of a predetermined conclusion. The designer was not hired to investigate an issue, nor was the purpose of the infographic to invite an audience to think through alternative solutions to a problem. Rather, these real-world infographics employed selectively shaped evidence to support one-sided reasoning. The audience "buys" (a product, idea, or belief) based on a delightful design—an aesthetic response that doesn't consider alternative viewpoints or question the premises.

We contend that students are doing too many of these persuasive infographics; schools cannot simply

become training grounds for advertising and marketing agencies. We believe that assigning persuasive infographics encourages the equivalent of the "backwards" paper in which students first arrive at an *a priori* conclusion and then write the paper, and, finally, search for sources to support their claims and pad their bibliographies. Indeed, if there was one inquiry disposition we especially wanted to develop in our students, it was an open mind. The key lay in instructional design.

Argument, Not Persuasion

The shift in our thinking from persuasion to argument enables us to describe our ideal infographic assignment as an opportunity for students to open-mindedly explore a complex problem (per CCSS.ELA-Literacy.RH.11-12.7) using disciplinary and new literacies. We imagine a process in which students develop a research question within a domain, investigate a variety of claims and evidence wherever they lead, play with connections and assess contradictions, and wonder about the possible significance of their findings (per CCSS.ELA-Literacy.CCRA.W.8).

Not only will students experience a discovery process and acquire disciplinary knowledge, but they will also analyze different options, construct a logical argument, reason through examples and analogies using multiple literacies, and learn that complex problems have qualified solutions from which new questions naturally arise. Well worth the effort, the result is an "ah-ha!" for both the creator and the audience.

One way to reframe this teaching challenge is to think about a specific purpose, genre, and product—in much the same way as the president's advisors develop their daily briefing

for him each morning. They offer their expert judgment by synthesizing complex issues and representing the strength of various positions honestly to provide the president with a complete brief so that he can make an informed decision.

Rather than suppress rebuttal evidence, disguise commercial motives, or manipulate an audience's self-interest or identity, we would like students to presume that, like the president, members of their audience want coherent information, fairly presented, so that they can reason through the curated evidence in order to understand and evaluate the merits of the claims. This is sense-making, not opinion-making (per CCSS.ELA-Literacy.RI.7.8).

Real-World Models

In real life we see argument infographics in investigative news, scientific papers, research studies, policy papers, and technical reports. *The Upshot* column edited by David Leonhardt for the *New York Times* <www.nytimes.com/upshot> and the *FiveThirtyEight* blog by Nate Silver and others <<http://fivethirtyeight.com>> are examples of conversationally written arguments in social media that use infographics to invite an educated reader into dialogue with the author and his sources. Rather than "eye candy—luscious but not nutritious" (Abilock, Bergson-Michelson, Fontichiaro, and Seroff), their visualizations employ photographs, charts, and graphs to elucidate ideas better than words alone can do.

As we began our own inquiry journey into instructional design, we wondered if we could craft an assignment that included a series of feedback loops so that students would create an *argument* infographic

i wonder...

of substance (per CCSS.ELA-Literacy.CCRA.W.8). For that achievement we needed to think more about the teacher's learning goal and how it would be assessed.

Time for Friction

The basic premise that emerged from our conversations was that the majority of student time should be spent prior to constructing the infographic. We identified teaching interventions, four key opportunities for "friction," where we could slow students' thinking (Abilock 2014a):

1. Craft a working inquiry question through exploratory pre-research.
2. Re-research and curate relevant sources to follow other lines of inquiry, harvest potential sub-questions, and identify common knowledge.
3. Select and closely read key resources to pinpoint disagreements and assess relative authority.
4. Extract essential notes, then re-read, annotate, and tag ideas, evidence, and data to compare and organize them.

From Topic to Inquiry

Many school and college librarians hope that the instructor's assignment will position students for inquiry. In reality, whether students are doing college research or second-grade animal reports, they often come to the library with broad topics. Jay Joel Burkholder,

instruction librarian and assistant professor at York College of Pennsylvania, shared with us that his business school students define their assignment as "to research a company." We've seen equivalent assignments in K-12 schools such as "Pick a topic from any time period we've studied this year..." or "Write about climate change." Students dutifully attempt to interpret these instructions, but, without the benefit of careful instructional scaffolding, they are unable to narrow the scope and uncover a topic that is both interesting and doable.

To gain teacher buy-in for reworking their assignments, Kristin Fontichiaro suggests somewhat tongue in cheek that we model the student's search process for the teacher:

If the teacher stands firm on dehydrating a source into discrete facts and then rehydrating those facts into an essay, it can be illuminating to model a sample student search: 'So, to research this, a student would search for... and then he'd click on the first link... aha! There's the answer! Yipes! That was awfully fast. Is that what you were hoping for?' (2014, 50)

Connie, a school librarian at Petaluma High School, respectfully requests a meeting with the



What Is an Argument? (CER+A)

Claim/thesis

Backed up with Evidence

Reason why the evidence supports the claim

Alternatives to consider (Rebuttal)

teacher before the infographic is assigned. She explains that, if they can identify the learning goal—for example, how the infographic demonstrates students' understanding of a big idea taught during the unit—she will be responsible for helping students develop a question that focuses on making new connections within learned material or applying the big idea in a novel way (Wiggins and McTighe 2005, 163). Debbie, the other author of this article, has identified infographics and student work (Abilock 2014b) that can help educators define high-caliber work and craft lessons that result in quality argument infographics rather than “eye candy” visuals. She conducts professional workshops for educators and librarians with “EyeCandyShop Thinkers” Kristin Fontichiaro of the University of Michigan, School of Information in Ann Arbor; Tasha Bergson-Michelson, instructional and programming librarian; and Jole Seroff, director of library and information services, both of Castilleja School in Palo Alto.

When advance consulting isn't possible, Connie has begun offering a version of “concierge service” (Abilock, Fontichiaro, and Harada 2012), working one-on-one with students by appointment on any aspect of their research. As she guides a student through a pre-focus

exploration (Kuhlthau 2004, 47) to stimulate initial wondering, she may pull an encyclopedia article for a “read-through” to seed questions based on themes, single events, or interesting people. If she senses that a student is apathetic about a chosen question, she will ask motivating sub-questions related to a student's personal interests so that, rather than taking notes, the student begins to take note of how, for example, sports or clothing styles might have been influenced by attitudes toward race or gender during an era.

The challenge of an inquiry process is moving from meandering “wonders” toward focused questions while maintaining the student's motivation. A number of general questioning strategies have emerged from literacy research to steer instructional winnowing. Cornelia Brunner (quoted in EDC 2012) modifies Donna Ogle's K-W-L questions (1986) to frame that process:

- What do I want to know about this topic?
- What do I need to know?
- What do I know already, and how do I know it?
- What might a possible answer be?

Gayle Gregory and Amy Burkman propose alternative wording for the

first question: “What do I think I know?” (2012, 108).

Violet H. Harada, emeritus professor, Department of Information and Computer Science, University of Hawaii at Manoa (quoted in Fontichiaro 2014, 50), suggests Cloze questions that scaffold a type of thinking (e.g., compare and contrast, cause and effect):

- How would _____ be different if there had been no _____?
- How would _____ have changed _____?
- How did power impact _____?

Deborah Levitov, previously a school librarian and coordinator of library services in Lincoln, Nebraska, who is currently the managing editor of *School Library Monthly*, recommends a traffic light metaphor of red light (convergent) versus green light (divergent) to frame students' self-assessment of their researchable (green light) questions:

- Does your question lead you to more information?
- Are you asking “why” or “what if”?
- Does your question make you investigate further?
- Does your question make you think of more ideas? (2009)

The Missing Piece: Authentic Context

What is absent from these questioning strategies is recognition of the necessity for a *genuine* audience or *authentic* disciplinary purpose, precisely those elements that can motivate students to care about their topic and process.

Therefore, when creating an argument infographic, the student's working questions must address five elements:

1. Who is an **audience that cares** about this problem?
2. What is the **problem or issue** that they care about?
3. What **choices, options, or trade-offs** will they need to consider in order to make a decision?
4. What **types of thinking** will you have to do to organize the information you gather?
5. What **content have you learned** that you can draw on?

We recommend that students use our Infographic Question Matrix (figure 1) to compose each of their draft questions so as to ensure that

all five elements (audience, problem, choices, thinking, and content) are addressed. In particular, the type(s) of thinking they expect to do informs how students will organize their information in preparation for synthesis.

A common misconception is that inquiry starts with an immutable, clearly formulated question. On the contrary, the question evolves during inquiry. Our matrix elements and the corresponding questions were revised multiple times based on what we learned during pre-search and re-research. Students must be encouraged (and even celebrated) as they continue to refine the wording in their cells, including the **thinking** category, as they evaluate source authority, weigh evidence, and organize facts, images, and data.

Scaffolding Synthesis

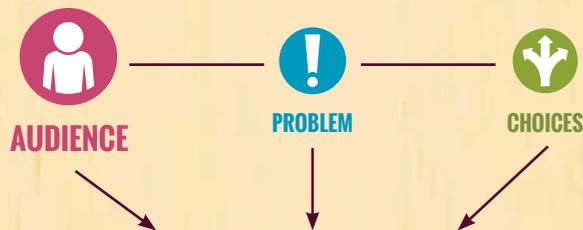
Inquiry—sometimes messy and even meandering—requires a systematic way to manage ideas, data, and other information as students uncover connections and perceive new patterns, evolving toward synthesis (Abilock 2014b). If we expect students to *think* (as opposed to just organize by keeping quotes connected to citations), they must sift, order, compare, and evaluate

their notes multiple times. Students working offline can use sticky notes or paper note cards of different colors to make notes and organize them into various categories. Online note cards enable students to tag by color, process, and keyword criteria (names, concepts, themes). By flexibly organizing notes in combination, then regrouping, and sorting categories into thinking diagrams, students will develop additional sub-questions for their outline.

As they review their notes, students may find that they started out with cause-and-effect reasoning but are now comparing and contrasting information. Re-reading, annotating, evaluating—and then tagging, ordering, reordering—help them identify the strongest evidence for their claims. It enables them to construct a reasoned argument that is understood by and useful to a specific audience for a particular purpose. When combined with the teacher's and librarian's just-in-time, right-in-place formative feedback in online note cards, students experience the necessary "friction" that will result in the deliberative thinking essential for inquiry research.



Example One: Infographic for a U.S. Government Class



Working Question:
What **options** do **undocumented**
immigrants have to **gain legal status**?



Infographic Question Matrix

AUDIENCE	PROBLEM	CHOICES	THINKING	CLASS CONTENT
Example One: An infographic for a U.S. government class				
Undocumented immigrants	Legal status	Legal options	Enumerate, describe	Immigration policy
Working Question: What options do undocumented immigrants have to gain legal status?				
Example Two: An infographic for a school recycling initiative				
Our town	Treating consumer electronics waste	Economic trade-offs	Compare and contrast, ranked results	Recycling
Working Question: What economic trade-offs should our town consider for treating consumer electronics waste?				
Example Three: An infographic for a health education class				
Doctors	Bacterial resistance to antibiotics	Treatment options	Cause and effect, classification	Wellness (health education class)
Working Question: How might doctors reason through their treatment options to minimize bacterial resistance to antibiotics?				
Example Four: An infographic for a world history class				
Sunnis and Shiites	Sectarian violence in Iraq	Conflict resolution options	Problem(s) and solutions, compare and contrast	Northern Ireland conflict
Working Question: How might the provisions and process of crafting Northern Ireland's Good Friday agreement provide Sunnis and Shiites with strategies and solutions to sectarian violence in Iraq?				
Example Five: An infographic for an elementary school unit on bees				
My parents	Bees dying off	Best plants for my yard that I can help grow	List, evaluate, rank	How honeybees get their food
Working Question: What are the best plants to grow in our yard that my parents and I can plant to give honeybees the food they need to stay healthy?				

Figure 1. Infographic Question Matrix to structure students' thinking about the components of an inquiry question.

Translating Thinking into Design

Essentially an argument infographic is intellectually designed as a coherent and creative response to an inquiry question. The next task is to organize information visually. Many educators steer students to Richard Saul Wurman's LATCH acronym (Location, Alphabetical, Temporal, Categorical, and Hierarchical) (2001). If a student is merely rehashing ready-made information on a poster or pushing a preconceived position into an infographic, LATCH is sufficient because its purpose is to shape the design *output*. It does not help students organize the *thinking that they must do before choosing a fitting display to communicate it*. For example, the "A" (alphabetical organization) is, by nature, random and likely to result in forced connections, a shortcoming often evident in picture-book alphabets. On the other hand, while an alphabetical design doesn't work for an entire infographic, an alphabetical *index* can provide quick access to definitions of specialized vocabulary (What does *afforestation* mean?) or symbols (What does N₂O stand for?) or as a legend for a map in one section of an infographic.

In contrast, we propose using an Infographic Design Matrix (figure 2) to scaffold students' use of evidence for each question and sub-question prior to visualizing an overall design. This second matrix prepares students to create what we're naming an Infographic Storyframe, a rough-draft design of a final infographic.

Scaffolding Visual Design

When the student is ready to make design decisions, the Infographic Storyframe uses a combination of **storyboarding** and **wireframing** to

plan the graphic design of the final visual product. A storyboard is a *progression* of squares that sequence the images in a video, photo shoot, multimedia news story, puppet show, or other type of storytelling. A wireframe visually maps the *relationship* among elements on a proposed webpage or website. For an Infographic Storyframe the student uses sticky notes on paper; the notes are connected by lines, arrows, circles, etc. to plot the *progression and relationship* of the elements within the confined space of the infographic.

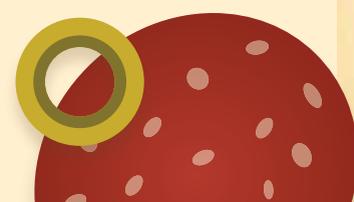
Continue to encourage students to experiment—this time with reorganizing their storyframes multiple times to test which display best addresses their infographic questions. Provide opportunities for audience feedback. For example, teachers can orchestrate a gallery walk to elicit peer feedback. Or pairs of students can exchange storyframes without the corresponding inquiry questions so that each student can speculate about the question that their partner's infographic draft addresses. By giving students access to multiple sources of feedback on their paper design, you deepen their thinking and motivate them to do high-quality inquiry *before* they become wedded to a single attractive format for their digital product. In addition, the subject-area teacher can use the storyframe to assess content knowledge and provide low-stakes feedback before the polished infographic is holistically assessed with a rubric.

Invitation to Cook with Us

As part of our workshops and presentations over the past two years the EyeCandyShop thinkers have been refining a rubric <<http://bit.ly/EyeCandyRubric>> (Abilock, Fontichiaro, and Bergson-



Stephanie (name changed) is working on an infographic for AP U.S. History about the Columbian Exchange. She believes that she will show that Columbus had an immense impact on the natives he encountered but that their impact on him and, ultimately, the rest of Europe was minimal. She has facts and ideas on how to present those facts, but, as she begins to associate the facts she has with discrete images, she realizes that the discoveries that Columbus brought back to the "Old World" indeed made an impact. Her infographic changes from being a critique of colonization to one about how cultures clash, change, and learn from one another. Her new visualization would never have come about if she hadn't been encouraged to keep an open mind and to take time to "play" with her notes.



Infographic Design Matrix

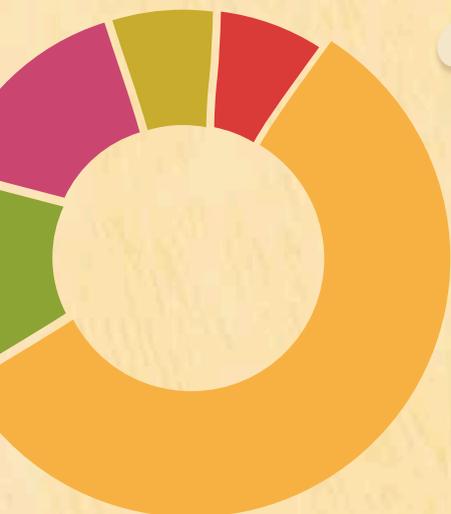
INQUIRY QUESTION	SUB-QUESTIONS	ORGANIZING INFORMATION	VISUALIZATION WITHIN THE INFOGRAPHIC	INFOGRAPHIC DESIGN
<p>What is the single driving question that my information answers? Who needs this information?</p>	<p>What sub-questions help me mine data and evidence for my question?</p>	<p>How might I organize each pile of evidence to help me synthesize my thinking about each sub-question prior to deciding how to display it in a section of an infographic?</p>	<p>What is the best way to display that specific sub-synthesis in my infographic?</p>	<p>(Storyframe) What metaphor or visualization or design coherently presents my entire inquiry question to that audience?</p>
<p>What options do eco-tourists in California have to view orca whales and learn more about their behavior in captivity and in the wild? (Audience: Tourists in CA)</p>	<p>Are whales smart? How do the brains of humans and orcas compare? Do orcas act differently in captivity than in the wild?</p>	<p>Parallel columns to record the function and volume of each brain region and the percentage of the whole that each region occupies in each animal Parallel columns to compare behaviors they would see</p>	<p>Two brain maps show the regions by volume with matching colors for similar functions for a human and an orca whale Pictures of orcas in different locations connected to a map of California</p>	<p>Might a geographical map with place markers and legends be useful to tourists? What about a large tourist poster? Maybe everything fits inside the shape of an orca whale? A tour bus or boat?</p>
<p>How can we reduce the crime rate in East Palo Alto? (Audience: Palo Alto and East Palo Alto town council members)</p>	<p>Why does the number of crimes increase in densely crowded, poorer neighborhoods?</p>	<p>Matrix to collect information by neighborhood in columns for population density, median housing prices, and crime incidents</p>	<p>A graduated circle map showing clusters of crime incidents by neighborhood (Midtown, Professorville, College Terrace, etc.), with population density shown by color and median housing prices in the legend</p>	<p>Student brainstorms</p>
<p>Do we have an effective plan for managing injuries from a terrorist act within the United States? (Audience: Department of Homeland Security)</p>	<p>How does a hospital decide what type of injuries to treat first?</p>	<p>Flowchart showing triage options by steps</p>	<p>A decision tree to show how triage works in a hospital emergency room</p>	<p>Student brainstorms</p>
<p>How could we translate <i>A Prayer for Owen Meany</i> into a movie? (Audience: Movie producers)</p>	<p>How does the order of the events contribute to the understanding of the main characters?</p>	<p>Timeline to sequence the order of events with notes about Owen's and John's character development and relationship</p>	<p>A storyboard of the selected flashbacks</p>	<p>Student brainstorms</p>
<p>What lessons can Hebei Province learn from our industrial revolution? (Audience: President Xi Jinping and the Chinese government)</p>	<p>How did technology inventions affect the way that our country grew and changed?</p>	<p>Fishbone for the causes and effects by type</p>	<p>A display of the effects of our industrialization under snippets from actual news stories about China's industrial problems</p>	<p>Student brainstorms</p>
<p>Should child offenders be sentenced to life without parole? (Audience: United States Congress)</p>	<p>How does the United States court system currently handle appeals from local court decisions?</p>	<p>Hierarchical diagram with flow chart lines</p>	<p>A chart of the process for appealing decisions from lower courts up to the Supreme Court</p>	<p>Student brainstorms</p>
<p>What dog should you get me for my birthday? (Audience: My parents)</p>	<p>Which dog is best for a family with a small apartment and young children?</p>	<p>Venn diagram to compare types of dogs by three criteria</p>	<p>Pictures of dogs grouped by signs (e.g., "Easy to Train," "Small Size," and "Low Shedding").</p>	<p>Student brainstorms</p>

Figure 2. An Infographic Design Matrix to structure students' thinking about how parts of the display will address questions and sub-questions.

Tools to Make an Infographic

TOOLS	WAYS TO VISUALIZE DATA	EASE OF USE	THE GOOD	GOOD TO KNOW
Google [drawing tools] PowerPoint	Both of these use drawing tools to create posters / infographics	Have standard drawing tools; once you know how the tools work, the files are easy to reuse	Download images, use text boxes; a myriad of options are available	Create in Google and save to your drive. PowerPoint: A single slide with flexible drawing tools
NCES	Graphs	Designed for younger students; easy to use	Many graph templates provided	Having previous knowledge of how graphs work will help
Chart Chooser	Charts	Knowledge of Excel important	Many choices	If you don't know Excel, learning will take time
Infogr.am	Graphs	Easy to use, especially if you have data ready to go	Can download charts	Easily sharable
Easel.y*	Variety of visualization options	Drop and drag visual is intuitive; no previous skills required	Text and images are simple and can be manipulated to create various "looks"	Completed infographic can be downloaded for printing; has an easel.y "look" to it
Piktochart	Allows you to choose a variety of presentation styles	Intuitive editing options	Many themes available in the free version	Only Pro allows for download; make screenshot or share via social media
Dipity*	Timeline maker; social media timelines	Allows inclusion of events, images, and text	Integrates Web information easily	Online only

* Easel.y was named an AASL Best Website in 2013; Dipity was named an AASL Best Website in 2011.



AASL Infographic Contest

AASL is hosting an infographic recipe contest for adults.

Craft your own infographic to teach students how to create an infographic as a product of inquiry. Post your submission on AASL's Facebook page at www.facebook.com/aaslala. Test the rubric <http://bit.ly/EyeCandyRubric> on your submission and post your feedback as part of your submission. AASL members will then vote for the entry they think best displays how to create an infographic through inquiry. The winning entry will be featured on AASL's website and through AASL's Hotlinks newsletter.

Michelson 2014). Join us in testing this argument infographic rubric by applying it to your students' work or asking your students to revise it to fit infographics they are making.

We've only begun testing other parts of our "recipe." We know that by closely observing individual student's visual choices we will gain a better understanding of, for example, the culturally constructed meanings attached to color, composition, and stylistic approaches. We feel sure that cultivating an open-minded disposition and thoughtful inquiry strategies will benefit students' civic literacy and creativity. We expect that students' thinking about the interaction between a complex text and images in the service of a purpose and audience will improve their reading comprehension. But we need your help. Join us in the collaborative test kitchen to cook up a rigorous learning experience that engages students in imaginative inquiry and high-quality learning.



Debbie Abilock, a former school administrator and school librarian, cofounded and directs the education vision of *NoodleTools*. She writes *Adding Friction*, a column in *Library Media Connection* <<http://bit.ly/FrictionLMC>>, and her recent publications include a co-authored award-winning reference book

Growing Schools: Librarians as Professional Developers (*Libraries Unlimited* 2012) and a contributed chapter in *Mining Complex Text: Using and Creating Graphic Organizers to Grasp Content and Share New Understandings* (Corwin 2014). She speaks internationally and consults in schools.



Connie Williams is the school librarian at Petaluma High School in Petaluma, California. She is a past president of the California School Library Association; cofounder of *Classroom Learning* and *School Library Learning 2.0* tutorials; author of articles for *Library Media Connection*, *Knowledge*

Quest, and other journals; and author of the chapter "They Call It Learning" in *Growing Schools: Librarians as Professional Developers* (*Libraries Unlimited* 2012). She presents at library, social studies, and other conferences.

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