A video made in the Pacific Subarctic Gyre zooms in on a basketball bobbing on a wave. In the next shot, the waterline crosses the center of the frame. Beneath the water, layers of crustaceans clinging to the ball sway in the current. The screen then fills with a swirling mass of trash and plastic that, like the basketball, is part of the “Great Garbage Patch.” A voice tells us that this garbage patch contains six times more plastic than plankton and is as big as Texas. The visuals and voice-overs provide important and relevant information about ocean pollution and surface currents. However, despite the dramatic visuals and informative audio, the average high school student is likely to have difficulty gleaning the scientifically relevant information presented in this Flotsam Found video (KCET and Wired Magazine 2007).

Today, the use of web-based videos in science classrooms is becoming more and more commonplace. With easy access to numerous science-related videos on YouTube, Wired Science, NOVA, and Discovery Channel websites (see “On the web”), teachers are often able to find video clips to illustrate almost any science concept. Many of these videos can be used legally
without charge. (Note: For more information on copyright and fair use for educators, see “On the web” at the end of this article.) These accessible resources have the potential to serve as powerful teaching tools. However, these videos are also often fast-paced and information rich—science concepts can be fragmented and embedded within larger cultural issues. Although these qualities enhance the value of these resources, they may undermine their instructional value.

In this article, we address the cognitive difficulties posed by many web-based science videos. Drawing on concepts from media literacy education, we provide strategies to reduce cognitive issues and enrich students’ understanding. These strategies support the development of science literacy as described in the National Science Education Standards (NRC 1996, p. 22), and help students learn to identify science concepts embedded in web resources and popular media.

**Overcoming cognitive obstacles**

There are many advantages to using web-based science videos in the science classroom. For instance, they offer current information and have short running times (usually less than 15 minutes). Often, these materials illustrate science concepts in context and provide opportunities to evaluate how science is interwoven with larger social and cultural issues. Moreover, watching videos in class is a shared experience. Everyone completes the viewing at the same time, which supports teachers in orchestrating group discussions and facilitating students’ skills “to engage intelligently in public discourse and debate about important issues in science” (NRC 1996, p. 13).

In multimodal presentations such as *Flotsam Found*, the verbal and visual information presented is processed through two different cognitive systems: the auditory and the visual. In order for students to learn from such presentations, they need to

- select essential information,
- organize that information in some sort of mental model, and
- integrate the information with previous and emerging understandings.

When students have difficulty with the cognitive work of selecting, organizing, and integrating information, the cognitive load is high and can impede learning. High cognitive load can be a legitimate result of the intrinsic complexity of a science topic; it can also be extrinsically produced by a material’s presentation style (Mayer 2001). Extrinsically...
generated cognitive load is likely to be an issue in web-based materials that are primarily designed for information or entertainment rather than instructional purposes.

Thus while the value of web-based science videos often rests in their complexity, that complexity can also make it difficult for students to sort through the presentation and identify essential elements. The challenge for teachers is to help students select essential information, organize that information, and integrate it with the current curriculum.

To assist teachers in this process, Figure 1 provides sources of high cognitive load in web-based science videos. In the section that follows, we describe media literacy strategies for addressing cognitive obstacles with students.

**Media literacy strategies**

Media literacy education is the process of teaching and learning about media. Students examine how words, images, and sounds combine to convey meaning and how different kinds of media (e.g., books or film) are organized by genre. They consider how purpose and audience shape what they see and hear. For example, students might evaluate an image such as a “yes” suggest parts of the video that might be difficult for students to understand without teacher support.

1. Is the sequence of events difficult to understand?
2. Are there places in the video where the audio and video do not match?
3. Are there points in the video where a viewer has to read, listen, and watch at the same time?
4. Are the images ordered in such a way that they suggest relationships that are not accurate?
5. Is it difficult to identify the scientific and the non-scientific information?

**FIGURE 2 Pre-viewing checklist.**

Teachers can use this checklist to identify aspects of the video that create a high cognitive burden. Questions answered with a “yes” suggest parts of the video that might be difficult for students to understand without teacher support.

- Is the sequence of events difficult to understand?
- Are there places in the video where the audio and video do not match?
- Are there points in the video where a viewer has to read, listen, and watch at the same time?
- Are the images ordered in such a way that they suggest relationships that are not accurate?
- Is it difficult to identify the scientific and the non-scientific information?

One way to help students process web-based videos is to introduce them to related online resources. For example, still images of abstract representations in *Flotsam Found*’s 9-second explanation of surface ocean currents are available on the Wired Science website (see “On the web”). Discussing these images as part of a pre-viewing activity gives students an opportunity to examine and make sense of the graphic before they watch the video. See Figure 2 for a pre-viewing checklist.

A second approach is to segment (and allow students to re-view) the video. The teacher hits pause, raises questions or points out essential elements, then rewinds and re-shows the discussed section. If the video is short, teachers can enhance the viewing experience by first showing the video in its entirety and then segmenting during a second viewing. Compared to older technologies such as the videotape, web-based videos allow much easier pause, replay, and screen capture capabilities.

A third option is to use the pre-viewing and segmenting techniques in combination with teaching the characteristics of genre—groupings of music, literature, art, or other forms of media that share common types of content or a common form or style and that use established con-
Characteristics of genre—used in conjunction with previewing and segmenting (and re-viewing)—can support students in developing the habits of active and skeptical viewership, which are key to developing both scientific and media literacy. Furthermore, engaging students in selecting essential elements and organizing those elements in meaningful ways can provide a context for discussing the complex relationships between science and the cultural context in which science topics are raised and investigated.

Web-based videos can be an exciting and valuable addition to the science curriculum. They can support different learning styles and foster discussion and critical thinking. Using this resource in ways that help students reap these benefits can lead to new literacies in science.

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On the web

Wired Science: www.pbs.org/kcet/wiredscience
YouTube: www.youtube.com
NOVA: www.pbs.org/usbh/nova
Discovery Channel: http://dsc.discovery.com
Mediafestival (copyright and fair use PDF): www.mediafestival.org/old_site/downloads.html

References