User Assumptions

This unit is designed for middle school students enrolled in an independent study virtual charter school. These students work from home with their parents as the primary learning coach. Completing a science project is a requirement for middle school students to receive a grade of “A” in their science course. Although synchronous online sessions are offered to discuss the scientific method, many students are unable to attend these sessions and need resources specific to the school’s science fair requirements to support them throughout the process. Most students have no experience in designing a science experiment, although all have participated in the scientific process as part of the science curriculum.

Graphic Descriptions

Image: Presenting
Design Focus: Shape

This image is intended to provide a simple graphic representation, so that students can easily remember the most important parts of presenting a project, a requirement for students participating in the science fair. Shape was used in several ways to communicate this message clearly. First, star icons were used as bullets in the text box, as suggested by Malamed, to improve learner selection. The five points are encased in a rectangle shape to emphasize and separate the text from the image, as suggested by Lohr (2008). A line was also used to highlight the title, and a talk bubble adds description for the fifth point, as well as a purpose to the cartoon person. Within the talk bubble, lines show volume around the word “loud.”

Image: Page Banner
Design Focus: Selection

The page banner is an integral feature of any website. This image effectively communicates the site title, and selection was carefully considered to ensure that the banner does not overwhelm and cause conflict with the instructional images on the page. Contrast draws attention to the text, and any conflict between figure and ground, as described by Lohr, is diminished.

Image: Display Board
Design Focus: CARP Principles

The purpose of this image is to show learners what an organized and colorful display might look like, supporting the lesson goal of designing a display, as well as introduce
the information on the webpage. The lesson goal is to organize the information in a way that is easy to read and eye-catching. The CARP concepts used include:

Contrast: This is a primary design element in this image because it is something that students tend to struggle with in their own designs. The bright blue was chosen to contrast the white background of the text elements, and the photographs contrast with the bitmap imaging to draw attention to the use of photos on the display. Titles were printed to contrast with the lines representing the text in each element, helping students to focus "on what is important by removing what is not important" (Lohr, p. 199).

Alignment: Each element is aligned with the title centered above and in close proximity to the associated paragraph image to demonstrate the need to label each element.

Repetition: The yellow "paper" behind the text portions of the display creates "harmony and unity" among each element (Lohr, p. 203). The font is also consistent throughout, as well as the backgrounds on each panel.

Proximity: Proximity and contrast are used to set the title and question apart on the display and associate the element title with the element text.

Image: Graph Parts

Design Focus: Typography

Typography, color, and proximity work together in this image to cue learners to important terms and support mastery of state Scientific Experimentation and Investigation standards. Colored text helps learners to locate each term on the sample graph. Proximity helps to organize the information in the text box, with less space between the title and corresponding text, and more white space to separate terms. Icons are also used to support cueing and vocabulary recall. Color was used sparingly and intentionally in this image to emphasize important areas, and limit conflict between elements.

Image: Scientific Process

Design Focus: Organization

The Scientific Process is a key concept in this unit, and all lessons and activities are related to this image. The image serves as the focus and starting point for students beginning their journey through the steps of the scientific method. Hierarchy is achieved in this image through decreasing font size, proximity, and successive indentation (diagonal alignment) to create a line of text that moves from the top left to the bottom right, indicating an order to the information, and lending excitement to an otherwise boring list of terms. The scientist drawing located in the top right helps to balance the image. Terms are chunked with their definition to create a relationship between the two elements. Font color is a repetitive feature that helps to unify the steps of the scientific method as one process.

Image: Types of Variables

Design Focus: Space and Depth

Students will view this image with two purposes: to provide a quick visual explanation of the three types of scientific variables; for use with an activity directing students to identify controlled variables in the experiment depicted in the image. The ability to differentiate between variable types is essential for mastery of CA state science.
standard 8.9.a., planning an experiment. Drop shadows accent the headings to draw attention and add depth. The plants also have shadows and splashes to make them more interesting and create dimension. The rulers were placed behind the plant leaf to add dimension, as well. The overall design is generally symmetrical. Whitespace creates a table-like appearance making it easier to see the structure of the text, and decreasing font sizes communicate relative importance.

**Image: Adding Details**  
**Design Focus:** Color

This image is designed to show the importance of including detailed steps in the procedure. Because many middle school students have never designed their own experiment or written a procedure, this image demonstrates how consequential details can be in a procedure and introduces the lesson. Colors are influential in instructional messaging because they can carry meaning and elicit emotion. Red and Green are the core colors in this image, contrasting between positive and negative examples, labeling, and eliciting excitement in learners. A dark gray text color helps to emphasize the color in the image, and provides contrast with the background. I specifically chose grayscale for the text so that it did not draw significant attention, and to make the figure more prominent than the background. (The text, although important, is not as important as the result of the text (the images) so bright/dark colors were intentionally removed from the directions so that it would not be a distraction (Lohr).

**Image: Data Sets**  
**Design Focus:** Organization

This image accompanies an activity where students evaluate the data and determine which type of graph would best display the information, a key component in the displaying data lesson. White space is used to create columns, and the design of the data set on the left was chosen so that it appears hand written by a child. Icons are used to help students make a connection between the data and the experiment it might represent.

**Image: Lemonade Recipe**  
**Design Focus:** Space

This image is also used with an activity where students will identify areas that are lacking and add details. The design principles used in this image include using contrast to differentiate the title, question, and recipe, and chunking to show the ingredients as a group separate from the directions. The image facilitates student understanding of writing a procedure.

**Image: Steps to Success**  
**Design Focus:** Typography and Shape

This icon is used to easily identify the area on each page containing tips and tricks on the website. Each page will have this. The placement and rotation of the letters convey motion, and the stars draw attention to the icon. The shape of the steps represents climbing closer to the goal.
Process Design

The science fair website is intended to stand alone as a resource for students and parents to learn and practice each step in the scientific method, with the ultimate goal of successfully completing a project for the school science fair. To facilitate this learning, students work through several pages with a general pattern of participating in an opening activity, viewing instructional images, and reading informational text. Once information is presented, students participate in a series of activities, culminating in the completion of one step in their actual science fair project. Several tips for success and links to extension activities on external websites follow each set of activities.

The unit design utilized systematic instructional design, as described by Smith & Ragan. A brief needs analysis was conducted among academic events leaders, and it was quickly determined that a single site to house resources and information directly related to the school’s science fair was necessary. The unit objectives guided the plan for individual lessons and activities, focusing on Bloom’s higher level thinking skills of application of information and creation, two of the cognitive processes that are most likely to result in retention and transfer of skills (Krathwohl, 2002).

Throughout this unit, images are used to illustrate important or difficult concepts contained within the text. Generally, these images were designed with selection and utilizing white space as a priority because competition between figure and ground can negatively affect learner focus and retention of information. By minimizing this conflict, images contained within this site support learner acquisition of the topics presented (Lohr). The images are accompanied by printed text to create a multimedia site. According to Clark & Mayer, the combination of graphics and text engages learners. The design of the site itself utilizes the essential design principle of repetition in the general site layout and the structure of each lesson (information, activities, tips, and extensions). Together, the images, text, and overall structure of the site work to create a cohesive and complete site that facilitates mastery of the unit’s learning objectives.

References


