Sketching Gadget Anatomy Lab

Main Idea: Close observation and sketching lead to a better understanding of how machines work.

Learning Objectives:

- Observe a machine closely from several angles while it operates.
- Identify the elements of machines combined in different gadgets.
- Show how the moving parts in machines relate to and affect each other.
- Create a clear diagram of how a machine works.

Time: about 30 minutes with one machine per group

Materials:

- Paper
- Pencils with erasers
- Notes from simple machine PowerPoint.
- A selection of small machines with visible working parts; i.e. egg beater, cork screw, car jack, can opener, garlic press, tongs, monkey wrench, hand drill, Vise-Grips, the mechanism from a music box, wind up toy, pencil sharpener, stapler, etc.

Procedure:

1. Work in cooperative groups (2-4 people).
2. Provide each group with one machine to examine in detail. CAREFULLY, Take turns operating the machine while remaining lab partners watch to see how each part moves.
3. Answer the following questions: I encourage thought and discussion within your lab group about each machine. Investigate your own questions as well. Record all data.
    - What is the function of this machine?
    - How many moving parts does it have?
    - How are the moving parts connected to each other?
    - What does each moving part do in the machine?
    - Which parts are elements of machines?
4. Place the machine at rest so that everyone in the group can see it.
5. Sketch diagrams of the machine. You should draw the machine from your own point of view first. Later move machine to a different position and draw it from a different point of view to show all working parts.
6. When the diagrams are completed, you should **add arrows and written notes to indicate directions of motion for each part, label the elements of machines involved, and explain connections.**
7. Display and explain your diagrams to other groups at end of class.
8. If time permits, each lab group will find a new machine to investigate and sketch.

- What are some similarities and differences between different diagrams?
- Which diagrams do they think are the easiest to understand and the hardest to understand?
- What techniques have the illustrators of the better diagrams used to make their work clearer?
- What techniques can the students apply from these examples to make their own machine diagrams more understandable?

Teacher Tips:

- Encourage students to draw systematically, starting at one point and drawing each part and connection in order.
- Emphasize that in this kind of drawing it is not important that their drawing look exactly like the machine; instead it should show how the machine works. For example, getting the exact proportions for the parts is less important than showing how they connect to each other.
- Encourage students to experiment with sketching enlarged views and cut-away views to show parts that are very small or obscured by other parts. Leonardo often left out the casing and structure surrounding machines in his illustrations so he could show the workings more clearly.
- Many of the published Leonardo resources in the Bibliography contain examples of his work that students will understand better after they have tried this activity. They may want to see how other artists have created diagrams of machines. David Macaulay's book *The Way Things Work* contains many wonderful and whimsical examples.

Real World Connections:

Ask students to get their parents involved in helping them locate examples of machine diagrams from home. The instructions provided by manufacturers with bicycles, kitchen appliances, tools, and lawn mowers often contain explanatory diagrams to help you understand these machines. Auto repair manuals also contain dozens of these diagrams. Many construction sets such as Lego® and K'NEX® also have similar kinds of diagrams to help you build particular toy designs.

When you have several diagrams from different sources, ask the students to compare them and discuss them using the following questions as starting points:

- What are some similarities and differences between different diagrams?
- Which diagrams do they think are the easiest to understand and the hardest to understand?
- What techniques have the illustrators of the better diagrams used to make their work clearer?
- What techniques can the students apply from these examples to make their own machine diagrams more understandable?