LESSON PLAN 1:

ARTISTS, SCIENTISTS,

& SKETCHBOOKS

Curriculum: Introduction to Biodesign
Unit: 1—Biomaterials
Grade Level: 10th-11th

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TO FIND MORE LESSON PLANS AND TO READ MORE ABOUT THIS CURRICULUM VISIT: BIODESIGNMAKERSPACE.ORG

Background Information For Teachers

Overview of this lesson:

This lesson plan was designed as the entry point into a ten-week curriculum called "Introduction to Biodesign." The lesson centers on sketchbooks as sites for inquiry, observation and reflection. Sketchbooks were the primary site for students' work over the course of the semester—this is where they worked out design ideas, recorded observations, and ended every lesson with five minutes of reflective drawing or writing. This lesson gets students utilizing and populating their sketchbooks right away.

With our tenth grade students, we used this first lesson as a way to gauge their level of understanding and comfort in the areas of science and art + design and to introduce key ideas related to biodesign and intersection of art and science. In our ten-minute introduction lecture, we established the goals of the curriculum, the differences and similarities between art and design, and the meaning of biology, ecology and biodesign (key underpinnings to the rest of the semester). We touched on Darwin's notebooks and the differences in documenting your observations in the natural world as an artist and as a scientist.

With the intention of getting students making and moving right away, the core of this lesson consists of three different artmaking exercises. First, students are taught how to do "blind contour drawings", in which the focus is on keenly observing an organism without concern for the rendering outcome. This helps to loosen students up and circumvents the inner critic that inhibits many people when they begin to draw. It also helps to create a field of seeing the object/organism as it actually is, not as our minds interpret it through symbolism (e.g., to see a fish as it actually is, not as a generic "fish"). The second project is to create abstractions of these organism through paper collage. Students are then introduced to scientific sketching and asked to sketch as a scientist would. Your students can stick with one organism or switch for each exercise (we encouraged our students to move around the room and look at different organisms). The lesson concludes with reflective writing and a discussion of the various contexts for artistic and scientific renderings.

Adapting this lesson to your classroom:

If you are teaching this lesson as a one-off lesson plan, rather than as part of the full curriculum, you can forgo the "biodesign lecture" and make your mini-lecture on "Artists, Scientists, and Sketchbooks" more robust by bringing in more examples of contemporary artists who use sketchbooks and/or who make frequent subjects of the natural world. (To name just a few: Kiki Smith, Herman de Vries, or for nineteenth century examples, The Hudson River School artists).

This lesson asks that students observe or-

Background Information For Teachers

ganisms (either living or preserved) in real life and sketch them. As such, it is important to have a number of examples of living or once-living organisms to show your students. You can do this in several ways. One option is for you to hold the artmaking portion of this lesson outdoors and gather around one organism as a group or let students find an organism of their choosing (though keep in mind that it may be challenging to guide the group through directions outside the confines of the classroom and that collage-making is considerably harder when you have wind to combat with.) A second (arguably much easier) option, is to pick out a number of organisms before class (these can be plants, taxidermy specimens, the class pet, fish in tanks, etc.) and bring it in for this class. If time allows, you could also have students go outside collect specimens to bring indoors. Also note that for the collage portion of this lesson, we saved in-class time by ripping out magazine pieces and sorting them by color prior to class. This way students were able to begin arranging and pasting pieces on right away, and as a result of time save, we were able to do three artistic exercises in one class, rather than one.

Standards, Objectives, & Supplies

Grade Level: 10th-11th

Duration: 2 hours

Lesson Concept: Artists and scientists have distinct ways of documenting and expressing their ideas, and different approaches are appropriate for different contexts. Sketchbooks can be a site for observing these different uses.

Lesson Objectives/Learner Outcomes:

1. Understand, in broad terms, the goals of the Introduction to Biodesign Curriculum.

2. Understand the distinct and overlapping uses of sketchbooks and drawing from observation for artists and scientists.

3. Utilize scientific drawing methods to inquire and observe.

Instructional Support Materials (if needed):

- Powerpoint with key terms and images
- LCD projector/Smartboard to show powerpoint
- Vocabulary cards for each student to paste in journal (see end of this PDF)
- Printed "Guide to Scientific Illustration" for each student to paste in journal (see end of this PDF)
- Organisms (living or preserved) for students to sketch, brought in from outside (we recommend having at least eight to ten organisms to choose from)

Supplies:

- Sketchbooks (one for each student)
- Pencils (one for each student)
- Colored pencils (an assortment of colors, ten-twenty for each small group of students)
- Magazines to tear out collage pieces (we tore out pieces of paper in advance and sorted by color to save in-class time)
- Glue sticks (one for each small group of students to share or one for each student)

Science / Art Standards

SCIENCE (Next Generation Science Standards):

ESS3C- Sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources, including the development of technologies

Science and Engineering Practices: Obtaining, Evaluating, and Communicating Information
Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

ART (National Core Art Standards):

VA:Re.7.1.ia
Hypothesize ways in which art influences perceptions and understandings of human experiences.

Learning Plan

Stage 1: Motivation

1. Introduction Lecture: What is Biodesign? Through a mix of lecture and question-asking directed to the group, establish the following: What are we doing this semester? What are some of our goals? What are our expectations? What is the difference between art and design? What do we mean by biology, ecology, and biodesign? *(Introduction with Powerpoint: 15 minutes)*

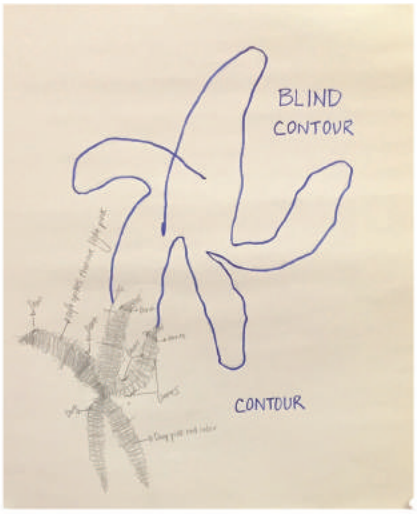
Stage 2: Exploration

1. Preview activity. Distribute sketchbooks and explain to students that for the rest of the lesson we will be thinking about intersections of art, science, and sketching from observation. Let students know that the purpose of the following activity is to think about the way an artist might observe and represent what she sees, the way a scientist might observe and represent what she sees, and how each way of perceiving and thinking may be useful in different contexts. (Artists have a wide variety of styles and media that they can use to express their ideas but scientists rely on accurate and reproducible illustrations to convey specific characteristics). *(5 minutes)*

2. Artist renderings of specimens. Students pick either a fish in the tank or a plant on the green wall to draw (you can take your students outdoors if desired or bring in organisms from outside). Begin with contour drawing of the specimen for five minutes (drawing without picking pen up off the paper and without looking down at the paper). Next, have students tear out shapes out of a magazine and make a collage abstraction of their specimen.

a. Blind Contour Drawing *(5 minutes)*
b. Collage *(15-20 mins or as long as desired)*

3. Scientific drawings of specimens. Provide students with handout and explain the necessary components of scientific drawing including coiling, contour, and stippling, to create 3-D shapes, labeling. Demonstrate coil drawing on the board, per the instructions in the worksheet. In scientific drawing the boundary structures of the specimen are more important than secondary features such as shadows, curvature, and

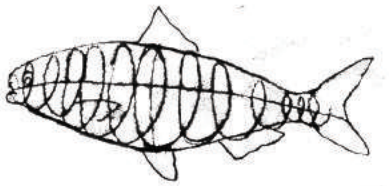


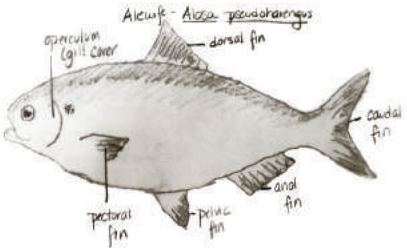
Images: blind contour and collage and colored pencil artwork made in our Biodesign Makerspace during this lesson.

color. Scientific drawings should be accurately labeled, include title and specimen name (genus and species name if known). Students then produce scientific drawings based on their instruction.

a. Teach coil drawing, outline of the organism *(5 minutes)*
b. Scientific Drawing, label the parts, stippling etc. *(15 minutes)*

4. Discussion of drawings. At the end of drawing period, gather students together and ask of the group: Which of your pieces do you like best? Which renderings are useful for which contexts? (Again emphasis that artists have a wide variety of styles and media that they can use to express their ideas but scientists rely on accurate and reproducible illustrations to convey specific characteristics). *(5-10 minutes)*





Images: Selected images from "Guide to Scientific Illustration" Handout. See end of this PDF for full handout.

Stage 3: Reflection

1. Five Minute Journaling. Students clean up and return to tables to journal for five minutes. Making use of their sketchbooks as a place for observation, inquiry, and reflection, students will begin the habit of writing in their journals at the end of each class period. Teacher can pick one prompt for all students to respond to, or students can choose from three prompts. *(Writing: 5 minutes. If desired: 5 minute pair share or group share)*

- What was different about the way you sketched your specimen as an artist and the way you sketched as a scientist would? Make a venn diagram.
- How would you explain to someone at home what you did today? What do you know about "biodesign" and how would you explain it? Write a paragraph.
- Combine one element of your "artist's drawing" and one element of your "scientist's drawing" in a sketch. What could this drawing be used for?

2. "So what?" Lesson Recap. Ask students: What did we do today? Why might it be important? Emphasize key ideas covered and larger context for today's learning—for example, "Artists and designers have different methodologies that are appropriate for different contexts, but these two ways of working and perceiving do not always have to exist separately. In future classes we will explore further how scientists and

artists/designers can implement each other's strategies to solve problems." *(5 Minutes)*

Guide to Scientific Illustration

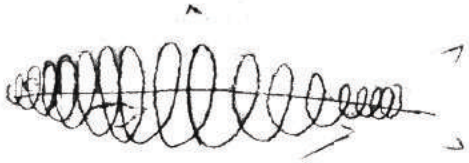
The history of scientific journaling is a long and auspicious one. You are following in the footsteps of Leonardo da Vinci, Charles Darwin and all of the many explorers from the Age of Discovery through the Victorian naturalists on to the present day. Scientific journals, field books, and field notes at their best consist of a medley of observations, both drawn renderings of animals, plants and communities found in the field, **notes** on their behavior, coloration and movement, and direct measurements from the field.

Drawing from direct observation has the benefit of not only allowing you to capture images, notes and observations in one book while you are in the field, away from computers and printers to manage digital photographs and create spreadsheets. The act of drawing actually allows you to process what you are witnessing as you witness it and imprints your observations more securely in your mind. Drawings can therefore be useful in both conveying your observations to others, and in helping you to more fully understand what you are seeing. A straightforward technique for drawing specimens is the coil method, outlined below:

1.

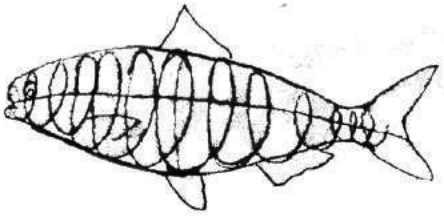
First, draw the longest midline of your object as it is oriented in space (this might not be a purely horizontal or vertical line – it might be at an angle). Draw a perpendicular line (or lines) from the midline to indicate the relative proportion of the volume

2.



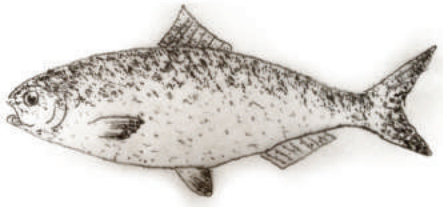
Begin to wrap imaginary coils around the surface of your specimen to indicate volume. These don't need to be perfect – you are basically just trying to lightly fill in the mass until the shape takes form. Flat areas can be indicated by angles and proportionate distances, or lightly modeled in with lines.

3.



When you are happy with the mass you have rendered, outline the mass to form the contour lines of your specimen. Connect the flat places as well.

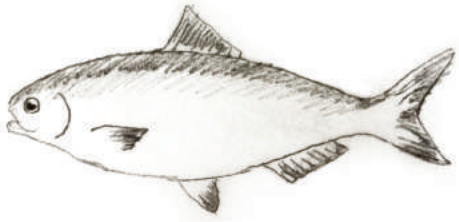
4.



Erase the midlines, and coils. True scientific illustration would have you use lines only where there are defined structures to note – changes in value would only be created using stippling. This ensures that there is no confusion as to what are the actual structures are, and what is shadow, coloration or pattern.

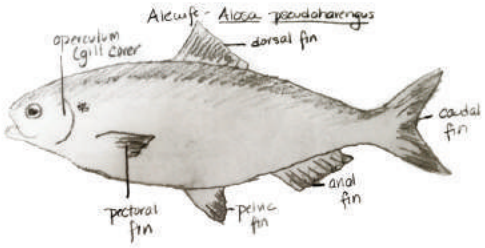
Guide to Scientific Illustration

5.



In the field, shading is acceptable, as stippling is time intensive.

6.



Add species name, identify characteristics of interest, add observations.

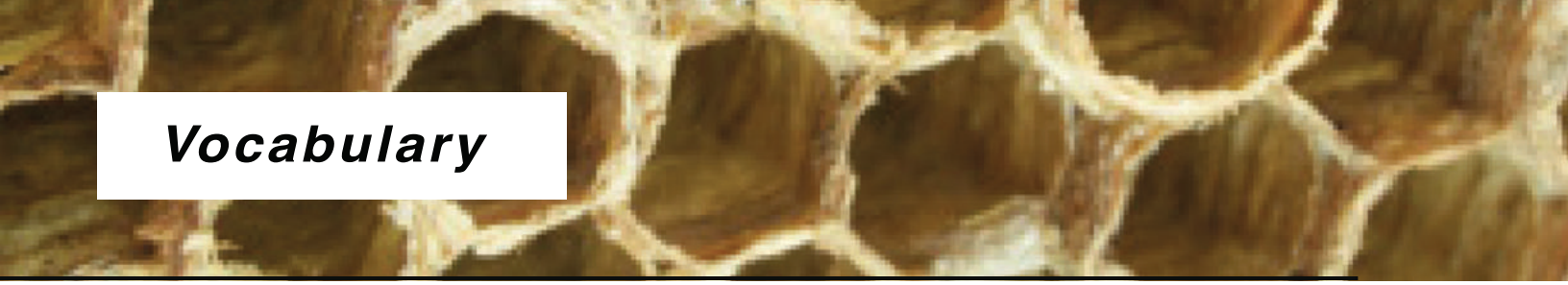
7.

Color may be added (typically using watercolor or gouache) or noted in the observations, or lightly modeled in with lines.

Rules of Scientific Drawing:

1. Draw as large as your page will allow.
2. Allow space for labels and observations on the right.
3. The boundary structures of the specimen are more important than secondary features such as shadows, curvature, and color.
4. Stipple areas dark to indicate depth and color. Shade or cross-hatch only for quick field sketches.
5. Draw clean lines. Structure lines should be definite, continuous and clear-cut.
6. Draw part for part, not from memory. Do not invent structures that are not there in the specimen. These are your observations!
7. Label parts you can identify with a solid straight line out to the out side of the drawing.
8. Do not cross label lines.
9. Label lines must touch the structure being labeled.
10. Do not add arrow-heads to the label lines.
11. Include title and specimen name (Genus and species name if known) at the top center of page.
12. Include a description of the nature of the specimen, such as the possible descriptors from the list below.
13. Include magnification when working from microscope.

NSF RISD Nature Lab



Vocabulary

Terms:

Design: A plan or an object created to solve a problem or serve a practical purpose.

Biodesign: A new field that uses ecological understanding to create better design solutions.

Biology: The study of living organisms.

Ecology: The branch of biology that deals with the relations of organisms to one another and to their physical surroundings.

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BioDesign:

A new field that uses ecological understanding to create better design solutions.