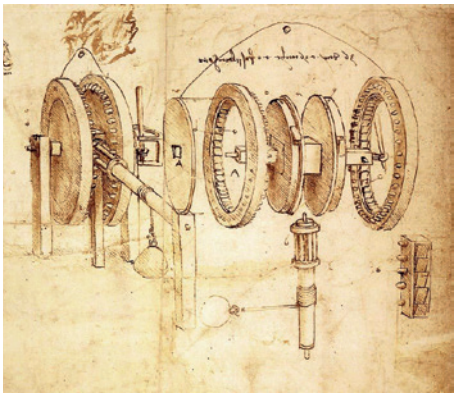
NATURE BLUEPRINTS

Students observe a complex natural object, break it down into component parts, and create a labeled diagram that reveals its symmetry and structure.

It can be overwhelming to draw complex subjects like pinecones or a tower of lupine flowers. Diagrams are tools for exploring and quickly describing structures in a way that is clear and easy to understand. Giving students a basic approach to diagramming is giving them a process they can fall back on when they encounter a complex subject. In the field, this is both a time-saving device and a way to achieve clarity and precision in drawings. Think of the blueprints that an architect makes to build a house. They are comprehensive and detailed, but there is no need to draw the details of every joint if they are repeated throughout the structure; the architect can just show it once. Exploded views show the parts of an object and how they connect, and detail insets highlight important features of a subject. Once your students have this formula for diagramming in their back pocket, they can focus on observation instead of monotonously drawing repeated shapes.



Definitions

Detail: a separate drawing that is an enlargement or elaboration of a part of the structure. This is often used on small, repeated parts such as a flower stamen.

Exploded view: a diagram that shows the relationship or order of assembly of the parts of an object.

NATURAL PHENOMENA

For this activity, you will need a collection of natural objects with repeating patterns or structure, such as a patch of flowers or a cluster of cones under a tree. This activity is best led once students have completed *Inside Out* or have some experience with diagramming. Once students understand the principles of diagramming, they can advance to more complex objects with repeating parts, as modeled in this activity (e.g., pinecones, fern fronds, lupine flowers).

PROCEDURE SUMMARY

1. To draw a diagram of a complex object with repeating parts: Make a few drawings to show different views of each repeating part, look at how the parts fit in to make the object as a whole, then use diagrams and text to describe how the parts fit together.
2. Make a diagram using the method just described, then record additional observations.

DEMONSTRATION

When the whiteboard icon appears in the procedure description: Create a diagram of a pinecone that shows the details of one scale and how the scales fit into the larger structure of the cone. If students have already practiced making side-, end-, top-, and section-view drawings of an object, use those

Time

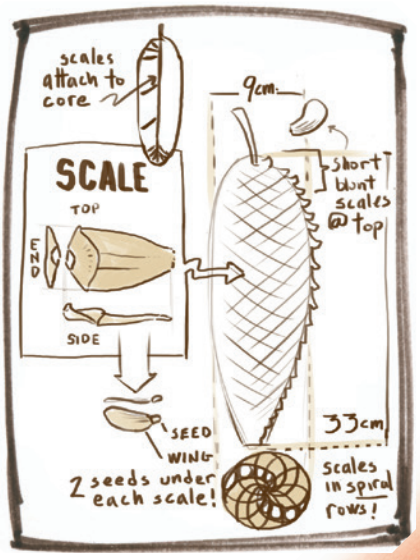
Introduction: 10 minutes
Activity: 30–50 minutes
Discussion: 10 minutes

Materials

- ☐ Journals and pencils.
- ☐ Engineering or architectural blueprints showing detail insets and exploded views. You may also collect examples of instructions for Lego kits or furniture assembly.

Teaching Notes

This activity is a great follow-up to *Inside Out.* Students can build on their learning about different views of an object by applying it in the context of drawing a more challenging subject.



ideas in this activity. Point out to students how you are avoiding drawing the entire cone and instead using a couple of drawings of the repeating parts as a shortcut.

FAIRIES AND TROLLS

A playful way to introduce this activity is to talk about creating blueprints or design plans for fairies. Tell the students that there is an emergency in the forest. Every evening, the forest fairies get out their tools and make new flowers for the next day. But last night the trolls stole all the plans to make the flowers. The forest fairies need your help. Before these flowers wilt, we need to create new design blueprints for the flowers. The goal is to make plans that are as clear and detailed as possible. To this end, students should consider how to use plan, elevation, section, and exploded views, and detail insets.

Most students will understand that this is an imaginary scenario. We do not want to leave the children thinking that there really are fairies and trolls in the woods. If students are very young or seem confused, make it clear that this is pretend.

PROCEDURE STEP-BY-STEP

1. **Explain that scientists and engineers use diagramming to efficiently draw complex objects, such as pinecones [or your chosen natural object].**

   a. "Drawing a pinecone like this one can be difficult. There are so many scales that your hand may cramp up before you get halfway through, or you might just get sick of drawing them. You might get so wrapped up in drawing the same thing again and again that you do not have time to make other observations."

   b. "Scientists and engineers have a great trick to help them handle this problem. It is called diagramming. Instead of drawing to make a likeness of an object, we draw to record as much information as we can in a way that is fast and clear. First, we need to break the object down into parts. Then we look at how the parts fit together."

2. **Show students examples of exploded views and inset details in blueprints or engineering diagrams.**

3. **Pass out one pinecone [or another complex natural object with repeating parts] to each student, and instruct them to examine it, looking for repeating parts.**

   a. "First, let's identify the repeating structures in this object. Are there parts of this object that repeat, or show up more than once or twice? What are they?" (Students might say: seeds, scale things, or spines.)

4. **Demonstrate how to diagram one example of each repeating structure.**

   a. "Let's start by using a couple of drawings to describe a scale [or other repeating part]. What views would help us show its shape and structure?" Make quick sketches representing student suggestions, being sure to include at least the top, end, and side view of the scale.

   b. Repeat step "a" with any other repeating structures (seeds, etc.).

5. **Ask students which views can be used to show the structure of the full cone or object, referring back to the activity *Inside Out* (if you have done it previously) and adding students' suggestions to the whiteboard demonstration.**

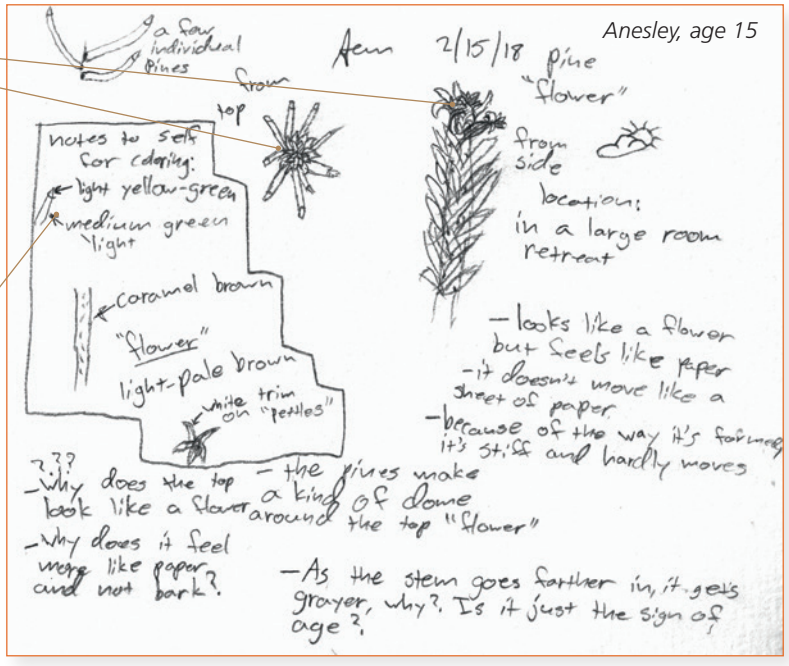
   a. "What views will help us show the structure of the cone or object as a whole?"

   b. Make quick sketches representing student suggestions, showing at least the side and end views.

6. **Explain and demonstrate how to use diagrams to show how the repeating parts of an object fit together.**

Top and side views of the same subject help depict the shape and structure.

Green and *brown* are inadequate words to describe color. How can we coach students to modify color words to be more specific?



Making a structural diagram helps put the emphasis on recording information rather than making a pretty picture. Show side, end, and cross-section views just as is done in architectural and engineering diagrams.

a. "Now that we have made diagrams showing the scales and the pinecone as a whole, we will use some simple drawings to show how the parts fit together."

b. "What do you see? How do the repeating parts like scales and seeds fit in with the structure of the cone as a whole? Where are they in relation to each other?" (Students might say: scales in diagonal rows, two seeds under each scale, scales attached to a central core.)

c. Make a couple of quick diagrams based on how students describe the repeating parts fitting in to the object as a whole. For example: "Where the cone has opened, I can see how the scales attach to a central core. We can use a cross section to show this view."

7. Summarize the general steps you took to make a diagram of a complex subject: First, identify and draw repeating structures from different views, then use diagrams to show how the repeating parts fit together to form a whole.

8. Tell students that they will now make their own set of diagrams, using labels, descriptive writing, and measurements to describe the object.

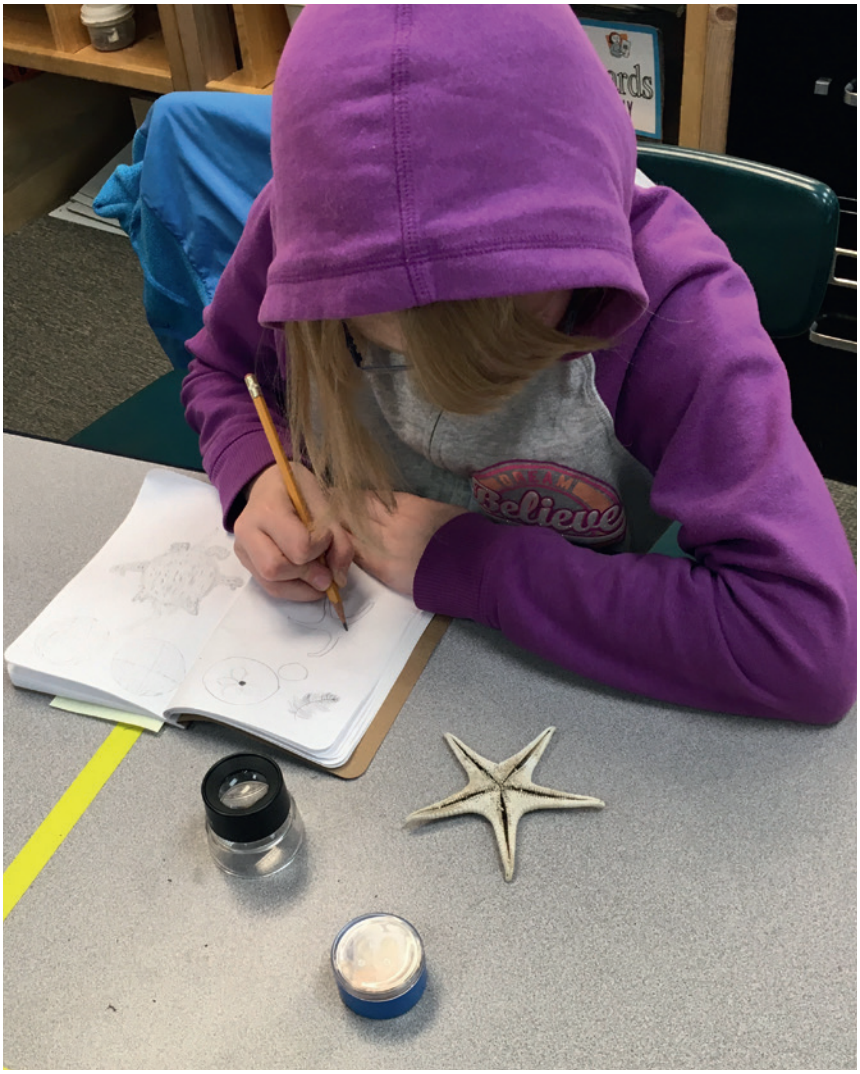
a. "You will describe an object with a set of labeled diagrams in your own journal. Look for the easiest ways to describe the most detail and structure without having to draw everything."

b. "Remember, first we identified repeating structures and made a couple of simple drawings of different views of each one. Then we observed how the repeating parts fit together in the object as a whole, and used diagrams to show this."

c. "Your goal is not to draw a perfect representation of the object, or a pretty picture. A diagram is meant to show information efficiently. If many parts have the same structure, you only need to draw one. This is not about art but about seeing details and finding simple and effective strategies to get them on paper. Think, What are the structures, and how do they fit together?"

d. "Add in labels, descriptive writing, and measurements. Once you finish making your diagrams, see how many more observations you can add. You want to create a page that is dense with information and is as clear as you can make it. You will have nineteen minutes to create your diagram."

9. About halfway through, bring the group together to discuss diagramming strategies and ideas in small groups.



a. "Let's pause for a moment to get some good diagramming ideas. At my signal, in groups of ten, lay your journals open on a table and share your diagrams with each other."

b. "Look for effective diagramming ideas: Maybe someone summarized a lot of information with a minimum of effort, or included useful views or ways of showing relationships between drawings or notes."

c. "We don't care if a diagram looks pretty or not. We are interested in the data or information and how clearly it is displayed."

d. "Look for ideas that might improve your own diagram. Once you have seen one another's work, you will have a few more minutes to improve your own diagram using these ideas. "

10. Give students time to use ideas from their classmates to improve their work.

a. "Now take a few minutes to improve your diagram using some of these ideas from your classmates. How can you make it more clear, or show more information?"

11. Call the group together, and ask them how they could use diagramming strategies in future journal entries.

DISCUSSION

Lead a discussion using questions from one Crosscutting Concept category. Intersperse pair talk with group discussion.

Patterns

a. "Were there any patterns in the individual repeating parts of the subject of your journal entry?"

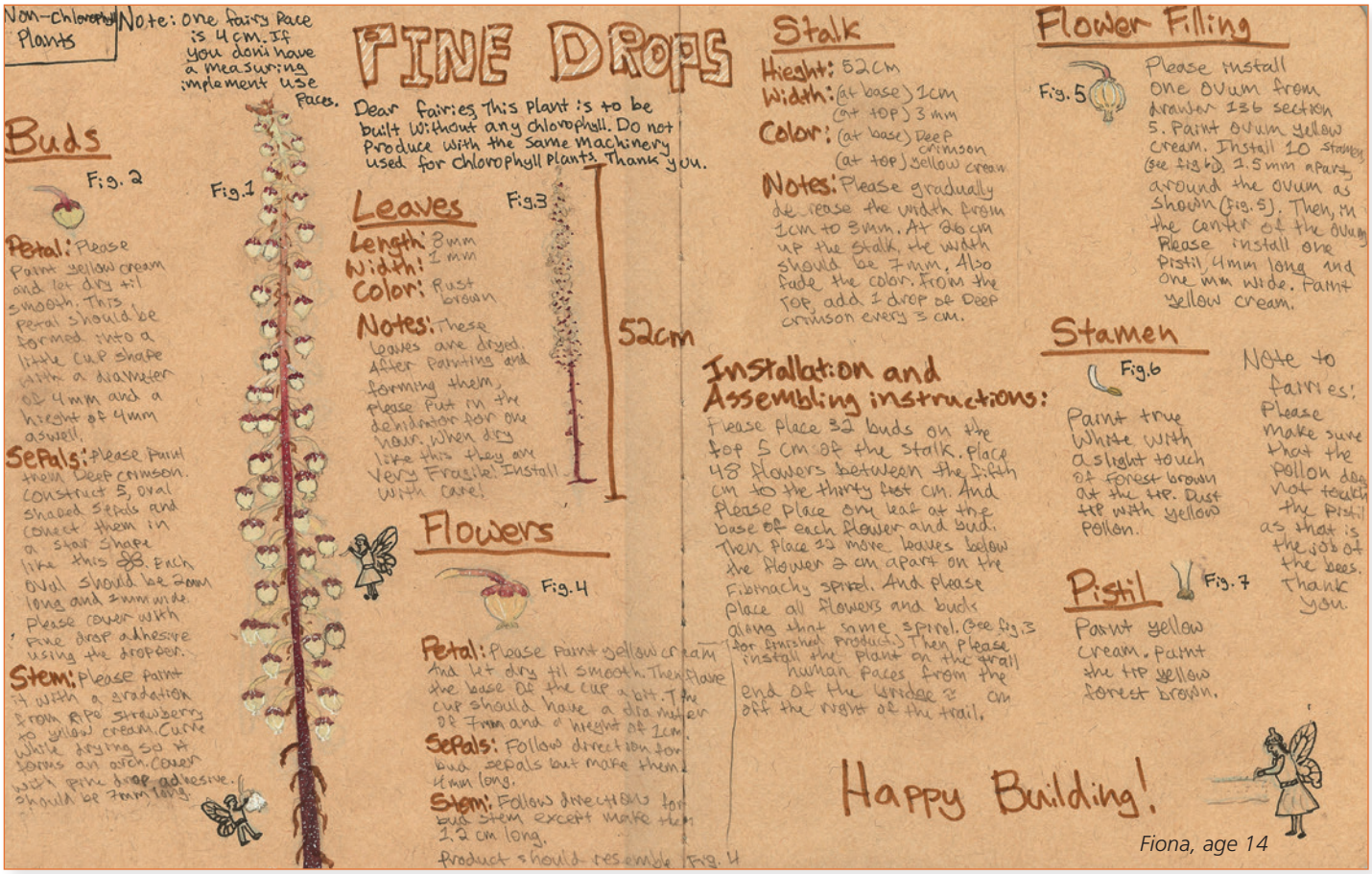
b. "Were there any exceptions to these patterns? Where were they? Why do you think these exceptions may have occurred?"

c. "What are some possible explanations for the patterns of growth we saw?"

d. "Was there a pattern to the way the individual parts fit into the larger structure?"

Structure and Function

a. "Look at one of the structures you drew in your diagram, such as a scale or a stem. How do you think this structure works? Why might it be shaped the way it is? How might its form, texture, and color affect how it functions?"



This student created an instruction manual for flower-making fairies. This was a playful angle that can inspire follow-up creative writing projects.