What's Going On Here?

Synopsis

Students are shown photographs, slides, or overhead transparencies of a natural phenomenon. After making careful observations, they are asked to infer how the phenomenon occurred.

Objectives

This exercise teaches students to use observation skills more rigorously than they are probably accustomed to doing, and to use these observations to make hypotheses about the origin of an unusual but natural phenomenon. After doing this exercise, students should be able to demonstrate the following abilities necessary to do scientific inquiry described in the *NSES Content Standard A (Science as Inquiry)* for levels 5-8:

- develop descriptions, explanations, and predictions using evidence,
- recognize and analyze alternative explanations and predictions, and
- think critically and logically to develop the relationship between evidence and explanation.

Introduction

WHAT'S GOING ON HERE? This is a question that scientists ask continually. They ask it of bacteria in a petri dish, fish on a coral reef, and land masses crashing into each other. Whether the phenomenon is quite unusual or a familiar, everyday occurrence, there are certain commonalties in the scientific approach to investigation. One of the first steps is *observation*. By observation, I mean *seeing*, not just *looking*. The distinction? When I *look* at something, it is mostly a passive experience. When I *see* something, on the other hand, my brain is actively involved in processing the sensory input, analyzing the data, and perhaps making cause and effect conclusions about the experience. The goal of these exercises is to get students to look carefully enough at some natural phenomena so that they actually see something--that is, make careful observations. The examples given below are just that--*examples*. They are taken from my experience, given the resources I have available to me. You will need to find your own examples from magazines or your own experiences or in your own neighborhood. I describe my examples in detail simply as a guide to the possibilities.

CLASSROOM EXAMPLES

Plants in Lines

There is a tendency for people to think of *observations* as relying on vision. Though this is certainly not true, I like to begin with a visual puzzle for my students, and then move on to include the other senses later. Over the years, I have collected a number of pictures of natural scenes. My favorite example is a slide I took at Hurricane Ridge on the Olympic Peninsula in Washington State. The scene is a fairly steep talus slope, strewn with loose rock fragments. This is an area that, in winter, is undoubtedly blasted by

wind, snow, and ice. However, even here there are plants eking out a living. Most are perennials. None is larger than a basketball; most are smaller. The peculiar thing about this scene is that the plants are all growing *in fairly neat lines running vertically up and down the slope*.

I start the lesson as a travelogue, showing slides of the general area, including patches of snow still present in mid-July. I talk about the loose rocks. I establish that this is a harsh environment. I then proceed something like this:

> "The next slide I'm going to show contains a puzzle. When I show it to you, I don't want anybody to say anything out loud. Just sit quietly and look carefully at the slide. Imagine you are there, that you have just come on the scene, and you have noticed something peculiar.
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> "After you have looked carefully for a few moments, write down what you see. Be as descriptive as you can be. Note any details. In particular, note anything that seems odd or peculiar."
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> I then show the slide described above--leaving it on the screen for the duration of the lesson. After several minutes of silence, I call for comments. I ask the students to read what they have written, to share their observations with the rest of the class. I make no particular comments; I just let the observations flow. Several of the students always note the linear arrangement of the plants. When the conversation begins to wane, I ask the big question:
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> "WHAT'S GOING ON HERE? How did these plants come to be growing in lines, with virtually no growth between the lines? Again, please do not answer out loud. Observe the slide. Look carefully for any evidence that might help you answer my question. *Any evidence, no matter how outlandish*. Then speculate, on paper, what might have been the chain of events that led to what we see here. I personally do not know the correct answer. I was not there when it happened. I have my opinion, but I want to hear yours."

Eventually, I ask the students to present their guesses. I ask them to read what they have written, not just tell what is on their minds. The extra step of writing it down formalizes their thinking. [In most classes, some of the students will notice that the plant growing at the top of each line is larger than all the plants below it. They then speculate that that plant somehow got started in a protected depression. As it grew, it provided protection below it, perhaps a windbreak or a barrier to melt water flowing down the slope. As numbers of these pioneer plants grew, each with its protected neighbors below it, they forced the melt water to flow in the channels between the lines, keeping those channels vegetation free. Is this the correct answer? I don't know, but it is my best guess and seems to be the best guess my students have come up with over the years.]

North-facing vs. South-facing Slopes

In another example, I show students a panoramic view of a very dry habitat in southwestern Montana. The view starts at a relatively high elevation on the left, slopes down to a dry stream bed in the center (a drop of about 100 meters), then rises again to higher elevation on the right. The vegetation is very sparse and short on the slope to the left. Lots of open space. The tallest shrubs are 20-30 cm tall. In the dry stream bed, there are assorted meter-tall shrubs, mostly sage, growing fairly densely, with very little open space.

About half-way up the slope on the right, scattered trees appear (limber pines), growing fairly evenly spaced (4-5 meters apart) with low vegetation in the spaces between.

The rest of the slides I show are close-ups of each of these regions, showing bare, cracked earth or various individual plants, including some scrawny prickly pear cactus, with something in the picture to show scale--a finger, a coin, or a person. This presentation has been accompanied by very little narrative on my part.

Next comes the question: "WHAT'S GOING ON HERE?" The procedure is basically the same as above. The students write a description of what they see. Then they are asked to explain why the plants are arranged the way they are. [In this case, the explanation involves the south-facing and north-facing slopes. In this dry climate, the south-facing slope (on the left) is exposed to the drying effects of the bright sun, summer and winter. There is barely enough moisture to support a sparsely distributed flora. The north-facing slope (on the right) is in shadow throughout most of the winter months when the sun is low in the sky. As a result, more moisture is retained in the soil. Over long periods of time, this is a significant effect, allowing a few scattered trees to get a foothold. The stream bed, though exposed to full sun at any season, does have the advantage of readily available water, in some quantity, as a result of the drainage from the surrounding hillsides. Thus the stream bed is sort of a middle ground between the drier south-facing and wetter north-facing slopes.]

OUTDOORS

I have been fortunate to have been teaching in a school in a rural environment, surrounded by fields and forests and streams. But even on an urban campus, situations analogous to those described below can be found. These outdoor activities can be run like those above or set up as a 'twenty questions' quiz.

Pine Woods vs. Deciduous Woods

This exercise works very nicely in the autumn, as the leaves are falling. I take my students on a short hike. At the first stop, I ask them to hold hands (titter, titter), close their eyes (nudge, nudge), and then follow me in single file as we walk along a path through a pine woods. I ask them to listen very carefully as we go. I am fortunate that this path, after crossing through the pines, then rather abruptly moves into a deciduous forest. Suddenly, the whole ambiance changes. The softness of the fallen pine needles makes for a very quiet, almost hushed experience. But when we break out into the deciduous forest, the dry, crisp, newly fallen leaves make a racket under foot. The object here is to show the students that they use more than just their eyes to "see."

Old Field Succession

In piedmont North Carolina, where I live, there are numerous forests that have grown up on abandoned fields that originally had been cleared in the first half of this century for planting crops. In some cases, these forests are fairly homogeneous stands of pines growing up in the furrows left behind by the farmers. So there are these evenly spaced trees growing up in an evenly undulating substrate. A perfect situation for asking the question: "WHAT'S GOING ON HERE?"

Windfalls

Another common situation here in North Carolina occurs when a deciduous forest has grown through and replaced a pine forest over time. Since young pines cannot germinate in the shade, but hardwoods can, the latter, over time, replace the former. As the hardwoods get older, the pines slowly disappear, though a few old ones will often linger on for years. And then there is a severe winter storm. The deeply-rooted hardwoods will barely be affected, while the shallow-rooted pines may all be knocked over, ripping the roots with their clinging earth right out of the ground. The result is a large hole where the roots were and a large root ball sticking up out of the ground. Quite often, the felled trees will all be lying in the same direction. Pines decay quite rapidly in our climate, so in just a few years, the only signs left of this storm are these dirt piles next to these holes, all in the same orientation. "WHAT'S GOING ON HERE?" An enterprising student may begin digging around and find some remnants of the old decayed pine, either bits of root in the dirt pile or bits of trunk under the fallen leaves. Eventually, as a group they will unravel the mystery.

What Is the Difference?

On our campus, we have a number of trees that were all planted at the same time. And yet, they are now all different sizes. In some cases, this is simply because they are different species. But in other cases, they are the same species, and they are even growing within several feet of one another. "WHAT'S GOING ON HERE?" There is lots of room for speculation here. Soil. Drainage. Herbivory (lots of deer in the area). Selective application of fertilizers. And much more.

Tree Rings

This is not your usual question about tree rings and the age of the tree. On a late-May field trip to a nearby flood control lake, I noticed that all the trees within about three meters of the lake shore had a yellow-green ring around them about 20 cm above the ground. Before my students had a chance to get close to the water's edge, I asked them the following question: "What annual biological event occurred shortly after the extended period of rain we had about 10 days ago? Search the area. There is some very strong evidence that should help you in answering this question." [In this case, the local loblolly pines all dumped their massive pollen loads shortly after the heavy rains. The lake level was high from the rains, but was gradually receding as water was released through the dam. The pollen that had been floating on the surface was left behind as brightly colored rings around the trunks of all the trees.]

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