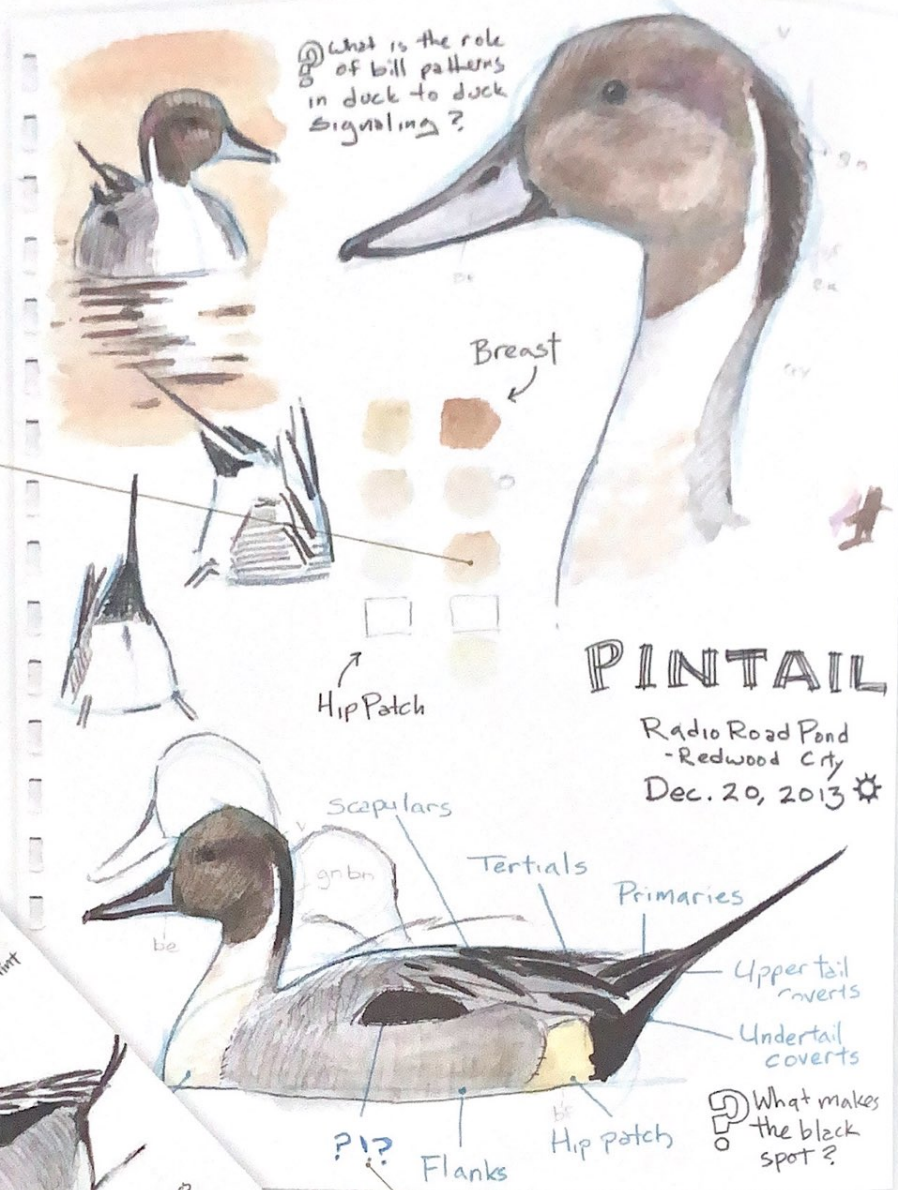


FOLLOW THE QUESTIONS

Ask and follow questions to go on a journey of wonder and discovery.

1 While sketching at a pond I noticed variation in the color of the breasts of pintail ducks. I made a color chart to record the range of colors that I saw.

2 My curiosity about the breast color grew and I began to compare the colors of other white-breasted ducks across the pond and ask questions about the staining I saw on their bellies.



3 Before leaving that afternoon, I labeled all the feather groups on the Northern Pintail's body. As I did, I discovered that I did not know what feathers made the black bar on its side. Writing down my question locked it into my memory as a puzzle to be answered another day.

"Where observation is concerned, chance favors only the prepared mind."

—Louis Pasteur

PINTAIL

BLACK SPOT MYSTERY
A It's the scapulars!
The lower scapulars!!

too long!!

DEAD DUCKS

No Pi II
Gw Te I
Am Co III
Unkn. VII
Cov I
Co Gro I
No Su III
Gadw I
Am Wi III
Gull Sp. I
TOT: 38

MEDIAN COVERTS

PRIMARY COVERTS

UPPER SCAPS.

SECONDARIES

PRIMARIES

DISEASE?

• Avian Chlora
• Avian Botulism

lots of dead ducks. What is happening?

Injury?

• hunting
• power lines

TOXINS?

• human
• natural

What am I not thinking of?

• lots of thick algal mats (green) near shoreline.
• Orange staining on duck bellies.

What is the "normal" baseline # of dead birds

Why no dead shorebirds?

4 Returning to the pond a few days later, I found a dead pintail. Remembering my question, I eagerly probed its feathers to discover what made the black bar.

5 I carefully drew the individual feathers and made a diagram of the extended wing, showing how all the feathers worked together to create the plumage patterns. I drew the feathers life-size, first tracing their shapes and then filling them in with detail. I was struck at how the curved edge on the spot on the feather itself was reflected in the pattern on the body.

6 As I continued my way around the pond, I began to pick out other dead birds. I might not have noticed these had I not focused on the dead pintail a few minutes earlier. I began to tally the number of dead birds. As the numbers grew I realized I was onto something big.



7 Mapping out my thought process helped me think critically about what was going on. This approach took me through the initial stages of generating alternative hypotheses. The category "what am I not thinking of" helped me to keep an open mind.

Epilogue: Within a few days the number of dead birds grew to over 150 and an outbreak of avian cholera was confirmed in the pond. The water was drained to halt the spread of the disease. Could the rusty stains on the birds' chests be an early warning sign of the disease? I will hold this question and look for other clues on future adventures.

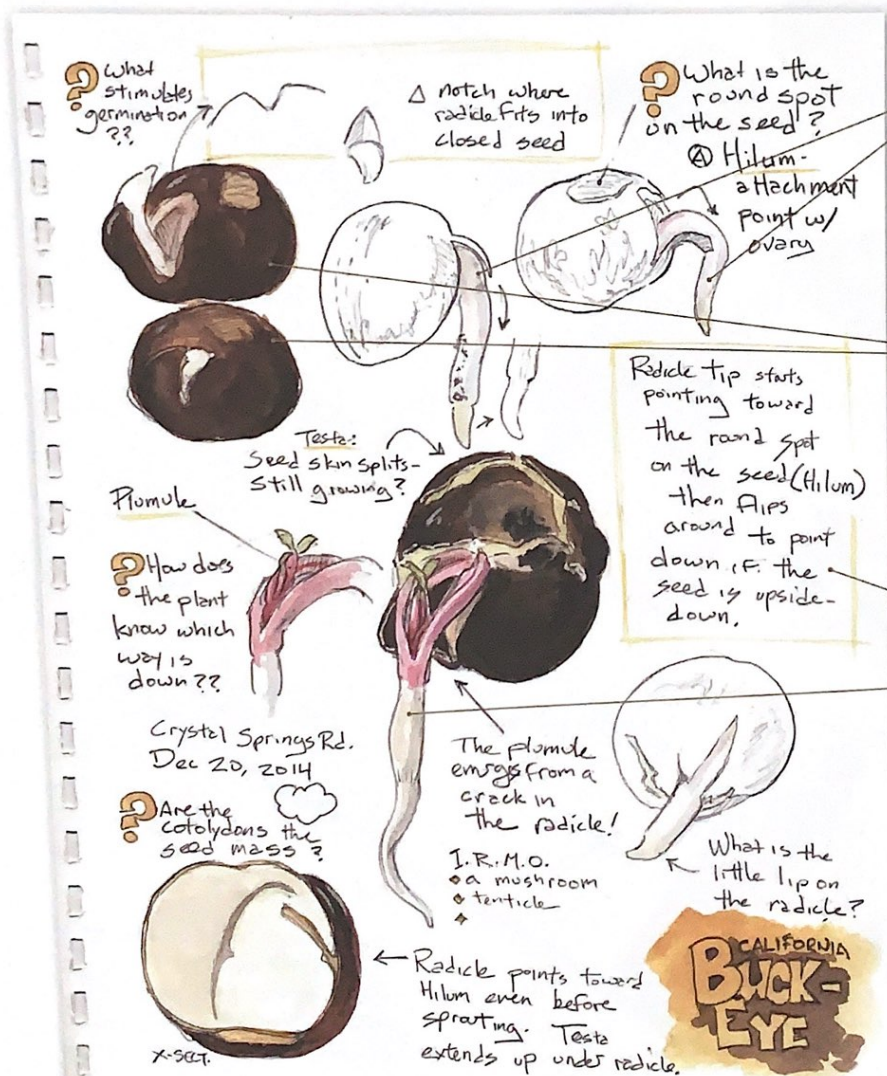
Radio Road
Dec 29, 2013

LOOK FOR PATTERNS, THEN FIND EXCEPTIONS

Scan for patterns in plant structures, animal behaviors, landform features, or any other part of the natural world. Behind the pattern you may discover an interesting process or mystery.

Practice searching for patterns in the environment until it becomes a habit. Patterns are the clues to mechanisms or processes at work in nature. Imagine you encounter a flock of ducks floating in a pond. What sort of patterns might you find? Are they facing the same way? Does this change as the wind direction shifts? How close are they to each other? Does this change when they are feeding or resting? Are males and females in separate groups within the flock? Do males and females seem to be swimming in pairs within the flock? Searching for patterns and asking these sorts of questions can key you into discoveries that you would otherwise miss.

Once you identify a pattern, intentionally look for exceptions to the rule: our bias toward confirming our expectations needs to be held in check. If you find a lot of exceptions, the pattern may be a weak one. However, if you do not find exceptions when really looking for them, you might be onto something interesting. Sometimes exceptions provide even greater insight into the pattern. If there are just a few exceptions, investigate those more carefully. Do the exceptions have something in common? Is there a pattern to the exceptions themselves? Discovering and unraveling patterns is fun and opens another door to inquiry.



1 I began this investigation when I discovered a cluster of sprouting buckeye seeds. Scanning for a pattern, I saw that the radicle (root) seemed to always point down. Often, the radicle grew straight down into the soil, but sometimes it came out curved or twisted.

2 I tried to find exceptions to this pattern. On a closer inspection I found a few seeds in which the radicle pointed up. All of these were young sprouts. I wondered what determines the direction in which the sprout begins.

3 I discovered that the radicle always emerges with the tip pointing toward the circular spot on the seed. When I did some research, I learned this spot is called the "hilum" and is the place where the seed attaches to the side of the seedpod. If the seed lands with the hilum on the bottom, the radicle grows straight down. However, if the seed lands with the hilum up, the radicle must twist over to make it to the soil. I also cut a few unsprouted seeds in half. There I saw the relationship between the hilum and the radicle even before the seed coat cracked.

4 I answered many of my own questions about buckeye sprouting and came away with even more interesting questions: How does the plant find which way is down? And do seeds that land hilum-down have greater chances of survival? I would not have asked these questions if I had not been looking for patterns. Sometimes you need to explore a bit for the really interesting questions to emerge.

MAKE COMPARISONS

Compare two individuals from the same species or two individuals from similar species. The slight differences between them will stand out and the process will help you to notice and describe subtle details.

NOTICING DIFFERENCES

An object's features stand out when you compare it with something similar. If you were to describe a single leaf, you might not mention the gloss or dullness of its surface. However, if you were to compare leaves of two different species, relative glossiness would stand out.

This joint evaluation is a powerful tool in your intellectual toolbox, making possible such observations as "bigger than," "rougher than," "darker than," or "more delicate than." Comparing two similar objects gives you a broader framework for evaluating and describing each one individually.

