HOMESCHOOL TEEN ART WORKSHOP
LESSON OUTLINE: SCIENTIFIC ILLUSTRATION AND INQUIRY

WEBSITE DESCRIPTION:
Learn how to think like an artist and scientist while experimenting with different mediums through observation, interpretation, and practice at the Natural History Society of Maryland (NHSM). This special program is in collaboration with the NHSM and National Geographic.

This workshop is designed exclusively for homeschool students ages 13-17 in collaboration with National Geographic’s Educator + Explorer Exchange Program. In partnership with teaching artist Susan Dorsey and National Geographic Explorer Dr. Harimalala Tsiory Andrianavalona, a paleontologist in Madagascar, students make observations and interpret findings about artifacts through creative and scientific processes. This special workshop will be held at the Natural History Society of Maryland where students can view, draw, and interpret from their collection of plant and animal fossils. Students will use their observations to uncover information about the artifacts’ environment of origin and make connections to the work of Dr. Andrianavalona.

OBJECTIVES:
• Utilize the creative and scientific processes to make discoveries.
• Experiment with observational drawing techniques to investigate a natural history collection and understand the role of observation in scientific inquiry.
• Analyze observational data and interpret findings.

MATERIALS:
- Animal Pictures
- Charcoal
- Drawing boards
- Drawing pencils
- Erasers
- Ink and trays
- Paper
- Rulers
- Scratchboard
- Sharpeners
- Styluses
- Watercolor brushes
- Water containers
- Watercolor paint
- Watercolor pencils

VOCABULARY:
Background: the objects, scenes or characters in a work of art that are furthest from the viewer
Biodiversity: the variety and interactions of living things on Earth, including species diversity, genetic diversity, and ecosystem diversity
Composition: refers to the way in which the elements of art (color, line, shape, and texture) and structural components (foreground, middle ground and background) are organized in an artwork
Crosshatching: short parallel and perpendicular lines that can be used to add value and texture to an object in a drawing
Focal Point: where your eye is drawn first in a work of art, its focus and main theme/idea
Foreground: the objects and/or characters in a work of art that are closest to the viewer
Gesture Drawing: a rapid drawing technique that captures the movement and essence of the subject matter
Inquiry: an investigation that begins with a question and involves gathering data to uncover any answers
Line Weight: refers to line thickness which can stimulate depth within two-dimensional artworks
Middle Ground: an area in a work of art that is between the objects and characters in the foreground and background

2:00 PM-2:20 PM INTRODUCTION AT THE NHSM:

- **Social Regulation Activity from Project Wild: K-12 Curriculum and Activity Guide:**
  - **Color Crazy Activity:** What might we be able to determine about an animal artifact based on coloration patterns? What makes you say that? Half of you will receive pictures of brightly colored animals, while the other half receives descriptions about those animals. For those of you who have descriptions, find the person who has your animal match. For those who have an animal picture, prominently display it with a noise or motion that represents your animal. Find your partner! *Examples:*
    - Animal Picture: Sphinx Moth Caterpillar/ Clue: This is what happens when an enemy bothers me! One of my ends will swell up making my fake “eyes” appear. I wave myself in front of my enemy and they run away thinking I am another animal.
    - Animal Picture: Striped Skunk/ Clue: I have strong black-and-white warning coloration. When animals recognize my warning colors they know to steer clear because I let off a foul-smelling oily musk.
    - Animal Picture: Red Squirrel/ Clue: My coloring helps me to camouflage. When a predator is soaring above, my dark fur blends in. When I’m in a tree and a predator is peering from below, my light belly fur blends in with the sky.
    - Animal Picture: Wasp/ Clue: I can be black and white, black and yellow, or black and orange. These colors warn hungry birds and other enemies that I can hurt them!
    - Animal Picture: Wandering Leaf/ Clue: Can you find me! I have a very tricky disguise. You could be staring at me for hours and not know I was there with my flattened shape and patterns. One week after I am born I turn green.

- **Collaborative Art Making Activity:** In each partner group, one of you will observe an artifact through touch and sight. This person is the describer. The other must have their back turned to the object and is the illustrator. The describer must describe the object in detail to the illustrator who is not allowed to see or interact with the artifact, but who will drawing it based on their partners description. The describer is not allowed to share the taxonomic identity of the artifact (ex: bird, insect, or plant), but only characteristics such shape, color texture, size, what it eats or how it moves. *Partners will switch roles and participate in the activity again with a different artifact.*

- **Learning Framework:** What was this experience like as the describer? What was it like as the illustrator? What makes you say that? Did anyone experience frustration? Describe what was frustrating. Maybe it was frustrating because the describer couldn’t reveal the identity of the object knowing it would help their partner. Maybe it was frustrating for the drawer because you didn’t have all the answers right away and had to keep listening and asking questions to understand what you were drawing. Did anyone find this process fun? Explain. Not having all the answers may evoke curiosity and challenge us in different ways. We are going to continue to build upon this model of curiosity and observation through inquiry investigation. Describe what this is and any experience you’ve had with it.

Art and science utilize similar inquiry processes. *Show students an image of the scientific process.* What do you notice about this process? What words would you use to describe the creative process? Where do you see the
creative process reflected in the scientific process? What makes you say that? Review the Explorer + Exchange Program with students. I will be participating as a co-inquirer by gathering your questions and data to post on the student blog for Dr. Andrianavalona to comment on and provide interpretation guidance.

2:20 PM-3:15 PM INQUIRY INVESTIGATION:

- **Discussion:** As we look more closely you might notice each artifact tells a story. I will quote from author Rusty Russell to set the stage for our investigation:

  “Dig a little deeper and you will find that each object can take you on a journey to another time and place. The objects tell many stories, depending on what you ask of them. They can offer information about conditions, events, or interactions during the time period they are from. A single collection object yields multiple stories when examined from different viewpoints...Collections are not only a time machine into the past, but also into the future. Specimens reveal changes on Earth, allowing us to better understand what may happen in the future.”

With that in mind, I also asked our National Geographic collaborator and Madagascar based Paleontologist to share a story of how she conducts investigations of objects similar to what we will be doing today as inspiration for our own investigations.

  “When I first went on paleontological fieldwork in 2010, I particularly wanted to know how sharks lived 23 million years ago. Were they diversified, did they interact with other species? What was the environment like where they lived? There were so many questions that needed to be investigated, so I decided to start investigating the shark’s teeth to understand their diet. I also observed the other species I collected in the same place as the shark teeth. A tooth shape shows the type of food a shark can chew. If it’s triangular and has many denticles (bristle-like small tooth projections), it is likely it was used to chew meat but if its round in shape (as ray teeth) they are used to crush mollusk shells. With the teeth, I also collected fossils of bivalves (a mollusk with two shells hinged together such as oysters, clams, scallops etc...), crabs and many bony fish teeth. These animals found near the shark teeth told me that the sharks lived with those animals who require shallow marine water. It gave me a clue as to what my field site must have looked like 23 million years ago; it must have been near the coast, and under shallow marine waters. While collecting fossils, I observed that most of the shells were crushed and not many were complete. This sparked my curiosity and prompted me to question if this had something to do with the energy level of the sea at that time. I knew that crushed shells are characteristic of tidal environments. As the sea goes back and forth during high and low tide, the waves crush the shells and rework them again and again. All these observations and inquiry based questions helped me to understand better how Malagasy sharks lived 23 million years ago.”

Today we will examine these artifacts from an artistic viewpoint and frame our observations using a focus question. We will use the worksheet provided to develop our questions. You can choose from the list of questions and investigation the ideas provided, or create your own. You can also choose to work with a partner on your investigation, or work independently. **Worksheet below:**
Focus Question Worksheet:

Use gesture drawing techniques to draw two objects that capture your interest.

Write a few sentences about why these objects interest you as well as three “I wonder…” statements about the objects.

Write down one question you would like to explore in an investigation of an object or objects. Describe what kind of scientific illustrations you will record to find an answer to your question. Look at the examples below for inspiration, or choose your own question to investigate.

Key questions to consider throughout your investigation:
What do you see?
What might that mean?
What makes you say that?

Focus question and investigation examples:
**Question:** What different wing shapes exist across species? How might the different shapes help the animal to move within its habitat? *Or choose to analyze the different wings of an artifact in a single taxonomic group such as the similarities and differences between bird species, or insect species.*

**Investigation:** Draw a variety of different wings from birds, insects and bats. Draw the similarities and differences, hypothesize through writing or drawing how these animals might move based on the size, shape, and structure of their wings. Draw how the animal may move in flight based on your observations using gesture drawing.

**Question:** What do different animals eat? What adaptations do they have to help them eat in their habitat?

**Investigation:** Draw a variety of different animal skulls, the similarities and differences. Hypothesize through writing or drawing—what each animal might eat and how it finds food.

**Question:** How do bird beaks vary across species? What do different shaped beaks allow each bird to eat? What does this tell us about the environment they live in?

**Investigation:** Draw a variety of bird beaks across different species, the similarities and differences. Hypothesize through writing or drawing—what each bird might eat and what this tells you about their habitat.

**Question:** What pattern and texture varieties are present on shells and crustaceans from similar environments? What might this reveal about their environment?

**Investigation:** Draw the differences and similarities in the morphology of shells and crabs. Hypothesize through writing and drawing what this might reveal about the environments in which they came from?

**Questions:** Do variations exist among the same species? What might this mean?

**Investigation:** Carefully observe the same set of objects and draw the variation you observe. Hypothesize through writing or drawing what this might reveal about the environments in which they came from.

**Question:** What can adaptations tell us about how animals live?

**Investigation:** Draw any adaptations you notice. Note the similarities and differences between species. Hypothesize through writing and drawing where the animal lived based on its adaptation. Create your own unique animals using the adaptations you observed that is able to survive in multiple habitats.

**Question:** Select several specimens from a similar biome, or a major habitat. What similarities and differences do you notice in their physiology that would help them survive in their biome?

**Investigation:** Carefully observe your objects and draw the similarities and differences you notice. Hypothesize through writing and drawing what this might reveal about how the animal is able to survive in its biome. What if the biome changed? How would your animal have to adapt? How might this create future change?
• **Techniques:** You can choose different science illustration techniques to draw your specimen. Can anyone tell me what scientific illustration is? This type of illustration merges composition, creative design, and drawing skills with scientific observation. *Demonstrate the following techniques.*
  
  o Pen and ink illustration
  o Line weight
  o Scratch board and crosshatching
  o Graphite reductions
  o Watercolor pencils
  o General tips: *Give students a half-sheet of paper with general tips for scientific illustration*
    - Blur your vision while looking at your objects and draw the shapes you see
    - Remember to look at your specimen as you draw it and record any unique intricacies such as irregular shapes, textures, or holes. Don’t rely on what you think the specimen looks like, but only on actual observation.
    - Include more detail by writing your observations, thoughts and/or questions near your drawing.

**3:15 PM-3:30 PM CONCLUDING DISCUSSION:**

Which drawing techniques did you try? Why did you choose those? What paths along the creative and scientific processes did you follow to conduct your investigation? What did you learn about your objects through observational drawing? Take turns sharing your questions, observations, and hypothesis while explaining your conclusions. Did anyone have trouble finding answers to their questions? Why do you think that was? Did anyone work in a team? Did this make your process easier or more difficult? What makes you say that?