K20 LEARN

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From the Dark, Damp Places

Alternation of Generations: Non-Vascular Plants

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Grade Level	9th – 12th Grade	**Time Frame**	3-4 class period(s)
Subject	Science	**Duration**	300 minutes
Course	Biology		

Essential Question

How does the relationship between organisms create generational change?

Summary

This lesson focused on the understanding of alternation of generations in plants, and began by examining non-vascular plants, including mosses and liverworts. It is intended for a botany or a phylogenic science class, and is not intended for introductory biology classes.

Snapshot

Engage
Teacher takes students outside to gather mosses and liverworts from a nearby source, such as the school campus.

Explore
Students will observe the samples in a lab setting.

Explain
The students will watch an animation over the life cycle of mosses and learn the academic language.

Extend
Students will examine slides of mosses in specific life stages.

Evaluate
Students will write a word splash using the vocabulary words.

Standards

ACT College and Career Readiness Standards - Science (6-12)

IOD203: Find basic information in text that describes a simple data presentation
IOD304: Determine how the values of variables change as the value of another variable changes in a simple data presentation
IOD403: Translate information into a table, graph, or diagram
SIN201: Find basic information in text that describes a simple experiment
SIN202: Understand the tools and functions of tools used in a simple experiment
SIN301: Understand the methods used in a simple experiment
SIN401: Understand a simple experimental design
EMI201: Find basic information in a model (conceptual)
EMI301: Identify implications in a model
EMI502: Determine whether presented information, or new information, supports or contradicts a simple hypothesis or conclusion, and why
EMI603: Use new information to make a prediction based on a model
EMI701: Determine which complex hypothesis, prediction, or conclusion is, or is not, consistent with two or more data presentations, models, and/or pieces of information in text

Next Generation Science Standards (Grades 9, 10, 11, 12)

HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
HS-LS1-4: Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
HS-LS3-1: Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

Oklahoma Academic Standards (Biology)

B.LS2.5 : Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
B.LS3.2 : Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.

Attachments

- I Notice I Wonder - Spanish.docx
- I Notice I Wonder.docx
- Lab Handout Extend - Spanish.docx
- Lab Handout Extend.docx
- Teacher Set Up Extend.docx
- Wet Mount Instructions - Spanish.docx
- Wet Mount Instructions.docx

Materials

- outdoor supply of mosses and liverworts
- collection tools (plastic spoons/knives) and collection dish/plate/box (pencil box or ziplock sandwich bag works)
- microscopes, dissecting scopes, and hand lenses
- glass slides
- cover slips
- water
- pipette
- prepared slides of moss and liverwort life stages
- pre-lab/moss stations/lab sheets/instructions
- Smartboard or other projector

Engage

Teachers will take students outside to collect moss and liverwort samples. Some sort of tool (plastic knife, spoon) is used to collect the plants and the soil to which they are attached, in order to keep the plant intact. Teacher should point out the conditions favorable to moss and liverwort growth (the dark, moist areas). Hornworts could also be collected, if there are any available. Assign groups of two so that one person is collecting a moss or liverwort sample, while the other person holds the plate, watch glass, or other collection device. At this time, many students may attempt to collect other types of plants, and this serves as an opportunity to identify misconceptions. Once back at the lab, the students investigate the properties of nonvascular plants.

Can't Find Any In Nature?

In the case of this lesson, it works best in early fall, when there are moist, cool areas where the plants grow. Visiting a park or some other area ahead of time may be needed in order to collect the specimens. Or, specimens can be ordered from Carolina or some other science supply company.

Explore

In the lab, students will use tools in order to investigate the characteristics of the nonvascular plants. Either pass out an I Notice/I Wonder worksheet, or have students draw a two-column table in their notes. As the students observe their collected specimens, have them document their observations and wonderings. Students should hopefully have access to dissecting scopes and/or hand lenses to view in greater magnification the gametophytes and sporophytes. Also, let students have access to rulers or any other lab supply they think they need to complete their observations. At some point, either encourage or answer the question (if it comes up) that drawings are very beneficial, and should be included in their observations.

Teacher's Note

There are so many things that can be observed, but try to keep students in the mind of the specifics of mosses and liverworts in comparison to any other plant. They should note that the relative height of mosses and liverworts is small compared to other plants they are used to seeing. They should also note the lack of true, branching roots, and vascular tissue to transport materials.

Explain

Show the link to the moss alternation of generation. The animation shows the phases of gametophytes and sporophytes, and the alternation of generations in nonvascular plants. Then, pass out the lab handout. There is extensive background information on the handout, so have students do a Stop and Jot as they read through the background information. Instruct the students to read each paragraph at a time, then jot down thoughts and main ideas for each paragraph before moving on to the next one.

Extend

One of the attachments is the lab handout, each student should get one. Using the drawing from the Explain portion, have students answer the pre-lab questions (this can be done as homework, if that fits the classroom climate more). When they think they've finished those, have the groups start walking from station to station, observing the slides in the microscopes.

No Microscopes? No Problem!

If microscopes are available, there is a link in the resources for slides of mosses in the different stages of the life cycle. If you have none of this available, the stations can still be set up, but with pictures instead (included in teacher set up attachments). It won't be as impactful, but we work with what we have.

What should be included at each station is in the attachments, and the set up of the stations should be completed before the students show up, so they can get right into the lab.

Extension

If students finish early, or the students are ready for a greater challenge, have them make wet mount samples of the samples from their explore activity. It can be scary for a teacher to allow this much freedom, but it's a great way to practice lab skills. Directions for making a wet mount slide are included in the attachments.

Evaluate

Post the following words on the board:

- Gametophyte
- Sporophytes
- Meiosis
- Mitosis
- Alternation of Generations
- Gametes
- Haploid
- Diploid

Have students construct a Word Splash, where they construct a paragraph using all eight words in the correct context. If time allows, have some students share their responses aloud. Have students turn in their paragraph as an exit ticket as they leave.

Resources

- Animation: http://www.sumanasinc.com/webcontent/animations/content/moss.html
- Example of liverworts for sale: http://www.carolina.com/catalog/detail.jsp?prodId=156500&s_cid=ppc_products&gclid=CjwKEAjwltC9BRDRvMfD2N66nlISJACq8591DhjehS5wQUvK4L4UlwZLrCAXlrFD_ZG4gjB-LTnz1BoCRmfw_wcB
- I Notice/I Wonder (Explore): https://learn.k20center.ou.edu/strategy/d9908066f654727934df7bf4f507d1a7
- Moss microscope slides (Extend): http://www.carolina.com/plant-microscope-slides/beginners-moss-life-cycle-microscope-slide-set/292434.pr?question=moss+microscope+slide
- Stop and Jot (Explain): https://learn.k20center.ou.edu/strategy/d9908066f654727934df7bf4f5077921
- Word Splash (Evaluate): https://learn.k20center.ou.edu/strategy/fe96d3de46cfdc1f385aab7e7500a888