



HIGH SCHOOL

 PRE AND POST VISIT ACTIVITIES

PRE-VISIT

GUIDING QUESTIONS

What is a botanical garden?

Why are botanical gardens important?

Plants give us clean air, food, fiber, medicine and other resources. They are important and everywhere, yet many people don't know how to identify more than a few different kinds of plants. How might having knowledge about plants help an individual person and society as a whole?

ACTIVITY Propagate your own Plant

At the Botanical Garden, horticulturists, or garden cultivation experts, often need to make more plants. In order to do that, they either plant seeds, or take cuttings from mature plants that are already in our collection.

- **Try propagating in your class.** Plant seeds or take a cutting from a houseplant like pothos, *Epipremnum aureum*. Place the seed or cutting in your preferred media (such as moist soil, water, agar, or water gel crystals), place in a sunny window and wait until the roots are established before transferring into a separate pot.
- How could this skill be beneficial even if you don't have a career in plants?

SCHOOLYARD WALK Get to Know a Plant

- **Take a walk** around the schoolyard and pick out an interesting plant.
- **Draw** a picture of the plant.
- **Identify** the plant using a plant identifier app on your phone or other resources.
- **Discover** information about the plant.
- Is it a native or invasive species?
- Is it beneficial to local wildlife?
- Has it at any time in history benefited humans?

POST-VISIT

PLANT CAREERS

There are tons of plant careers out there that range from botanist to turf management to photography and floral design. Go to seedyourfuture.org/careers for an extensive list of plant careers.

Pick out a few to explore.

- What education or training is required?
- What is the average salary for this career and does it come with additional perks?
- Search for people currently working in the field and reach out to ask more questions.

BIO INSPIRED DESIGN

- The same features that help a plant survive in its environment can inspire scientists to create solutions to help humans thrive in their environment.
- Go outside and find an interesting plant.
- Draw the plant in person, taking time to examine all sides of the plant.
- Back in the classroom brainstorm how those features help the plant survive or reproduce.
- Is it helping the plant soak in sunlight, absorb water and/or nutrients, or perhaps defending the plant from predators?
- Design a solution for a human problem inspired by the plant's features. The problem can be as simple as cleaning up messes around the house or as complex as climate change.
- Share out ideas.
- Could you test any of them out?



OH YOU'RE FANCY

GSE SB3.c Construct an argument to support a claim about the relative advantages and disadvantages of sexual and asexual reproduction.

NGSS HS-LS2-8 Evaluate evidence for the role of group behavior on individual and species' chances to survive and reproduce.

Vanilla is a flavor that everyone is familiar with though most don't realize it's expensive or that it comes from an orchid. Vanilla is grown in various parts of the world like Mexico, Madagascar, India, and Indonesia. It is expensive because the plant flowers infrequently and the blooms last for less than 24 hours. Its only known natural pollinator, *Melipona beecheii*, is at risk of extinction and is not present in the majority of regions where it is commercially grown. Each vanilla blossom must be pollinated by hand in order for a vanilla seed pod to form. The pods that are produced from this pollination process are picked, dried, and processed in order to create natural vanilla flavoring.

Some flowers, like the vanilla vine, have specialized relationships with one or only a few pollinators. Although reproducing sexually will increase genetic diversity, relying on pollinators can come with disadvantages. If the plant's pollinator becomes extinct or if the plant is moved to a different habitat, it has no way to reproduce, and as a result, it too can become extinct.

PLEASE DON'T EAT ME

GSE SB6.c Construct an argument using valid and reliable sources to support the claim that evidence from comparative morphology (analogous vs. homologous structures), embryology, biochemistry (protein sequence) and genetics support the theory that all living organisms are related by way of common descent.

HS-LS4-1 Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.

Please don't eat me explores how analogous structures in two distinct pitcher plant genera, *Sarracenia* and *Nepenthes*, have evolved in habitats with nutrient poor soil. *Sarracenia* pitcher plants are native to marshy bogs in North America while *Nepenthes* pitcher plants inhabit tropical islands of Southeast Asia. Both of these plants live in nutrient poor soil and rely on animals for their needed nutrients. Both have developed a passive trap through their pitcher shaped leaves. Both use colors and nectar to attract their prey and employ liquids and enzymes to digest it. Despite their similarities, *Sarracenia* pitcher plants are actually more closely related to kiwis than *Nepenthes* pitchers.

INSPIRED BY NATURE

GSE SEV4. Obtain, evaluate, and communicate information to analyze human impact on natural resources.

NGSS HS-ETS1-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

Plants are the best, and most abundant, producers on the planet. Studying oak trees can give us insight on how to build tall structures that withstand wind and the elements. Carnivorous plants can teach us how to design effective passive traps. The waxy coating on lotus leaves that repel water can inspire stain wicking design for stain wicking materials. The possibilities are endless when we understand how plant structures are built to maximize their effectiveness for particular functions.

WE COULD BE HEROES

GSE SB5.a. Plan and carry out investigations and analyze data to support explanations about factors affecting biodiversity and populations in ecosystems.

NGSS HS-LS2-6 Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

Rosy periwinkle, *Catharanthus roseus*, is a highly toxic plant. Despite its toxicity it has been commonly used in traditional and modern medicines and is also used as an ornamental annual that gardeners display in the United States during the summer. Even though this flower can be readily found in plant stores, the plant's numbers are steadily declining in the wild. The rosy periwinkle is endangered in its native habitat in Madagascar, not because of its medicinal use but because of deforestation. There may be other plants in the spiny forests of Madagascar that also offer healing properties like the rosy periwinkle that are being actively destroyed by habitat loss.



OUT OF THIN AIR

GSE SB1.e Ask questions to investigate and provide explanations about the roles of photosynthesis and respiration in the cycling of matter and flow of energy within the cell

NGSS HS-LS1-5 Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.

HS-LS1-6 Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.

HS-LS2-7 HS Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

When we decrease global warming we decrease climate change. Carbon dioxide is responsible for causing the majority of global warming. Trees and plants are an excellent carbon sink. If we plant more trees, those trees can absorb more carbon dioxide from the air. When the trees and plants die, their carbon then gets returned to the soil, increasing the health and nutrient content of that soil.

MUTANT PLANTS

GSE SB2.b. Construct an argument based on evidence to support the claim that inheritable genetic variations may result from: new genetic combinations through meiosis (crossing over, nondisjunction); non-lethal errors occurring during replication (insertions, deletions, substitutions); and/or heritable mutations caused by environmental factors (radiation, chemicals, and viruses).

NGSS HS-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)

Not all mutations are harmful nor are all beneficial. Variegation in leaves caused by mutation is non-lethal, meaning that it does not kill the plant. However, variegation in leaves can be helpful or harmful to a plant depending on its environment. For some plants, variegation causes stunted growth and development because the plant does not contain enough of the sun trapping pigment chlorophyll resulting in lower rates of photosynthesis. Other plants, often found in the forest understory, benefit from the mimicry and camouflage offered by variegation patterns. The variegated plants can use their coloration to appear as if they have eggs laid on them already, been eaten, sickly, or not as easily visible. This provides them an advantage over other fully green foliage.

IT'S ALL IN THE FAMILY

GSE SB4.a Construct an argument supported by scientific information to explain patterns in structures and function among clades of organisms, including the origin of eukaryotes by endosymbiosis.

NGSS HS-LS4-1 Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence

Depending on the time of year, one might find multiple plants representing several families in the Edible Garden. Present year round, are members of the rose family, *Rosaceae*; apple trees, blackberry brambles, strawberry plants. Other members of the rose family including roses, quince, and crabapple can also be found in other parts of the Garden. In the summer, many plants from the nightshade family, *Solanaceae*, are often present in the Edible Garden including: peppers, potatoes, tomatoes, and eggplant. Petunias and angel's trumpet are additional nightshade plants found in other parts of the Garden. During the winter, plants in the mustard family, *Brassicaceae*, are often used. Members include broccoli, bok choy, kale, collards, kohlrabi, cabbage and radishes. Finally, many herbs in the *Lamiaceae* family, like rosemary, sage, mint and basil, can be found in the planted pots throughout the Edible Garden.

ALLERGY SEASON

GSE SB3.c Construct an argument to support a claim about the relative advantages and disadvantages of sexual and asexual reproduction.

NGSS HS-LS2-8 Evaluate evidence for the role of group behavior on individual and species' chances to survive and reproduce.

Many of us suffer from allergies and may be hesitant to interact with plants as a result. However, generally, only a few plants trigger an allergic response in some humans. Wind pollinated plants benefit from the genetic diversity from reproducing sexually and don't have to depend on another species for their reproduction. However, pollination by wind is not as direct as animal pollination. Therefore these plants have to produce billions of smaller pollen grains in hopes that one will randomly reach the flower of a nearby plant of the same species. Because of the smaller size of the pollen grains, and the massive amount of pollen released into the air, it is much easier for this pollen to be inhaled by an unsuspecting human and unintentionally trigger a seasonal allergic reaction.



NAME _____

Photo Scavenger Hunt

Directions: Using the information and Garden Map below, find and answer the questions about our fascinating collections. Once found, take photos of the items listed and get bonus points for extra effort. **Thanks for staying on the path and following signage in the Garden.**

WE COULD BE HEROES

Scientists are constantly discovering new plants to fight and prevent disease. The Rosy Periwinkle, *Catharanthus roseus*, is endemic to the Madagascandesert and on display in the Desert House. It contains several compounds currently used to treat various cancers.

- **How might its usage as a medicinal plant affect the plant's population numbers in the wild?**

Photo Challenge: Take a photo with the Rosy Periwinkle in the Desert House or another medicinal plant in the Garden.

Photo Bonus: be a superhero

INSPIRED BY NATURE



Plants with interesting features often influence scientists and artists. Hitchhiker seeds that cling to animal fur led to the invention of Velcro and water-repellent lotus leaves inspired the development of super hydrophobic materials.

- **What other interesting plant features could be used to create solutions to human problems?**

Photo Challenge: Take a photo with a plant with features that you find interesting.

Photo Bonus: show your “aha!” face

PLEASE DON'T EAT ME

*Sarracenia**Nepenthes*

Carnivorous, or meat eating plants, are found on every continent except Antarctica and have adapted to survive in nutrient poor soils by attracting and trapping bugs and other animals. Compare *Nepenthes* pitcher plants throughout the High Elevation House in the Fuqua Conservatory to *Sarracenia* pitcher plants in the Conservation Garden. They look similar, but the *Sarracenia* pitcher plants are more closely related to kiwis than the *Nepenthes* pitchers.

- **Even though these plants are not closely related, how have they adapted in similar ways?**

Photo Challenge: Take a photo with your favorite carnivorous plant.

Photo Bonus: pretend they eat humans

OH YOU'RE FANCY

Vanilla is the second most expensive spice on Earth. Vanilla orchids reproduce sexually and can only be pollinated by one type of bee native to Mexico, so commercially owned plants must be pollinated by hand.

- **What are some disadvantages of reproducing sexually?**

Photo Challenge: Take a photo of a vanilla vine, *Vanilla planifolia*, in the Orangerie in the Fuqua Conservatory.

Photo Bonus: make it fancy



NAME _____

Photo Scavenger Hunt

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OUT OF THIN AIR

During photosynthesis, plants absorb sunlight, water and carbon dioxide to create the sugar glucose, while releasing oxygen. This glucose can form long chains of cellulose that make up most plant structures. The more carbon dioxide the plant absorbs, the bigger the plant can grow. Scientists estimate that around 95% of a tree's mass comes from the air.

- **How might plants be a solution to combat climate change?**

Photo Challenge: Take a photo with a plant that has absorbed a lot of carbon dioxide

Photo Bonus: breathe in that fresh oxygen it releases

MUTANT PLANTS



Variegated (spotted) leaves occur because there is less of the green pigment chlorophyll in some of the plant's leaf cells. This is often the result of a DNA mutation within the cells that could be inherited or occur randomly.

- **Does the DNA mutation seem to be harming the plant? Why or why not?**

Photo Challenge: Take a photo of a variegated plant

Photo Bonus: use forced perspective to make it look like a giant mutated plant or a tiny mutated plant.

IT'S ALL IN THE FAMILY

Rosaceae

Rosa

"F.J. Lindheimer"

Found Rose

2004

Scientists classify plants into families based on their characteristics. At the Garden plant family names are included in the upper left hand corner of plant labels and end in the Latin suffix "aceae". Look for two different plant species from the same family in the Edible Garden.

- **Why do you think these plants are classified in the same family?**

Photo Challenge: Take photos of at least two different plant species in the same family

Bonus: make it a full house (find five plant species in a family around the Garden)

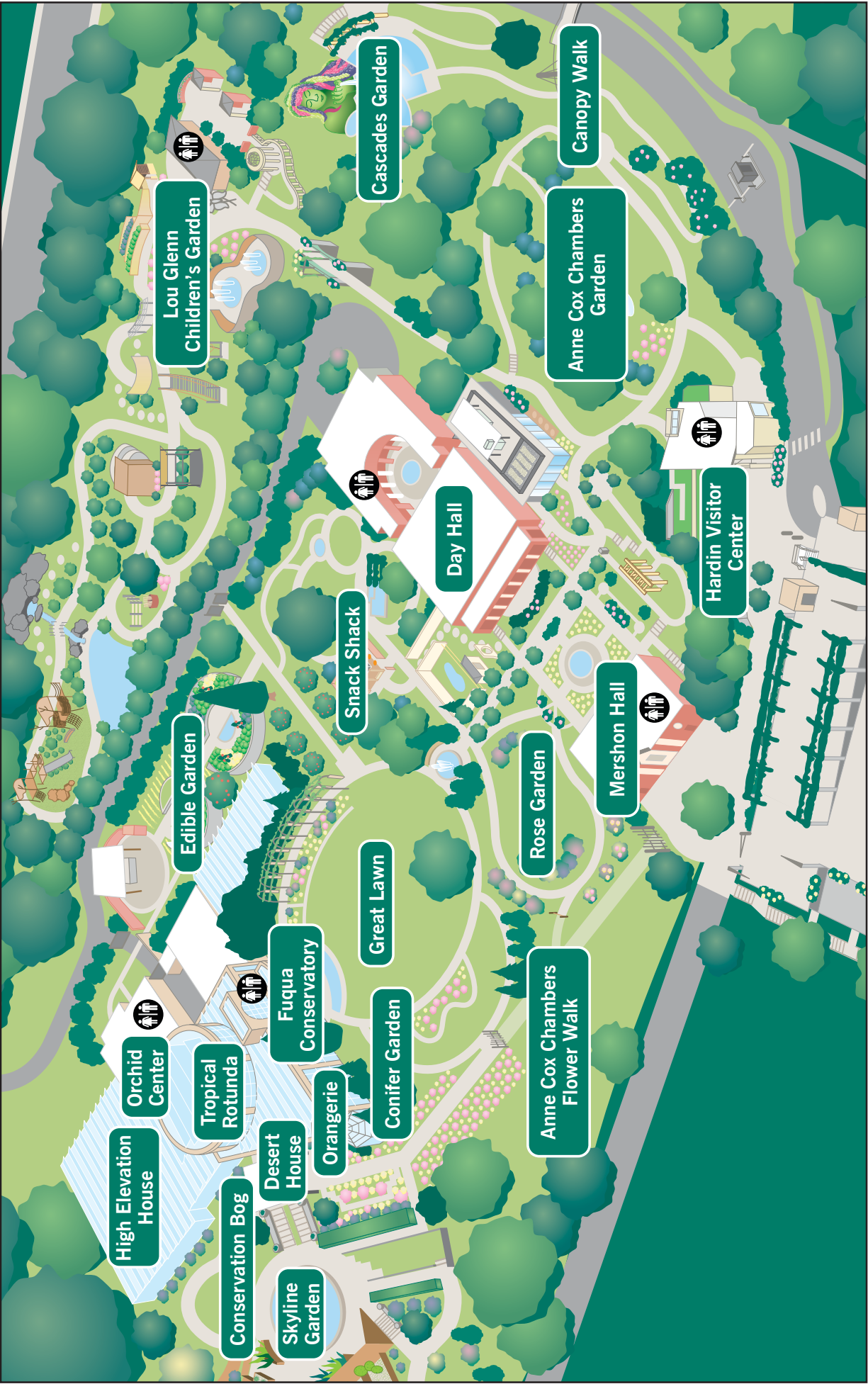
ALLERGY SEASON

Most of the pollen that makes us sneeze come from sexually reproducing plants who release their pollen into the air instead of relying on pollinators. Examples of wind-pollinated plants are grasses, oak trees, maple trees, and conifers.

- **What are some advantages to this form of reproduction?**

Photo Challenge: Take a picture with a wind pollinated plant.

Photo Bonus: try not to sneeze



High Elevation House

Orchid Center

Tropical Rotunda

Conservation Bog

Desert House

Skyline Garden

Fuqua Conservatory

Orangerie

Conifer Garden

Great Lawn

Edible Garden

Snack Shack

Day Hall

Mershon Hall

Hardin Visitor Center

Anne Cox Chambers Flower Walk

Rose Garden

Anne Cox Chambers Garden

Canopy Walk

Lou Glenn Children's Garden

Cascades Garden