The Buzz About Bogs!

Growing Pitcherplants and Bog Wildflowers from Seed

Essential Questions:
What is a seed?
How does a seed break dormancy?
How do scientists get clues about growing plants from studying a plant's life history and habitat?
What is phenology?

Background Information:

These directions are specific for bog plants, pitcherplants, other carnivorous plants, and bog wildflowers. If you use this soil mix and wet technique for other non-bog wildflower species, you will rot them.

Contact EPSN Headquarters any time you have questions or need help.

I. What Is A Pitcherplant?
A **pitcherplant** is a **perennial**, non-woody plant with special leaves that eat insects. They are long-lived plants, and some scientists estimate that pitcherplants can be over 100 years old. Pitcherplants are in the genus *Sarracenia* in the *Sarraceniacea* plant family along with other carnivorous plant genera the genus *Darlingtonia* with Cobra Lillies in California and the genus *Heliamphora* with Marsh Pitchers found primarily on table-top mountains or "Tepuis" of Venezuela. There are eight species in the genus *Sarracenia*, all living in the Southeast United States.

Pitcherplants are carnivorous plants. They eat insects and sometimes small animals. Pitcherplants have special leaves called "pitchers," and they trap plants passively – not actively like the Venus Flytrap which grasps its prey. Pitcherplants capture insects by luring them inside their tubular leaves with sweet nectar and fragrance. Once inside the insects are forced deeper and deeper inside the tube of the pitcher by stiff, downward facing hairs, slippery surfaces, misleading false escape windows, and some even believe intoxicating chemicals that confuse the insects so they cannot escape. In the belly of the pitcherplant are digestive enzymes just like in our stomachs that digest the insects leaving their exoskeletons behind.

Location: indoors

Objectives: *Learners will:*
1) Observe and document the life cycle of a rare plant species.
2) Explore how conservation horticulturists design a propagation protocol by observing a plant species in its natural habitat.
3) Learn what seed dormancy is and different techniques for breaking dormancy.
4) Investigate seed viability.
5) Grow rare plant species from seed.
6) Study the reasons plant species are threatened and develop strategies to help those species recover.

Grades: K - 12

Skills: communication, analysis, measuring, observing, data collecting

Supplies:

- 5 x 5 inch cell pots or plastic tub that is wider than deep.
- pitcherplant and other bog wildflower seeds
- peat (milled sphagnum moss, smallest bale you can find)
- dust masks
- river sand
- plant labels
- large tray with no drainage holes (non-drain flats)
- newspapers
- large plastic tub for mixing soil
- water
- paper cups
- water
- pipettes
- pencils
- data sheet
- scissors
- humidity dome or plastic wrap & large rubber bands

Subjects: science, horticulture, history, botany, phenology

Time: 30 minutes

Pitcherplant species are threatened and endangered throughout their range in the Southeast US because of loss of habitat. Their bog habitat is destroyed by digging for development, silting over from erosion, and shading and smothering by shrubs from lack of fire. Invasive plant species like Chinese Privet take over the bog wetland. Herbicides used to spray ditches along roadsides destroy bogs as well. And pitcherplants are dug up from the wild by plant collectors. So you can see, these special plants really need your help!

II. What is a bog?

Coastal Plain Pitcherplant Bogs where once common throughout the Southeastern United States. They are part of the Longleaf Pine Ecosystem found throughout the southern states, which is now reduced to 3% of its original area (pers. comm., Rob Suter, The Nature Conservancy). Stands of Longleaf Pine exist but much of the understory has been destroyed due to suppression of fire, erosion, cultivation, and chemical use. One of the most common problems these beautiful habitats face is wild collecting, or people digging up plants from the wild instead of getting them from a propagated source. Please remember that if you do decided to create a pitcherplant garden with carnivorous plants there is a responsibility that comes with their acquisition. Pitcherplants and many other carnivorous species are actively collected from the wild. So check carefully with your nursery about their source for these plants before purchasing.

A Coastal Plain Pitcherplant Bog generally lies on a very slight slope. A stream or a spring seeping out of the ground at the upper end of the bog feeds the habitat. Water flows through the bog site in a sheet as it spreads through the grasses, sedges, and sphagnum moss. The water is held at the surface by a high rock table that you can easily hit with a metal pole by pushing down just a couple of feet. Without the rock table, the water would simply percolate down into the sandy soil. Healthy bogs lie in full sun, are fed by a clean water source, and have an intact herbaceous layer with incredible diversity. It literally is a wet, wildflower meadow.

To create a bog on your schoolsite, you will need to mimic these natural bog features: rock layer (pond liner), slight slope (shallow hole dug with gently sloping bottom), bog soil (sand layer below, peat and sand layer above), water flow (soaker hose feeding the top of the bog and water flowing to the bottom), full sun (four hours afternoon sun is a minimum). *(Tip: When conservation horticulturists study ways to grow rare plants from seeds, they will first study the natural history of that species in its natural habitat. Looking at the sentence above you will find clues on how to grow pitcherplants from seed.)*

Besides carnivorous plants of wondrous diversity like Pitcherplants, Sundews, Bladderworts, and Flytraps, you can also grow from seed a suite of herbaceous bog plants that include many wildflower genera (*Rhexia, Ludwigia, Xyris,* and *Eriocaulon*), terrestrial orchids (*Calapogon, Spiranthes, Pogonia*), grasses (*Aristida, Sporabolis*), and sedges (*Fimbristylis, Furina*). Always be sure to check your sources so you don't

contribute to the demise of these endangered plant communities. If you are an educator in the EPSNetwork, we offer a free seed exchange for you.

What are pitcherplant seeds like?
Pitcherplant seeds look like tiny pumpkin seeds. *Sarracenia* fruit has five **locules** (rooms within the ovary of the fruit). The fruit of a pitcherplant is called a **capsule**. It is a dry fruit and looks like a small basketball with seams running down the sides, marking the different chambers. There can be many seeds within each locule. *Sarracenia psittacina* produces lower amounts of seed numbering around 150. *Sarracenia leucophylla* can have 300 seeds per flower. *(Question to ponder: If pitcherplants produce so many seeds and growing pitcherplants from seed is no secret, why do people dig pitcherplants from the wild?)*

As an EPSN educator, seed will arrive in an envelope. This seed has already been cleaned (removed from fruit) and is ready to be sown. If you have more seed than you can sow, or if you must delay sowing seed, store it in a paper envelope. Place this paper envelope in a sealed plastic container and put it in the refrigerator. *Sarracenia* seed can be stored this way for several years, but the percent of seed that will **germinate** lowers as time goes on.

What is germination?
Germination is the act of a seed waking up from its dormancy. Seeds wake up in the wild after they receive clues from the environment that the time is right to wake up and grow. These clues include changes in temperature, water, and light. In the Southeastern United States most plant species' seeds germinate in the spring after a cold, wet winter. There are species who germinate at other times (waking up in the winter) or from other clues (being exposed to the acids and scraping in a bird's crop or heat from fire). But most species tend to germinate in the spring. So there clues may be a combination of cold and wet for specific amount of time and then warm. When germinating seeds, we give them a cold, wet period called **stratification** followed by a warm period to help break the seed out of dormancy. Stratification is a pre-treatment for seeds to help wake the embryo up from its dormancy. Stratification tries to mimic natural conditions that the seed would experience in its natural habitat. So, studying plants and observing them in their natural habitat is important for learning how to grow plants from seed.

How do we know when a seed has germinated?
Germination is recognized when the seed-root (the **radicle**) emerges from the seed. When a seed is buried under the soil, you cannot see this happening. Most of the time, we know a seed has germinated when we see the **cotyledons** (seed leaves) emerge from the soil. But if you sow seeds on top of wet sand in a Petri dish wrapped in plastic wrap or better still parafilm, you can watch seed coats split and radicles emerge as the seeds germinate. *(Tip: This is a great experiment to do with larger seeds like lima beans or sunflowers. Use a jar and wet sand or a plastic ziplock bag and wet paper towels to observe germination in detail. Have students draw pictures of what they observe.)*

What is Pitcherplant Phenology?

Phenology is the study of plants and animals over the seasons, observing how they change. In plants, students can study the phenology of flowers. Observing the phenology of rare plants is an important investigation for learning about their life history and applying this knowledge to growing plants from seed and caring for them.

Pitcherplant species in the Southeastern United States flower in the spring before new pitcher leaves emerge. Emerging flowers look like lollipops. The stems elongate, opening into a pitcherplant flower with five petals. The style of the flower is modified and looks like an upside down umbrella. The **stigma** (female part of the flower receptive to pollen) is on the curved parts of the "umbrella." The stamens (the male parts of the flower that carry and present the pollen) are tucked under the stigma umbrella. Bees and other pollinators must crawl under the petals and into the bell of the umbrella to gather their pollen and nectar rewards. The petals and stamens fall off the pitcherplant flowers and the ovules inside the ovary (at the base of the upside down umbrella handle) begin to grow and mature. The ovary swells through the summer to a five chambered, dry fruit capsule. In the early fall, the fruit splits along seams, shaking its seeds out through the fall. The seeds are exposed to water with the fall rains of the Southeastern United States. Pitcherplant seeds float which is unusual for most seeds. *(Tip: Have your students test if pitcherplant seeds do indeed float. Most other plant species have seeds that sink. For most species, if the seeds float they are hollow and not viable.)* Pitcherplant seeds float, moving through the bog habitat away from the parent plants and eventually settle, most often germinating on bare soil, where they are exposed to light. *(Question to ponder: Why would seeds have clues like exposure to light to help break their dormancy? Clue – Think about competition from other plants and how an embryo inside a seed coat would receive clues that there is no competition.)* Seedlings germinate in the spring after temperatures warm. They've been exposed to cold, wet, and light all winter. When growing pitcherplants from seeds, we'll be recreating these clues to break dormancy indoors.

Getting Ready

1. Leave the peat in the rain. Milled sphagnum moss can absorb 19 times its weight in water. Poke holes all over the plastic wrap and leave it in the rain. It will be very heavy to leave it as close to the door to your classroom as possible. Purchase the smallest peat bale you can find.

2. Set up the soil in a central location of the classroom. Cover the floor or table with newspapers. If the peat is dry, have the students making the pitcherplant propagation mix wear dust masks for they'll spend the rest of the day blowing peat out their nose. Have the students mix the peat and sand in a ratio of 3:1, peat:sand. Wet the soil until you can make "soil snowballs."

3. You can purchase your propagation pots from a horticulture supply company. You are looking for large cells, 5x5 inches, like a cell pack that pansies come in but much wider. The corners of the cell packs – even the large 5"x5" ones – are very sharp. Cut the corners off before the students handle them.

You can also use butter tubs or some such as long as the container is wider than deep, not more than three inches deep though. You are looking for containers that hold volume so that don't dry out quickly. Propagation pots with small cells are too risky for drying out. Don't forget to very carefully cut holes into the bottom of your tubs.

4. Divide students into teams. Cover each working station table with newspaper. Give each team the following:
- 5"x5" propagation pot with corners removed or butter tub with holes
- scissors (teachers with young students may want to have pot holes enlarged by a grownup before class)
- plant label
- seeds of pitcherplants or other bog wildflower species
- clean, dry cup to pour seeds into
- cup of water
- pipette
- plant label – plastic or popsicle stick, but not cut window blinds = lead concerns
- data sheet (copy below)
- pencil
- trays with no holes in the bottom – we call these "non-drain flats"

5. Students should know about pitcherplants, bogs, and their life history. See if they can rationalize why the seeds get a four week cold-wet stratification treatment (thinking about our climate in the fall, winter rains, when we generally see seedlings in the wild).

Procedure:

The propagation techniques below for pitcherplant and bog wildflower species were designed by the Atlanta Botanical Garden.

1. Make the holes bigger - Cut triangles in the bottom of the 5"x5" cell propagation pots to allow better drainage. There should be slits already in the bottom. These should be enlarged, and triangles seem to be the easiest shape to cut. If using butter tubs, cut triangles about the size of dimes in the bottom of the pots. Have an adult do all of this cutting.

2. Fill the pots with soil - Fill 5 x 5 pot with peat:sand pitcherplant propagation mix. Press down the soil to pack tightly. This is tighter than you would fill any other pot. This soil is light so you need to press it in well, but don't go crazy, smashing it to make a peat brick. Fill to 1/2 inch from top of tray (about the width of one adult's finger).

3. Water soil into pots - Water medium into trays. Soak well letting water run through the bottom. Soak a couple of times and let the soil sit and drain for a few minutes while the students get their hands dry and set up for sowing the seeds.

4. Sow seeds carefully - Sow seed across the top of the soil in your propagation pot. Students can lay the seeds in a grid – say three rows of three seeds each. Laying seeds in a grid is helpful for tracking the percentage of seeds that germinate. If sowing seeds in a grid (as in 3 rows of 3 seeds each – 9 seeds total), it is helpful to mark the edge of your pot that is the top so that you know which is seed 1,1; 1,2; 1,3; 2,1…. Think of looking down on your pot like looking at a piece of paper. You'll need to know which side of the pot is the top left corner so you can read your seeds from left to right, top to bottom. Use a permanent marker and write the word "top" in the top left corner of the edge of your pot. Or cut a distinct nick out of the edge of your pot above seed 1,1.

Sow the seeds in the middle area of the propagation pot – not right up on the edge of the pot. Leave a finger space between the side of the pot and the first row of seeds. Seeds can get lost down the sides of pots; can rot (called "damping off") if touching wet plastic, and the sides of the pot are the first areas of soil to dry out. Your seeds can not dry out once they are sown.

Or if you are growing seeds for production for your bog, students can sow many seeds in each propagation pot, sprinkling them across the top of the soil. 5"x5" trays can hold approximately 350 seeds. **Avoid piles of seeds.** Try to sprinkle them out in an even layer. This can be done by gently shaking seed from a paper cup (bend one end of the cup rim into a pour spout), or by sprinkling seed with your *dry* finger like you would if adding spices to a pot while cooking.

For these experiments, it is wise to sow everything. Do not be concerned that you will have more plants than you can possibly display on your school grounds or in your classroom. If you have a bumper crop of pitcherplants, they can be shared with other EPSN schools and museums for displays, traveling exhibits, and research projects. This is another way in which you can help with the recovery of these species. And you can always keep them in large pots in your classroom and on your schoolsite (the main office comes to mind!) and pack your bog habitat garden full with them.

Once the seeds hit the wet soil, they are difficult to move, so place seed carefully avoiding piles. **Do not cover seeds with soil.** *Sarracenia* seeds require light to germinate; other bog wildflower species have teeny-tiny dust-like seeds – don't cover these with soil either.

5. Press the seeds against the soil - Press the seeds lightly with finger to make certain they are touching the soil well. Make certain you wipe seeds from your fingers before going to the next pot of soil. Seed tends to stick to hands, and you do not want to risk mixing seed of different species or seed from different locations.

6. Write plant labels for each pot – On your plant label, write in pencil the following:
- Species name – Use the Latin! – And pot number in case each team of students is sowing more than one pot of each species – "*S. purpurea* 1"
- Teacher name and student team name – "Johnson/Ann & Louis" or "Johnson/Table 1"

Some teachers may need to add a class period to this if working with more than one class – "Johnson/p1/Ann & Louis"
• Number of seeds – "N = _____" or "N = 9" or "N = appox 50" if sowing seeds in bulk
• Date the seeds were sown – "S = _____" such as "S = 3-12-2008"
• Treatment seeds received – Bog species seeds are going to receive four weeks cold-wet stratification in the refrigerator, sitting in a tray of water, no soil over the seeds. Students can write or note all of this detail in their notebook. But on the plant label have them write "4 wks strat in H2O no soil" – At least get the "4 wks strat" on there.

Plant label example:
S. purpurea 1
Johnson/p1/Ann&Louis
N = 9, S=3-12-2008, 4 wks strat

Place label horizontally along one edge of 5"x5" pot, between the pot and the edge of the soil. Be careful not to disturb seed. Each pot must have a label.

7. Make a record in a propagation journal. All students need is a 3-ring binder and some sheets of paper or some such. You could have each student keep a journal or have one journal per team. Have the students write down:
• information from the plant labels (species, pot #, team detail, N=, S=, treatment)
• **the date the pots will come out of the refrigerator!** "Out of fridge 4-12-2008"
• source of the seeds - Did you get them from EPSN? – Then write something like "EPSN 2006 seed exchange." Or perhaps the seeds came your bog garden?)
• any observations students have - What were the color of the seeds by species? Were some seeds squishy and others of the same species hard? (Could mean some seeds are not viable.) Draw pictures of the seeds.

8. Put propagation pots into trays – Combine the pots into non-drain flats, community trays with no holes in the bottom. If you don't have non-drain flats, you can use a cookie-sheet with sides. You'll need to set your pots in water while they are in the refrigerator.

9. Add water to your trays – Pitcherplants and bog wildflower species need moisture in order to break dormancy. The seeds do not need to soak in water though. Add one inch of water to the community tray so that the propagation pots are sitting in water.

10. Put humidity domes over trays - Cover the tops of each tray with a humidity dome to keep the moisture up. If you don't have a humidity dome, use a sheet of plastic wrap secured around the edge of the pot with a large rubberband. Be sure to pull the plastic wrap taught. The plastic wrap must not touch the soil or the seeds or it will cause rot.

11. Put covered trays in the refrigerator - Place the entire unit – non-drain community flats with propagation pots within, one inch water, covered with humidity dome - in the bottom of a refrigerator (40˚ F) for exactly four weeks.

12. Put a note on the refrigerator door – Put a note on the outside of the fridge (or someplace else where you will be sure to see it, like a special classroom calendar.) reminding you which species come out of their cold-wet stratification treatment on which day. Have the students figure dates out on a calendar.

13. Check the trays – Have students check the trays once a week at least to be sure the humidity domes are on or the plastic wrap is taught. Water will collect on the under side of the plastic covers. Students can gently thump or tap the plastic, returning the water droplets to the soil. Make certain there is still one inch of water in the community tray. **Write refrigerator tray check dates and observation in propagation journals.** Are any of the seeds germinating in the cold, dark, refrigerator?

14. Fill out data sheets – If student's sowed their seeds in a grid to better track seed germination, have the students fill out a **germination data sheet**. Students will need their journals or they can refer to the plant labels to fill out the top of the data sheet. Then they will need to draw circles representing each seed, laid out in the same pattern they sowed the seeds. For example, if they sowed three rows of three seeds each (nine seeds total), they'll need to draw three circles in three rows. When these pots are removed from the refrigerator and placed in the Grow Lab, students will be checking the trays daily to make certain they are moist and look for signs of germination. When they see something emerging, they will write the date of germination for that seed in the corresponding circle on their data sheet.

Four weeks pass and the stratification treatment is over. It is time to move your plants to your Grow Lab.

Grow Lab

After four weeks of cold stratification, remove the tray unit (tray, pots, humidity dome) from the refrigerator. Leave the tray unit together and place it under the lights in your Grow Lab. A **Grow Lab** is a shelving unit with banks of shop lights. The light bulbs in the shop lights must be "cool light" light bulbs. Regular shop light bulbs get too hot and may damage the embryos in the seeds and they can burn student's hands as they reach under the lights to tend to their plants. "Full spectrum" light bulbs are nice, but expensive and not necessary. You'll need at least two sets of lights (four bulbs) suspended over a table or shelf and a timer for the electrical outlet to make the most basic grow lab. But this works beautifully! A full Grow Lab is a plastic shelf unit (often home-made of PVC pipe and ply-wood shelves). The more shelves you have, the more space you have for trays and pots for all of your classes.

Adjust the lights so that they hang four inches of the humidity domes of the trays. Set a timer at the electrical outlet for 18 hours on. The seeds should receive 18 hours of light every day. Make certain the Grow Lab is away from vents blowing cold or warm air. You may need to close, block, or re-direct air vents, especially if they blow cold air on your Grow Lab. Seeds require warmth to germinate, above 80˚ F and below 90˚ F. It is actually better for the seed if the temperature fluctuates between these two limits.

Do not remove the humidity domes or plastic wrap. Leave the pots sealed under plastic, creating a mini-greenhouse inside each pot. Make certain you still have one inch of water in trays. Seed should germinate in two weeks. Water will need to be added every few days to keep it at the one inch level.

If you do not have a Grow Lab, place the tray unit at a window, getting the most light you can. South facing windows are often best. You may need to warm your seeds at night, placing them on top of a refrigerator so that they get bottom heat. And make plans for building even a very simple Grow Lab. It will save you time and move your plants along quickly.

Have your students visit the Grow Lab every day making certain the trays still have one inch of water in them and the soil is still moist. Have the students touch the soil at the edge of the pot, not in the middle where the seeds are. During this time, students can take measurements like temperature (under the plastic inside the pots, on the Grow Lab shelf, room temperature), and they can log their activities like the days they had to add water to the trays or the days they had to change out the water because it was getting fetid. Students should record any observations they have. (Is there mold growing on top of the soil? Are their gnats buzzing about?)

Recognizing Pitcherplant Germination

After two weeks under the light, the *Sarracenia* seed should begin to germinate. First students will see the seed coat split (looks like tiny pistachio shells) and tiny white hairs will emerge from the seed. This is the radicle of the *Sarracenia* seeds. The radicle is wild with hairs that are trying to absorb water for the embryo inside. **The seeds cannot dry out at this stage, even for half a day!** Leave the plastic humidity domes on and maintain one inch of water in the bottom of the trays.

Fill out data sheet - Students should begin using their data sheet, filling in the date in the circle for each seed as it germinates. Next students will see the tiny cotyledons (first leaves) emerge. In pitcherplants, these looks like blades of grass. Have the students draw pictures and write down any observations they have. (Did seeds of a certain color germinate better others? Perhaps white seeds had a fungus or dark seeds had a mold problem?)

Seedling Care in the Grow Lab

Set up your Grow Lab watering log – Set up a schedule for student pairs to check and water the grow lab every day and record their actions and observations in a **Grow Lab Log**. A Grow Lab Log is a journal or three ring binder that remains at the Grow Lab to track the care of the plants. Have two students water, check for problems, massage (see below), and wean (see below) the seedlings every day. Have the students write what tasks

they did, the date, and their initials, and write any observations they have. If there is a problem or concern, they should let the teacher know immediately. Concerns may include bugs, wilted plants (check the log to see who missed a pot…), and moldy looking plants (damping off fungus is attacking – take the humidity domes off and consider adding a small, desk fan to that shelf of the Grow Lab to increase air circulation).

As the seedlings mature, you will see tiny pitchers emerge and develop. Write observations, drawings, and take measurements about once a week to monitor growth rate. Leave the seedlings under the light source at four inches and 18 hours a day.

Wean your seedlings from the humidity dome - When all the seeds have germinated (or all that you think will germinate have, giving each pot a good two weeks), lift the plastic humidity dome up, propping one end up on a pencil or ruler, for half an hour the first day, one hour the next, two hours the next…. Keep the one inch water level in the bottom of the tray. This is weaning your seedlings from the humidity dome.

Massage your seedlings - After the seedlings are two weeks old, have the students very, very gently rub over the tops of the seedlings with the open palm of their hands – as if letting the seedlings barely tickle their hands, once a day. The seedlings need to strengthen the lignin in their cell walls. They've never been exposed to wind and will easily flop over if watered from the top or left outside on a breezy day.

Yo-yo the water – When you see true leaves (tiny pitchers) on all of the seedlings, lower the water level to ½ inch of water in the non-drain trays for one week. Have the students record details in the Grow Lab Log. The next week, lower the water level to approximately a quarter inch (just covering the bottom of the tray) for one week. If your classroom is warm or dray, you may have the students up the amount of water over the weekend, especially if there is a three day weekend, to make certain the seedlings stay moist while everyone is away. **(*Tip: This is a good trick to use for any species any time when you are away from your plants for 2-3 days. Leave a goodly amount of water in each tray after each pot has been thoroughly watered. You may also want to put the humidity domes back on seedlings over the weekend as long as no leaves touch the plastic. Plants touching wet plastic = rotted plants.)***

After two weeks of water-weaning, begin "yo-yoing" the watering. Never let your pots dry out completely. Under the warm grow lights, the pots may need to be watered every day. Have the students check each pot carefully with their fingers, touching the soil at the edge of the pot – not where the seeds are. If dry, the students should water the pot carefully until water comes out the bottom of the pot. A lab squeeze bottle is especially good for this. A small plastic watering can with a narrow spout is good as well. Have students put the pad of one finger over the end of the spout while pouring to let just a small steady trickle of water come out. Students may need to practice this at the sink to get the hang of it. A trickle of water is important so that seedlings aren't blasted out of the soil. Always water until water is coming out of the bottom of the pot. Extra water will need to be carefully poured out of the non-drain trays. If students water thoroughly when they water, they will not need to water every pot every day. Pots do not need to be

sopping soaking wet, but they do need to be moist and stay moist until the next day. **Watering is an art and takes practice!**

If pots every dry out such that they can't take up the water (the water runs over the sides of the soil and out the bottom of the pot, water pots from the bottom soaking them for an hour or two and then dumping the water out completely. Write this in the Watering Log and check the Log to see when the pots were last watered and what got missed so that everyone can learn from this (without pointing fingers and blame).

Stepping Up – Potting Seedlings and Introducing them Outside

Pitcherplants and bog wildflower species can stay in their community pots for a year. But as the community pots become crowded, the plants risk drying out and disease from being stressed. Plus, plants will normally triple in size each time they are potted up to the next size pot. But when you pot them up in the cold months, make certain you have room Grow Lab or classroom for the individual pots.

Pitcherplants are slow but tough. Once your plants have 2-3 pitchers each or the pitchers are 2" tall, they can be potted up to the next size pot or larger community tray. It may take them a couple of months to get to this stage. You can plant them directly into your bog habitat garden at this size if you have weaned them from the Grow Lab (see next paragraph), if it is past the frost date for your area, and if you can water your bog every day for two weeks straight until those young pitcherplants establish themselves. *(Tip: Check the weather before planting any young plants outside. If a thunderstorm is predicted, wait, or your seedlings may wash away.)*

Grow Lab grown plants cannot go outside in one step. Like weaning from the humidity dome and water in the tray, plants will have to be weaned of the Grow Lab and introduced to the great outdoors. Take your plants (seedling pots and older Grow Lab plants) outside on warm days for a few hours in the sun as often as you can. But start with 30 minutes one week, one hour the next week…. Bring them indoors at night and keep them in on hot, dry or windy days. After they are weaned from the Grow Lab, they can be planted outside after the last frost date (usually between St. Patrick's Day and Mother's Day in the Southeast United States.)

Potting bog plants is just like potting most other kinds of plants, but bog plants require a special soil mix.

This can be done inside or outside.

Materials for potting pitcherplants and bog wildflowers:

- large community trays with drain holes (not the regular crate-like flats that you carry your pansies in) – cell packs with six cells per pack (like the cell packs pansies come in) will work ok, but this take a lot (a whole lot!) of room in the Grow Lab or classroom
- scissors (enlarge drain holes on bottom)

• peat:sand soil mix, 3:1 (wear dust masks while preparing) wetted to the soil snow-ball stage
• large tub or bin for mixing soil
• plant labels
• sharpened pencils
• journal
• water
• watering cans
• newspapers
• permanent marker
• non-drain trays (used for germination – just washed clean with water and scrubbing)

Set up is the same as described in detail above for sowing pitcherplants, but instead of working in teams sitting at their tables, have the students stand at a table or counter or kneel on the floor, working around the big tub of soil mix. Divide students into three teams:
1. students prying the plants out of their germination pots with pencils and teasing apart roots,
2. students preparing the trays with soil, watering in the soil in before planting, and watering the plants in after planting,
3. students potting in their new larger community trays.

You can have the teams switch tasks so each student gets experience with all of these horticulture skills.

1. Fill and water trays - Fill the new large community flats with bog mix. Press the mix gently into the pot. Water the mix in and let drain for a few minutes.

2. Pry seedlings out - Use the tip of a pencil as a prying tool gently removing the seedlings from the 5”x5” germination pot. Push the pencil into the soil next to a seedling and pry or pop the seedling up. The roots will be tangled so tease the individual seedlings gently. They should come out of the soil easily.

3. Set up rows - In your new larger tray, set up rows down the tray. Use a permanent marker to put hash marks along one edge of the tray to mark the rows. Do not plant close to the plastic tray (this area dries out quickly). Do not worry about planting on a grid. Get as many plants as you can reasonably get into the large tray, spacing each seedling about one inch apart. Students can lay a ruler across the soil to help keep rows straight.

4. **Plant seedlings** -Use another pencil to make holes for the seedlings. The roots should have enough room to extend to their full length. Place the seedling within the hole. The bottom of the pitcherplant where the roots begin should be at the top of the soil. With your fingers, press the soil mix firmly around the seedling. Add soil as needed to tuck the seedling in well. The **crown** of the pitcherplant (the swollen area where the roots and pitchers join) should be right at the surface of the soil. The crown should not be buried, nor should the pitcherplant be toppling on the surface.

5. Water seedlings in - Once all the seedlings are planted in their new tray, water the tray again from the top. Water gently being careful not to knock the seedlings around.

6. Label each tray - You can re-use the labels you used for the germination pots, stepping the labels up with their corresponding species. Just add the "P Date" to the information already on the label. P = potted date. Each time these plants are repotted, the label information can travel with them as new "P Dates" are added. This way you can track a plant's history through its label.

Plant label example:
S. purpurea 1
Johnson/p1/Ann&Louis
N = 9, S=3-12-2008, 4 wks strat, P = 5-10-2008

7. Put plants back into non-drain trays – Put your potted trays of plants back into the non-drain trays. The non-drain trays will catch excess water. This is an especially good idea with the shop light's electricity nearby! The potted trays can be lifted out of the non-drain trays and the excess water dumped out.

8. Put the plants back under lights - Place the large seedling tray (with its non-drain tray under it) back under in the Grow Lab or at a sunny window. You may need to raise the lights so they do not touch the seedlings. Lights should remain four inches above plants and should stay on 18 hours a day.

8. Care for plants – Now these plants go back to the daily checking routine, with students recording their tasks and observations in the Grow Lab Log. Students should check the plants daily for water. When the soil is dry to the touch at the edge of the tray, have students water the seedlings gently from the top with a watering can using a finger over the spout to control the water flow. Students should water trays thoroughly until the water drains through the bottom. If students notice that they are having to water a lot through the week, leave an inch of water in the tray over the weekend to the plants do not dry out. Watering is an art and takes practice and daily observation! Have the students gently massage the seedlings as well.

9. Write in journals – Have the students write down their observations, make drawings, and record watering times, growth rate measurements (measure the height of the plants each week, the lengths of the leaves, number of leaves… and graph this data), and any other data (temperature for example).

Moving Plants Outside
Soon, you will be able to move your seedlings outdoors to your display bog or into display pots. The time you do this will be determined by the growth rate of your seedlings and the species. Seeds sown in January can usually be planted outdoors in March or April. Until then, it is very important that you care for the seedlings and record data and observations.

Pitcherplants are slow but tough. Once your plants have 2-3 pitchers each or the pitchers are 2" tall, they can be potted up to the next size pot or larger community tray. It may take them a couple of months to get to this stage. You can plant them directly into your bog habitat garden at this size if you have weaned them from the Grow Lab, if it is past the frost date for your area, and if you can water your bog every day for two weeks straight until those young pitcherplants establish themselves. *(Tip: Check the weather before planting any young plants outside. If a thunderstorm is predicted, wait, or your seedlings may wash away.)*

Disscussion/Assessment:
Why do you sow pitcherplant seeds in a peat mix and keep the pots sitting in water?

What was your percent germination for each pot? – How many seeds germinated out of the total number of seeds you sowed?

What was the percent germination for each species? – You'll need to add the number of seeds that germinated and the total number of seeds sown and then divide these numbers:

<u>total number of seeds that germinated</u> = % germ.
total number of seeds sown

Did different species have different germination numbers? Which species seems to have the most viableseeds?

How much time did it take for the seeds to germinate after the pots were put in the Grow Lab? Are there ways to speed this up? (Was it cold in your Grow Lab?)

Did you observe the radicles emerging and the cotyledons? Did you see the discarded seed coats?

Digging Deeper:
There are many ways to test seed viability. One quick way is to gently squeeze a seed to see if you feel anything inside. Or you can put the seeds in a glass of water. Generally, viable seeds sink, but sometimes surface tension keeps seeds at the top of the water. Add a drop of dish soap and see if the seeds sink. But! Pitcherplant seeds float. This is an adaptation for dispersing seeds away from the parent plant in the bog. Have the students test the viability of several different species of seeds including pitcherplants.

Looking at the life history of each species (meadow vs. bog for example), do seeds float because they are non viable or because of adaptation?

When did the first true leaves emerge? Did the pitcherplants begin to trap gnats or fruit flies?

How many pitchers did plants have after 2 weeks, 4 weeks, 6 and 8?

EPSN Propagation Data Sheet

Team names: _____

Species: _____ Pot number: _____

Date sown (S =): _____

Number of seeds (N =): _____

Seed treatment: _____

Date in cold: _____ Date out of cold: _____

Propagation pot – TOP
Look down on your propagation pot and choose which side will be the top of your pot. Mark that spot. Each time you return to your pot, you'll need to look at it in this same position. Now look at the way you sowed your seeds. Did you sow the seeds in rows or in a square? Draw large circles in the box below in the same pattern as the seeds in your pot. The circles represent the seeds sown in your pot. Be sure to mark the "top" of the pot so you always know which seed is which. As each seed germinates, write that date in the circle representing that seed.

Top of Pot

Observation dates and drawings:
1. Date of first radicles? _____
2. Date of first cotyledons? _____
3. Date of first true leaves? _____
4. How many seeds germinated? _____