Science Unit: ***Plants 'n' Bugs***

Lesson 5: ***Plant Colours and Smells***

School Year:	2010/2011
Developed for:	McBride Elementary School, Vancouver School District
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Grade level:	Presented to grades K and 1; appropriate for grades K – 7 with age appropriate modifications
Duration of lesson:	1 hour
Notes:	This lesson was taught at Van Dusen Botanical garden, but could be done anywhere with a herb garden and many blue/pink/purple coloured flowers.

Objectives

1. Discover some chemistry underlying flower colour.
2. Learn that flower colours are for attracting insects and other pollinators.
3. Become familiar with some herbs and their smells.
4. Learn that some smells are for attracting pollinators and other smells (e.g. herb leaf smells) are for repelling insects.

Background Information

Botanical gardens are a wonderful place to teach hands-on science. With their wealth of examples and sensory experiences, students can immediately and directly relate the hands-on activities to the natural world around them.

Vocabulary

pigment	a coloured chemical in plants or animals
odour	a smell

Materials

- mortar and pestle, as many as possible, to reduce the number of students in a group
- bluebell flowers, 4 per student (or an equivalent amount of blue/purple/dark pink petals - make sure they are tested and found to work for this activity)
- vinegar in dropper bottles (I made dropper bottles using empty water bottles with a pin hole through the lid)
- herb garden, or access to fresh herbs. We used marjoram, mint, rosemary and lavender.

- 2ml water per student
- small paint trays, or dishes, one per student
- pipette, to transfer pigment to the paint trays
- dried herbs in colour coded tubes or sachets - the same kinds as the fresh herbs available.
- fresh herbs for herb necklaces (extra herbs must be brought in if working in a botanical garden)
- small tube hanging on a necklace thread, one per student

In the Botanical Garden/Park/Garden

Introductory Discussion

Ask students to observe the wealth of colours and smells of the plants, as we walk to our activity site. Instructions for each activity will be given at the site.

Brief description of science activities:

- Extract coloured pigment from flower petals, and change the pigment colour by adding acid.
- Match fresh and dried herbs by smell, and make a herb necklace.

Brief description of the processes of science that the students will focus on: observation, careful manipulation, prediction.

Safety guidelines: none

Science Activities

(1) Activity Title: Flower colour

Purpose of Activity: Change the colour of flower pigments, and find out why flowers have different colours.

Methods and Instructions:

Set-up prior to experiment: none.

Students work in groups of 3 or 4 for making the pigment (or as limited by the number of mortar and pestles), then individually.

1. Introduce the activity: flowers have bright colours to attract insects and other pollinators. There is a coloured chemical in their petals - these bluebells have a blue chemical (show the bluebells to be used in the activity, and if possible, bluebells growing nearby). The same chemical that makes these bluebells blue, also gives other flowers their own colour. Let's find out what other colours this blue pigment can make.
2. Each student adds 4 bluebell flowers to the mortar (or other equivalent amount of blue/purple/pink petal that has been tested and found to work). So if 4 students are working at one mortar and pestle, there will be 12 bluebells in their mortar.
3. Add 2ml water to the mortar for each student.

4. Ask the students to take turns grinding the petals and water together with the pestle. This extracts the pigment (colour) from the petals. This is best done by pushing down hard on the pestle while making a stirring motion. Bluebells tend to make a goopy pulp, but as long as some blue water is produced this is OK. Try not to stir so vigorously that a froth is produced. Rose petals make a cleaner pigment solution that is easier to work with, but it is more meaningful for the students if the petals of flowers nearby are used.
5. Use a pipette to distribute the pigment solution between the students' paint trays. If time is short an adult should do this. If there is more time, or the students are older, the students can do this. Try not to suck up the petals, but just the blue water. Ideally, each student has pigment in a couple of wells of their paint tray, so they can experiment for longer.
6. Ask the students to add a little acid (we are using vinegar) to their pigment, and stir with a toothpick.
7. What new colour is made? (Pink). Information on flower pigments in ref 1.
8. Ask students to look around and find flowers that are the same colour as the one they just made.
9. Summarize the activity: the chemical in bluebells that makes them blue can also make the pinks and purples of the other flowers we see around us. Different flowers have different amounts of acid in their petals, and so are different colours. We have discovered the secret chemistry of flower colour!
10. Discuss why flowers have all these colours: to attract insects and other pollinators to them.
11. More hands-on activities and information on pollination and the relationship between insects and flowers in ref 3.

(2) Activity Title: Herb smells

Purpose of Activity: Become familiar with herb smells and learn why herbs have smells.

Methods and Instructions:

Students work individually.

1. Walk around the herb garden with the students, and teach them how to gently brush against the herbs to smell them (if in a botanical garden, no picking is allowed). Familiarize the students with the herbs used in this activity (we used marjoram, mint, rosemary and lavender).
2. Students smell the dried herbs, and try to match each of them with the fresh herb. This should not be an activity where students fail if they get the match wrong, but a challenge to really think about the odours and their similarities. Every person smells quite differently, and so different students will be able to match with very differing abilities. The goal is to familiarize students with herbs and their smells.
3. Once the students have smelled all the herbs, they choose a favourite.
4. Each student picks one leaf of their favourite herb (in a botanical garden, extra fresh herbs must be brought in), roll it and crush it slightly to release the odour, then push it into a small tube hanging on a string.
5. Each student hangs their herb around their neck. They can open the tube any time they want to smell their herb.
6. Discuss why herbs have such a strong smell: scientists are not sure, but it is thought that the strong smells of herb leaves repel insects, and stops them from eating the plants. Insects are attracted to the sweeter smelling flowers (and therefore pollinate them) but are repelled by the stronger smelling leaves.

Closure Discussion

Summarize:

We learned something about the chemistry of flower colours - how some of the many flower colours are made, and that the variety of flower colours are for attracting insects to them.

We learned something about plant smells. Many flower smells are for attracting insects and other pollinators to the flowers. But some herbs have strong smells, which are thought to repel insects from the leaves so they do not get eaten.

Follow with a lesson on insect pollination - see ref 3.

References

1. Farrant, Bernie. 1999. Colour in Nature. A Visual and Scientific Exploration. Blandford Press.
2. Atkins, P.W. 1987. Molecules. p. 156. Scientific American Library.
3. <http://scientistinresidence.ca/science-lesson-plans/plants-n-bugs/> Scientist in Residence Program lessons on the relationships between insects and plants, including pollination. Accessed June 3, 2011.
4. Bauer, Kurt and Garbe, Dorothea. 1985. Common Fragrance and Flavor Materials. pp. 46 (- carvone structure) and 167 (carvacrol structure). Publishers: VCH.

Extension of Lesson Plan

1. For older students, they can make molecule models of the flower pigments. Cyanidin, the pigment in dark pink/red roses, changes from purple/blue to red/pink when acid is added. See ref 1 and ref 2 for more molecular details.
2. For older students, they can make molecule models of herb odours. Marjoram (carvacrol odour molecule, or 2-hydroxy-4-isopropyltoluene) and mint (-carvone odour molecule) have very similar structures but smell quite different, as they match different receptors in our nose. See ref 4 for molecular structures.