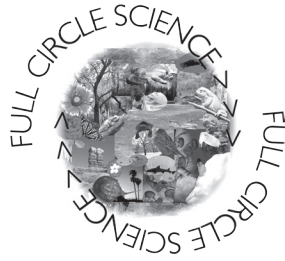


Garden with Science

IMPLEMENTATION MANUAL
FOR PARENTS AND TEACHERS

Jen Seron
“Science Jen”

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Full Circle Science by Jen Seron

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Hi! I'm Science Jen. When I have something to say, you'll see my comments in a text box like this. These boxes exist to provide additional information that relates, however tangentially, to the topic at hand.



WELCOME TO FULL CIRCLE SCIENCE

Dear Parents and Families,

Full Circle Science lessons exist so that you can teach science joyfully and provide the most personally relevant experiences that can be had while learning science. This curriculum is, for everyone at all levels, play-based, intense, concentrated, and action-packed. These lessons should inspire you as an instructor, complement your teaching style, and extend your prowess—whatever your strengths and interests might be and whatever your environment. Parents are collaborators who deserve to have fun and learn, too!

Full Circle Science provides young people with inspiring experiences in the natural world, a strong science background, and opportunities to utilize the scientific framework in everyday life across subject areas in collaboration and conversation with others, via hands-on real-life experiences that will cultivate individual interests, skills, and talents in all fields.

Full Circle Science objectives:

- Learn science joyfully and use the scientific framework in everyday life
- Observe closely, appreciate, and connect personally to our beautiful natural world
- Promote lifelong learning within a respectful, positive, inclusive environment
- Find, develop, apply, optimize, and actualize interests, skills, and talents through science

A clearly defined framework for teaching science is key. This brief Implementation Manual exists to facilitate deeper understanding of the natural world (as contextualized within the scientific framework) for those gardening with young people of all ages. Materials you will need are listed in the appendix at the end of this book.

Family involvement is key. The purpose of the Implementation Manual is to explain briefly how parents or teachers can facilitate learning and provide engaging, relevant real-world hands-on science content over the summer while gardening with young people.

Spending time outdoors is key. Although in the background the Full Circle Science focus is always on each child's perceptions and interests and how the current lesson can excite individuals, in the foreground of each lesson is the lesson's content as well as the natural world of the garden. In addition to this series of gardening lessons, Full Circle children should spend time each week outdoors in the garden observing, playing, and interacting with the natural world in both structured (related to their interests and what they're learning) and unstructured ways (free play).

I hope you enjoy using Full Circle Science to meet the unique needs and to develop the talents, skills, and interests of your young people.

Scientifically yours,



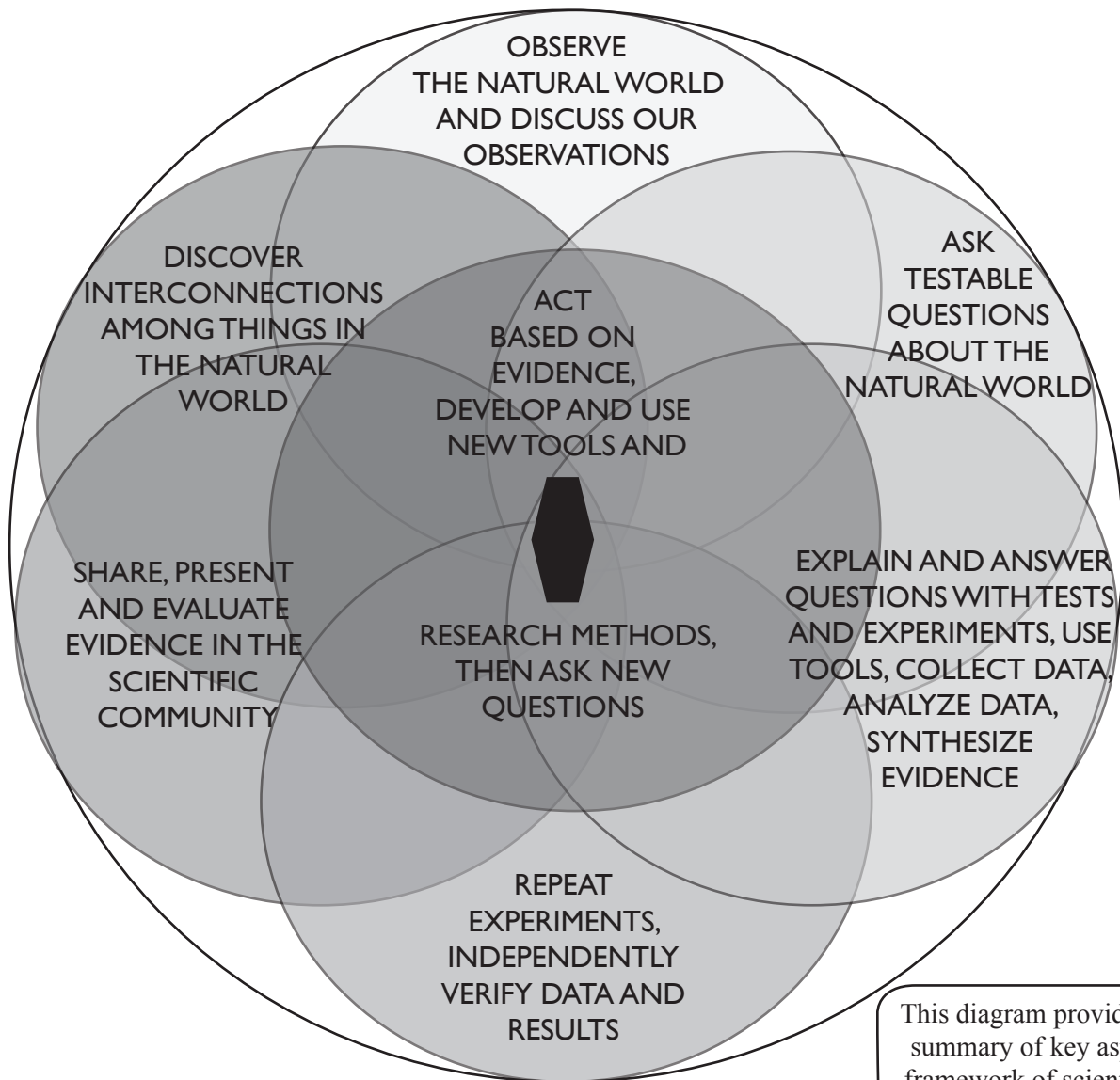
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WHAT IS THE SCIENTIFIC METHOD?


The scientific method is a process by which people answer questions about the natural world with evidence obtained through repeated collection and analysis of data. The diagram below illustrates how the main activities of scientists overlap and come full circle.

A hypothesis is a testable question that not only explains the natural world, but also predicts what will happen under specific conditions.

A scientific theory is an explanation of some aspect of the natural world that reputable scientists accept because it has been repeatedly and independently verified by evidence.



This diagram provides a graphic summary of key aspects of the framework of scientific inquiry. In life, I often use aspects of the scientific framework to help me make decisions. Do you also seek evidence before making key decisions in your life?



LESSON 1


WORMS, SOIL, SEEDS AND SCALE



OVERVIEW

In this first lesson children will learn about themselves and others, this series of lessons, the scientific framework, and different aspects of the garden, beginning with what is in the soil and how we measure and count things at different scales; from observing small things in the soil using simple tools like a magnifying glass to studying large things like our sun and other stars out in space using telescopes and complex technology. Watch *Powers of Ten* by Ray and Charles Eames.

BEFORE: QUESTIONS FOR CHILDREN AND PARENTS




While waiting for the lesson to start, take two minutes to look around the garden. What is the one thing in the garden that is most interesting to you? Write it down or draw a picture of it or take a photo. Why do you like that thing? Be ready to share your thoughts during the lesson!

OUTLINE OF LESSON I

Goal: Understand that gardens are special places where we can have fun and enjoy learning new things about the world, science, nature and ourselves! Inspire love of science and respect for self.

Time: 30 minutes

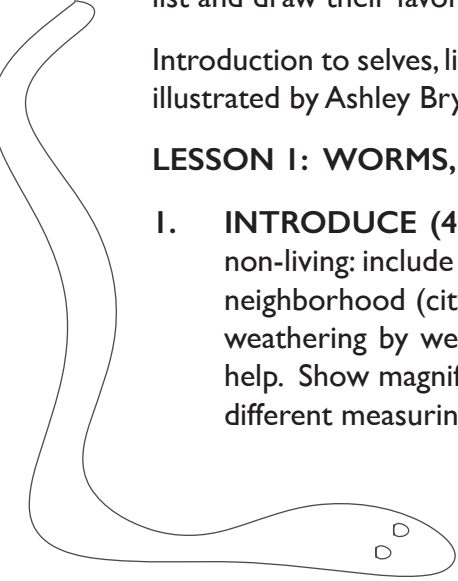


Content: Before class, share answers from last session and from today's exploration; introduce scientific framework and these lessons via singing book then introduce today's topic: soil, seeds, and scale; search for stuff in soil, list and/or draw/photograph what you find; tell about composting; demonstrate seed planting technique then plant seeds with labels; finish by counting seeds planted and singing book backward; conclude by asking questions for next time.

Before class: Instructor asks questions and children explore garden for 5-10 minutes. Children list and draw their favorite thing or things in the garden and explain why they like those things.

Introduction to selves, life, this class and scientific method via singing *What a Wonderful World* book illustrated by Ashley Bryan. Discuss what children like most about the garden and why.

LESSON I: WORMS, SOIL, SEEDS AND SCALE

- I. INTRODUCE (4 minutes):** Introduce the topic of what is in a garden, both living and non-living: include sunlight, air, water, rocks, soil, plants, animals people, bacteria, fungus, and neighborhood (city, suburban, rural)! Tell how soil is made by rocks breaking down due to weathering by weather, chemicals, and living things. Explain composting and how worms help. Show magnifying glasses and demonstrate how to use them. Discuss scale, rulers and different measuring tools and technology.
- 

2. **LOOK (5 minutes):** Children look for things in soil and with help or not, list and draw what they find.
3. **DISCUSS (5 minutes):** Discussion, including show and tell, pertaining to what children found in the soil.
4. **DEMONSTRATE (5 minutes):** Demonstrate how to plant seeds 2-3 times as deep as the longest side of each seed. Measure seeds with rulers to see how long they are, then ask children to show you 2-3 times as big so they know how deep to plant each type of seed. Children need not plant in rows; can plant in circles or other shapes. Count seeds while children plant; label, make a diagram or map on paper or take a photo before they cover seeds with soil. Document in journals their ideas or draw what might happen by next session to the seeds if children remember to water them enough.
5. **CONCLUDE (5 minutes):** Conclude by singing the *What a Wonderful World* book backward. Each page, ask children if they remember what was on the prior page.

Hi, I'm Science Jen! I hope that even though you might want to do all the lessons NOW, you will only do one or two per week. Why? So children can have time to play with the ideas and concepts in their own way. Children benefit from free play directly after these lessons.



AFTER: PLAY, REFLECT, FOLLOW-UP, QUESTIONS

PLAY: After each lesson, let children play freely outside to work through ideas in their own ways.

PLANT: Between now and the next lesson, plant seeds at home or observe and document (write, draw, keep journal, take photos or videos) how bean seeds grow in plastic bags on windows, start a compost bin. Also, ask children to dig in the earth in some other location (lawn? forest? beach? marsh?) then document what they find (living, non-living) at each location in their journal.

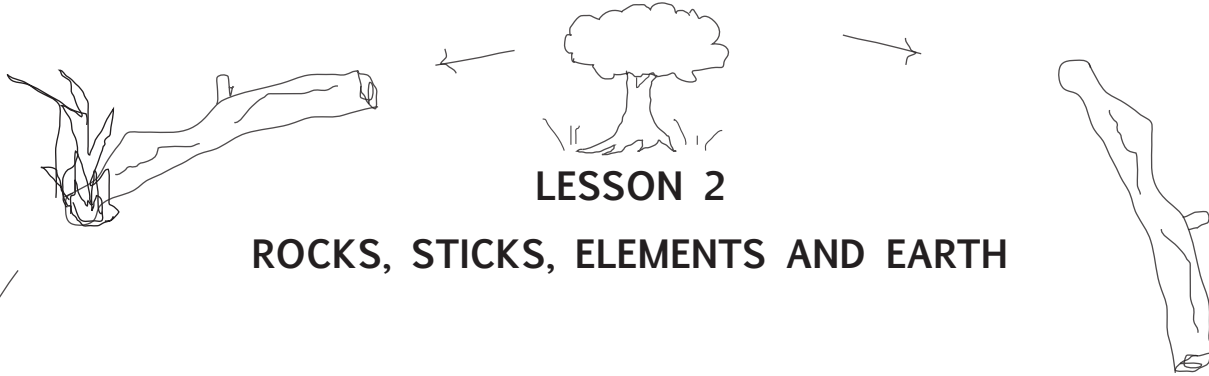
SHOW AND TELL: Be ready at the start of next session to tell what they found in the earth in some other place. And, if they want, they can show and tell about any plants they have at home or what happened to their bean seeds since last time.

MATERIALS

Garden, book (*What a Wonderful World* illustrated by Ashley Bryan), magnifying glasses, rulers, journal or paper for each child, writing and coloring implements, camera to take photos or videos, seeds to plant, sealed sandwich-sized plastic bag with soaking wet paper towel and three big bean seeds of any type hidden in the wet paper towel. Children will tape seeds in bags to a window at home and observe what happens in their journals or in other ways.

In order to have what will be needed, order supplies early:

- For next session will need rocks already identified (igneous, metamorphic, sedimentary), self-drying clay, plastic garbage bag with balloons already blown up, clean balloons for children to try to blow up balloons themselves under VERY TIGHT supervision.
- Look at the *Materials List* in the appendix a the back of this book to have supplies when needed.



LESSON 2 ROCKS, STICKS, ELEMENTS AND EARTH

OVERVIEW

This lesson is about earth science which includes the three types of rocks (igneous, metamorphic, sedimentary), the rock cycle, minerals, atoms and elements.

BEFORE: QUESTIONS FOR CHILDREN AND PARENTS

While waiting for the lesson to start, take two minutes to look around the garden. Search the garden for rocks and minerals, sticks and stones. Which of the things you found do you like best? Why do you like that thing best? Be ready to share your thoughts during the lesson!

OUTLINE OF LESSON 2

Goal: Understand that plants, just like us, need nutrients in healthy food; nutrients come from rocks and minerals! Rocks form in three different ways and are made of minerals that are made of atoms of elements of the periodic table (a kind of alphabet of the building blocks of all matter). Inspire love of rocks and minerals and respect for Earth's geological processes.

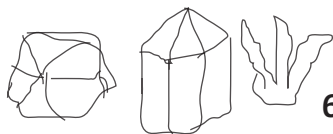
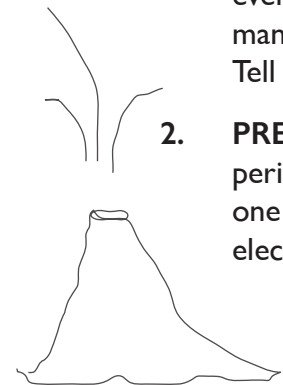
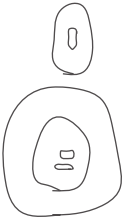
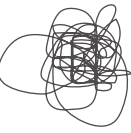
Time: 30 minutes

Content: Before class, share answers from last session and from today's exploration; introduce young people to the topic; interactively read a related story; act out being elements that are in the most common minerals (Oxygen, Silica, Carbon) and in the sun (Hydrogen, Helium); collect sticks and rocks in the garden, then sort, count, and use the clay, rocks and sticks to make atoms, then small houses or other constructions; finally, read rock book and sort rocks, possibly by rock type and origin; conclude by asking questions for next time.

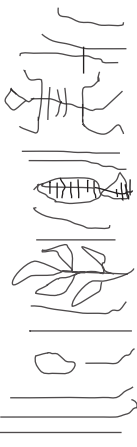
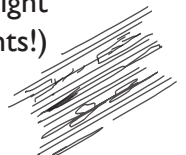
Before class: Instructor asks questions and children try to find rocks and sticks in the garden for 5-10 minutes. Children list and draw their favorite rock, then explain why they like it. Ask children about what they found in soil, how their seeds grew and if they started composting.

LESSON 2: ROCKS, STICKS, ELEMENTS AND EARTH

- 1. INTRODUCE (5 minutes):** Read *Zoom* by Istvan Banai and review how some things are small and others are large. Explain how there are some tiny things called atoms of which everything else is made. These atoms are organized in a periodic table of elements by how many protons (positively charged particles) there are in the center of each atom (nucleus). Tell how electrons spin around the nucleus like planets around the sun at the grand scale.
- 2. PRETEND (5 minutes):** Children pretend to be atoms of elements. Show children the periodic table. Start with Hydrogen (H); one proton, one neutron (neutral so no charge!), one electron! Helium (He); two protons, two electrons! Oxygen (O); eight protons, eight electrons and carbon (C); six protons, six electrons. If there is time (and enough students!)



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for H, He, and C. Demonstrate by holding a balloon and asking a child to hold a balloon and run around you in a circle. Tell them you are the proton and the student is the electron and that element is hydrogen, one proton. Then ask another student to come stand beside you with their own balloon and two other students with balloons to run around you both in circles. That is helium, two protons in middle with two electrons. These are the main elements in the sun! If you can build up to Oxygen (8 protons), great! Stop with Neon (N, 10), even if you have enough children. Warn children not to put balloon in their mouths.

3. **PLAY (5 minutes):** Give children time to play freely with rocks, sticks, clay and build atoms and elements of their own, then reuse the materials to build houses or anything they like in order to represent that the entire world is made of atoms of elements.
4. **READ THEN CLASSIFY ROCKS (5 minutes):** Read a rock book like *Rocks! Rocks! Rocks!* by Jen Seron, then children look at rock types and sort rocks into groups however they like but each child or group should explain their rationale for organization.
5. **CONCLUDE (1 minute):** Ask children to draw and label some atoms in their journal. End with *The Little Island* by Margaret Wise Brown; it is a deep book (think Jung). Then toss around the “electron” balloons because quantum physics says that although probabilistically most electrons are in a cloud around their atoms, they really could be anywhere! Each child gets to pop their own balloons at the very end of class, or take it home.

AFTER: PLAY, REFLECT, FOLLOW-UP, QUESTIONS

PLAY: After each lesson, let children play freely outside to work through ideas in their own ways.

ROCK COLLECTION AND PLANT GROWTH: Between now and the next lesson, start a rock collection (write, draw, keep journal, take photos or videos). Keep track of how seeds in soil and bean seeds are growing in plastic bags on windows or in the ground if they transplanted them.

SHOW AND TELL: Be ready at the start of next session to show their rock collection, to tell their plant observations, what happened to their bean seeds, or any other science observations.

MATERIALS

Garden, books (*Zoom* by Istvan Banai, *The Little Island* by Margaret Wise Brown and/or *Rocks! Rocks! Rocks!* by Jen Seron), rocks, sticks, self-drying clay, one copy of periodic table per child, preblown balloons in a big plastic garbage bag, extra balloon for each child to try blowing one themselves under very tight supervision, “Rock Kit” (see *Materials List*), journal or paper and writing implements.

In order to have what you need, order or prepare supplies early:

- Next session will need 2-3 big bins filled with water (one warm, one lukewarm, one cold), two ice cubes per child (one control, one experimental), mister or spray bottle, watering cans and cups for children to pour/play and to water plants, hose for them to play with water pressure using their fingers or hands to block the water, tin foil, wax paper, saran wrap.
- In two sessions will need prism, mirror, water bottle with water, red/yellow/blue paint to mix, food coloring, clear plastic cups, white carnations.