

SCIENCE

Earth and Space Science, Chemistry, Physics, and Botany

- INTRODUCTION
- CURRICULUM OBJECTIVES (ACROSS MONTESSORI AGE RANGE)

Primary (Casa dei Bambini) – 3 to 6 years

Elementary – 6 to 12 years (Lower: 6–9, Upper: 9–12)

- CURRICULUM BY AGE RANGE

INTRODUCTION

Montessori Science Curriculum: An Integrated Approach to Discovery

Introduction to Montessori Science Education

The Montessori science curriculum is a hands-on, inquiry-based program that nurtures children's natural curiosity about the natural world. It integrates **Earth and Space Science, Chemistry, Physics, and Botany** into a cohesive framework, emphasizing **observation, experimentation, and critical thinking**. Rooted in Maria Montessori's belief that children learn best through direct interaction with their environment, this curriculum transforms abstract concepts into **tangible, sensorial experiences**.

Science in Montessori is not taught in isolation but connects to **geography, history, and practical life**, helping children see the interdependence of all living and non-living systems

Core Objectives of the Montessori Science Curriculum

1. Earth and Space Science

- **Objectives:**
 - Understand Earth's structure (layers, landforms, water cycles).
 - Explore the solar system and cosmic phenomena.
 - Investigate weather, climate, and geological processes.
- **Key Skills:**
 - Observing and classifying rocks/minerals.
 - Tracking lunar phases or weather patterns.
 - Modeling tectonic plate movement.

2. Chemistry

- **Objectives:**

- Introduce states of matter (solid, liquid, gas).
- Study mixtures, solutions, and simple reactions.
- Explore the periodic table (elements, compounds).

- **Key Skills:**

- Conducting safe, hands-on experiments (e.g., baking soda/vinegar reactions).
- Sorting materials by properties (density, solubility).

3. Physics

- **Objectives:**

- Investigate forces (gravity, magnetism, friction).
- Explore energy forms (light, sound, electricity).
- Experiment with simple machines (levers, pulleys).

- **Key Skills:**

- Building and testing hypotheses (e.g., ramp angles and speed).
- Constructing circuits or balancing scales.

4. Botany

- **Objectives:**

- Study plant anatomy (parts of a flower, leaf, root).
- Explore photosynthesis and plant life cycles.
- Classify plants by environment (biomes, adaptations).

- **Key Skills:**

- Dissecting seeds/flowers.
- Maintaining a classroom garden.

Key Montessori Principles Underpinning Science Education

1. "Hands-On, Minds-On" Learning

- Children manipulate **real materials** (e.g., rock specimens, magnifying glasses, lab tools) rather than relying solely on textbooks.
- Example: Using a **water cycle in a bag** experiment to observe condensation.

2. From Concrete to Abstract

- Start with **sensorial exploration** (e.g., feeling different rock textures) before introducing theory.
- Example: Before teaching atomic structure, children classify objects by weight or density.

3. Interdisciplinary Connections

- Science ties into **cultural studies** (e.g., how geography affects ecosystems) and **practical life** (e.g., gardening).
- Example: Studying Native American agricultural practices while learning about plant growth.

4. Child-Led Inquiry

- Teachers **follow the child's interests**, allowing deeper dives into topics (e.g., a child fascinated by volcanoes may research and model eruptions).
- Example: After a lesson on magnetism, children design their own experiments.

5. Observation & Documentation

- Children record findings in **science journals**, developing skills in data collection and analysis.
- Example: Tracking plant growth with measurements and sketches.

6. Respect for Nature

- Lessons emphasize **stewardship**, sustainability, and the interconnectedness of life.
- Example: Composting food scraps to study decomposition.

How Montessori Differs from Traditional Science Education

Aspect	Montessori	Traditional
Approach	Discovery-based, child-paced	Teacher-led, standardized pacing
Materials	Tactile, self-correcting (e.g., puzzle maps of the solar system)	Worksheets, textbooks
Assessment	Observation, journals, presentations	Tests, quizzes
Focus	Process over product	Memorization of facts

Conclusion: Why It Works

Montessori science cultivates **lifelong learners** who:

Ask questions and seek answers through experimentation.

Understand the **scientific method** naturally.

Develop **awe and respect** for the natural world.

"The goal is not to fill a bucket but to light a fire."

— Adapted from W.B. Yeats, reflecting Montessori's vision for science education.

- CURRICULUM OBJECTIVES (ACROSS MONTESSORI AGE RANGE)

Primary (Casa dei Bambini) – 3 to 6 years

Elementary – 6 to 12 years (Lower: 6–9, Upper: 9–12)

CURRICULUM OBJECTIVES ACROSS AGE RANGE

Montessori Key Themes, Principles & Objectives by Age Group

The Montessori curriculum is designed to align with children's developmental stages, fostering independence, critical thinking, and a love of learning. Below is a breakdown of the **key themes, guiding principles, and main objectives** for each age group:

1. Primary Level (Ages 3–6) – Casa dei Bambini

Key Themes:

- **Sensorial Exploration** – Learning through the five senses
- **Order & Classification** – Sorting, sequencing, and organizing
- **Nature & Culture** – Introduction to the natural world and human societies

Guiding Principles:

- **"Help me do it myself"** – Foster independence in daily tasks
- **Concrete to Abstract** – Hands-on materials before abstract concepts
- **Absorbent Mind** – Children effortlessly soak up knowledge from their environment
- **Prepared Environment** – Classroom is structured to encourage self-directed learning

Main Objectives:

- ✓ **Practical Life Skills** – Pouring, dressing, cleaning
- ✓ **Sensorial Refinement** – Discriminating size, color, texture, sound
- ✓ **Early Science & Culture** – Living vs. non-living, land/water forms, continents

- ✓ **Language & Math Foundations** – Sandpaper letters, number rods
- ✓ **Social Grace & Courtesy** – Conflict resolution, polite interactions

Example Activities:

- Sorting leaves by shape
- Pouring water between jugs
- Tracing sandpaper continents

2. Lower Elementary (Ages 6–9)

Key Themes:

- **Cosmic Education** – Understanding the interconnectedness of life
- **Moral & Social Development** – Fairness, justice, community
- **Exploration & Discovery** – Hands-on experiments and research

Guiding Principles:

- **"Going Out"** – Learning extends beyond the classroom (field trips, community visits)
- **Imagination & Reason** – Using stories (Great Lessons) to spark curiosity
- **Collaborative Learning** – Group projects and peer teaching
- **Freedom Within Limits** – Structured choices in research and exploration

Main Objectives:

- ✓ **Scientific Inquiry** – Simple experiments, botany/zoology studies
- ✓ **Historical Understanding** – Timelines, ancient civilizations
- ✓ **Geographical Fluency** – Country maps, landforms, biomes
- ✓ **Mathematical Reasoning** – Multiplication, fractions, geometry
- ✓ **Literary & Writing Skills** – Research reports, creative writing

Example Activities:

- Building a timeline of life

- Conducting sink/float experiments
- Writing and illustrating a "History of Numbers" book

3. Upper Elementary (Ages 9–12)

Key Themes:

- **Interdisciplinary Learning** – Connecting science, history, and culture
- **Critical Thinking & Ethics** – Analyzing cause/effect, debating moral dilemmas
- **Real-World Application** – Problem-solving projects with community impact

Guiding Principles:

- **"Education for Life"** – Preparing children for real-world challenges
- **Self-Directed Research** – Long-term projects with teacher guidance
- **Responsibility & Leadership** – Mentoring younger students, community roles
- **Abstract Reasoning** – Moving from concrete materials to conceptual thinking

Main Objectives:

- ✓ **Advanced Scientific Method** – Hypothesis testing, lab reports
- ✓ **Global Citizenship** – Studying economics, government, environmental issues
- ✓ **Deep Historical Analysis** – Cause/effect in history, primary sources
- ✓ **Mathematical Mastery** – Algebra, data analysis, applied math
- ✓ **Persuasive Communication** – Debates, presentations, research papers

Example Activities:

- Designing a sustainable city model
- Simulating a UN debate on climate change
- Creating a business plan for a student-run café

Comparison of Montessori Principles Across Age Groups

Aspect	3–6 Years	6–9 Years	9–12 Years
Learning Style	Sensory-motor exploration	Story-based, imaginative	Abstract reasoning & research
Key Materials	Sandpaper letters, knobbed puzzles	Timeline of Life, Fraction Insets	Microscope, Historical Documents
Social Focus	Grace & courtesy	Group collaboration	Leadership & ethical debate
Assessment	Observation-based	Project presentations	Research papers & self-evaluations

Conclusion: The Montessori Journey

- **Ages 3–6:** "What is this?" (Exploration & Order)
- **Ages 6–9:** "Why is it like this?" (Discovery & Connection)
- **Ages 9–12:** "How can I use this to make a difference?" (Application & Leadership)

Montessori education progressively builds **independent thinkers, compassionate leaders, and lifelong learners** by aligning with children’s natural developmental stages.

- CURRICULUM BY AGE/YEAR GROUP & PROGRESS/ASSESSMENT TOOLS

CURRICULUM BY AGE/YEAR GROUP & PROGRESS/ASSESSMENT TOOLS

Montessori education allows learners to progress at their own pace within the age range. For purposes of presentation, the Science is presented here is based on a average of how a student will progress across the following year groups and what assessment tools will be used to evidence progress.

Preschool

Reception

Year 1 to 6

MONTESSORI SCIENCE FOR AGES 3–4

Montessori Science Curriculum for Ages 3-4

(Chemistry, Physics, Earth/Space, Botany – Term-by-Term Breakdown)

Introduction for Ages 3-4

Developmental Focus:

- **Sensory exploration** (touch, sight, sound)
- **Concrete experiences** (no abstract theories)
- **Nature-based discovery** (real objects over pictures)
- **Language enrichment** (vocabulary building)

Montessori vs. UK EYFS (Nursery) Comparison:

Aspect	Montessori (3-4)	UK EYFS (Nursery)
Approach	Structured hands-on experiments	Play-based exploration
Materials	Real objects (rocks, leaves, etc.)	Toys and picture books
Assessment	Observation + work samples	Early Learning Goals (ELGs)

Term 1: Foundations of Science (Sept-Dec)

Chemistry: States of Matter

Key Topic: Solid vs. Liquid

- **Activity:** "Ice Melting Race"
 - Place ice cubes on different surfaces (metal, wood, fabric)
 - Observe and discuss melting speeds

- **Outcome:**
 - ✓ Identifies ice as solid, water as liquid
 - ✓ Uses words "melt" and "freeze"

Assessment:

- Teacher observes child describing changes
- Photo journal of melting experiment

Physics: Sink & Float

Key Topic: Density Basics

- **Activity:** "Treasure Hunt in Water"
 - Test natural objects (pinecone, stone, cork) in water tub
- **Outcome:**
 - ✓ Predicts 3+ sink/float results
 - ✓ Uses words "heavy" and "light"

Assessment:

- Checklist of predictions vs. results
 - Verbal explanation during play
-

Earth/Space: Weather & Seasons

Key Topic: Seasonal Changes

- **Activity:** "Weather Wheel"
 - Turn dial to match daily weather (sun, rain, cloud)

- **Outcome:**
 - ✓ Names current season
 - ✓ Matches clothing to weather

Assessment:

- Daily weather chart participation
- Dress-the-doll activity (seasonal clothes)

Botany: Living vs. Non-Living

Key Topic: Basic Classification

- **Activity:** "Nature Sort Tray"
 - Sort objects (leaf, rock, twig, plastic toy)
- **Outcome:**
 - ✓ Correctly sorts 5+ living/non-living items

Assessment:

- Sorting tray accuracy log
- Nature walk observations

Term 2: Deeper Exploration (Jan-Mar)

Chemistry: Mixing Colors

Key Topic: Primary Colors → Secondary

- **Activity:** "Dropper Color Lab"
 - Mix food coloring in water (red + yellow = orange)
- **Outcome:**
 - ✓ Creates green/purple/orange

Assessment:

- Color wheel completion
- Verbal labeling of mixtures

Physics: Magnetism Intro

Key Topic: Magnetic vs. Non-Magnetic

- **Activity:** "Magnet Fishing"
 - Fish for objects in sensory bin (paperclip vs. cork)
- **Outcome:**
 - ✓ Identifies 3 magnetic items

Assessment:

- Object sorting game
- Child explains "sticks/doesn't stick"

Earth/Space: Rocks & Soil

Key Topic: Earth Materials

- **Activity:** "Texture Scavenger Hunt"
 - Find rough/smooth items outdoors
- **Outcome:**
 - ✓ Describes 2+ textures

Assessment:

- Texture bag guessing game
- Matching objects to words

Botany: Parts of a Plant

Key Topic: Roots/Stems/Leaves

- **Activity:** "Carrot Top Garden"
 - Grow carrot tops in water, observe roots
- **Outcome:**
 - ✓ Points to roots/stems

Assessment:

- Plant part puzzle completion
- Gardening participation log

Term 3: Scientific Inquiry (Apr-Jun)

Chemistry: Baking Soda & Vinegar

Key Topic: Simple Reactions

- **Activity:** "Fizzing Volcano"
 - Mix ingredients in tray, observe bubbles
- **Outcome:**
 - ✓ Describes reaction ("bubbly!")

Assessment:

- Video of child's reaction
 - Verbal recall next day
-

Physics: Ramps & Motion

Key Topic: Speed/Gravity

- **Activity:** "Toy Car Ramp"
 - Test angles (high/low) with timers
- **Outcome:**
 - ✓ Says "faster" or "slower"

Assessment:

- Ramp experiment photos
- Teacher notes on vocabulary

Earth/Space: Sun & Shadows

Key Topic: Light Effects

- **Activity:** "Shadow Tracing"
 - Trace chalk shadows at different times
- **Outcome:**
 - ✓ Notices shadow changes

Assessment:

- Shadow drawing portfolio
- Outdoor observation notes

Botany: Seed Growth

Key Topic: Life Cycles

- **Activity:** "Bean Sprout Journal"

- Plant seeds, draw changes weekly
- **Outcome:**
 - ✓ Names "seed → plant" stages

Assessment:

- Growth chart drawings
- Sequence cards ordering

End-of-Year "I Can" Statements

Chemistry:

- "I can mix colors to make new ones"
- "I know ice melts into water"

Physics:

- "I can guess what will sink or float"
- "I know magnets stick to some things"

Earth/Space:

- "I can name sunny/rainy weather"
- "I see how shadows move"

Botany:

- "I can sort living and non-living things"
- "I know plants need water to grow"

Benchmark: Montessori vs. UK EYFS

Skill	Montessori (3-4)	UK EYFS (Nursery)
Scientific Method	Predicts & observes simple experiments	Notices changes in nature
Language	Precise vocabulary (melt, texture)	General descriptors ("wet," "big")
Assessment	Work samples + observation	Broad "Emerging/Expected" markers

Key Differences:

- 1. **Materials:** Montessori uses **real scientific tools** (magnets, droppers), while UK uses **play-based props**.
- 2. **Focus:** Montessori **isolates concepts** (e.g., only magnetism), while UK **integrates loosely** through play.
- 3. **Outcomes:** Montessori children **classify scientifically**, while UK focuses on **general observation**.

MONTESSORI SCIENCE FOR AGES 4–5

Montessori Science Curriculum for Ages 4-5

(Chemistry, Physics, Earth/Space, Botany – Term-by-Term Breakdown)

Introduction for Ages 4-5

Developmental Focus:

- **Curiosity-driven exploration** ("Why?" questions)
- **Hands-on experimentation** with simple tools
- **Nature-based learning** (real specimens, outdoor observation)
- **Vocabulary expansion** (scientific terms in context)

Montessori vs. UK EYFS (Reception) Comparison:

Aspect	Montessori (4-5)	UK EYFS (Reception)
Approach	Structured experiments with controls	Play-based discovery
Materials	Real lab tools (magnifiers, pipettes)	Generic sensory play items
Assessment	Observation + child-led documentation	Early Learning Goals (ELGs)

Term 1: Foundational Concepts (Sept-Dec)

Chemistry: Properties of Matter

Key Topic: Solids, Liquids, Gases

- **Activity:** "Matter Sorting Basket"
 - Sort objects (rock, water bottle, balloon) into categories
 - Freeze water → liquid to solid observation

- **Outcome:**
 - ✓ Classifies 5+ items by state
 - ✓ Uses terms "solid," "liquid," "gas"

Assessment:

- Sorting accuracy checklist
- Verbal explanation during play

Physics: Force & Motion

Key Topic: Push/Pull Effects

- **Activity:** "Marble Maze Challenge"
 - Use blocks to create paths, test forces
- **Outcome:**
 - ✓ Demonstrates "push" vs. "pull"
 - ✓ Predicts marble movement

Assessment:

- Maze complexity rubric
- Video recording of explanations

Earth/Space: Weather Systems

Key Topic: Precipitation Types

- **Activity:** "Rain Cloud in a Jar" (shaving cream + food coloring)
- **Outcome:**
 - ✓ Names rain/snow/sleet
 - ✓ Connects clouds to weather

Assessment:

- Weather chart participation
- Drawing of cloud types

Botany: Tree Study

Key Topic: Parts of a Tree

- **Activity:** "Bark Rubbings + Leaf Matching"
- **Outcome:**
 - ✓ Labels roots/trunk/leaves
 - ✓ Sorts 3+ leaf types

Assessment:

- Tree part puzzle completion
- Nature journal entries

Term 2: Intermediate Exploration (Jan-Mar)

Chemistry: Mixing & Solutions

Key Topic: Dissolving

- **Activity:** "Magic Potion Lab" (salt vs. sand in water)
- **Outcome:**
 - ✓ Predicts what will dissolve
 - ✓ Uses "mix" and "dissolve"

Assessment:

- Lab sheet with smiley/frowny faces

- Verbal recall next day

Physics: Sound & Vibrations

Key Topic: How Sound Travels

- **Activity:** "Spoon Bell Experiment" (string/ears)
- **Outcome:**
 - ✓ Explains "vibrations make sound"
 - ✓ Tests materials (loud/quiet)

Assessment:

- Sound source guessing game
- Teacher anecdotal notes

Earth/Space: Sun & Earth

Key Topic: Day/Night Cycle

- **Activity:** "Globe & Flashlight Demo"
- **Outcome:**
 - ✓ Shows Earth's rotation
 - ✓ Names "sunrise/sunset"

Assessment:

- Day/night sorting cards
- Shadow tracking drawings

Botany: Seed Germination

Key Topic: Plant Life Cycle

- **Activity:** "Grass Head Growing" (nylon/soil)
- **Outcome:**
 - ✓ Orders seed → sprout → plant
 - ✓ Waters plant independently

Assessment:

- Growth timeline drawings
- Caretaking responsibility chart

Term 3: Scientific Inquiry (Apr-Jun)

Chemistry: Chemical Reactions

Key Topic: Baking Soda + Vinegar

- **Activity:** "Colorful Eruptions" (add food coloring)
- **Outcome:**
 - ✓ Describes "fizzing reaction"
 - ✓ Predicts outcomes

Assessment:

- Experiment video review
- Child's drawn observations

Physics: Simple Machines

Key Topic: Ramps & Levers

- **Activity:** "Toy Car Slope Test"
- **Outcome:**
 - ✓ Explains "steep = faster"
 - ✓ Builds basic lever

Assessment:

- Photo journal of builds
- Ramp angle vocabulary

Earth/Space: Rock Classification

Key Topic: Igneous/Sedimentary

- **Activity:** "Rock Scratch Test" (hardness)
- **Outcome:**
 - ✓ Sorts rocks by texture
 - ✓ Uses "smooth/rough"

Assessment:

- Rock collection labels
- Sensory bin exploration notes

Botany: Flower Dissection

Key Topic: Pollination Basics

- **Activity:** "Parts of a Flower" (real tulips)
- **Outcome:**
 - ✓ Identifies petals/pollen
 - ✓ Role-plays bee pollination

Assessment:

- Flower part matching game
- Pollination story drawings

End-of-Year "I Can" Statements

Chemistry:

- "I know solids, liquids, and gases"
- "I can mix things to make new colors"

Physics:

- "I know how to make sounds louder/softer"
- "I can build ramps for toy cars"

Earth/Space:

- "I know why we have day and night"
- "I can name different rocks"

Botany:

- "I know how plants grow from seeds"
- "I can name flower parts"

Benchmark: Montessori vs. UK EYFS

Skill	Montessori (4-5)	UK EYFS (Reception)
Scientific Process	Predicts, tests, and observes	Notices changes through play
Vocabulary	Precise terms (dissolve, pollen)	General descriptors

Skill	Montessori (4-5)	UK EYFS (Reception)
Independence	Conducts simple experiments	Adult-guided exploration

Key Differences:

1. **Tools:** Montessori uses **real science equipment** (pipettes, magnifiers), while UK uses **everyday play items**.
2. **Documentation:** Montessori tracks **individual progress** through work samples; UK assesses **broad ELGs**.
3. **Depth:** Montessori **isolates concepts** (e.g., only levers); UK **integrates loosely** (e.g., "exploring forces").

MONTESSORI SCIENCE FOR AGES 5–6

Montessori Science Curriculum for Ages 5-6

(Chemistry, Physics, Earth/Space, Botany – Term-by-Term Breakdown)

Introduction for Ages 5-6

Developmental Focus:

- **Hypothesis-driven exploration** ("What if...?" questions)
- **Structured experiments** with variables
- **Nature-based investigations** (outdoor labs, specimen collections)
- **Scientific vocabulary** (precise terms like "evaporate," "attract")

Montessori vs. UK National Curriculum (Year 1) Comparison:

Aspect	Montessori (5-6)	UK Year 1
Approach	Child-led experiments with controls	Teacher-directed topic units
Materials	Real science tools (microscopes, scales)	Worksheets + generic resources
Assessment	Lab journals + photo evidence	Phonics screening + written tasks

Term 1: Scientific Foundations (Sept-Dec)

Chemistry: States of Matter

Key Topic: Solid/Liquid/Gas transformations

- **Activity:** "Water Cycle in a Bag" (evaporation/condensation demo)

- **Outcome:**
 - ✓ Labels all 3 states of water
 - ✓ Predicts outcomes (e.g., "steam is gas")

Assessment:

- Drawing of water cycle stages
- Oral explanation video

Physics: Light & Shadows

Key Topic: Opaque/Transparent

- **Activity:** "Light Box Exploration" (test materials: foil, wax paper, glass)
- **Outcome:**
 - ✓ Sorts materials by light interaction
 - ✓ Creates shadow puppets

Assessment:

- Sorting tray accuracy
- Puppet show demonstrating concepts

Earth/Space: Rock Cycle

Key Topic: Igneous/Sedimentary/Metamorphic

- **Activity:** "Crayon Rock Cycle" (shave/chill/press crayons)
- **Outcome:**
 - ✓ Matches rocks to formation process
 - ✓ Uses terms "layers" and "heat"

Assessment:

- Rock type identification game
- Crayon model labels

Botany: Photosynthesis

Key Topic: Plant Needs

- **Activity:** "Sunlight Experiment" (cover leaf sections, observe chlorophyll loss)
- **Outcome:**
 - ✓ States "plants need light"
 - ✓ Draws before/after results

Assessment:

- Lab journal entries
- Plant care responsibility chart

Term 2: Intermediate Investigations (Jan-Mar)

Chemistry: Mixtures & Solutions

Key Topic: Dissolving rates

- **Activity:** "Hot vs. Cold Water Test" (time salt dissolution)
- **Outcome:**
 - ✓ Records time differences
 - ✓ Uses "dissolve" and "solution"

Assessment:

- Pictorial lab report
- Temperature vocabulary checklist

Physics: Magnetic Forces

Key Topic: Attraction/Repulsion

- **Activity:** "Magnet Maze Challenge" (guide objects with wands)
- **Outcome:**
 - ✓ Demonstrates poles attracting/repelling
 - ✓ Tests magnetic permeability

Assessment:

- Maze completion photos
- Verbal explanation of findings

Earth/Space: Solar System

Key Topic: Planetary orbits

- **Activity:** "Planet Walk" (scale model with fruit: Sun=grapefruit, Earth=peppercorn)
- **Outcome:**
 - ✓ Names 3 planets
 - ✓ Explains "orbit" with movement

Assessment:

- Planet ordering game
- Kinesthetic demonstration

Botany: Seed Dispersal

Key Topic: Adaptation strategies

- **Activity:** "Seed Travelers" (match seeds to dispersal: burrs, wings, etc.)
- **Outcome:**
 - ✓ Sorts 5+ seed types
 - ✓ Role-plays dispersal methods

Assessment:

- Seed matching worksheet
- Dramatization video

Term 3: Advanced Inquiry (Apr-Jun)

Chemistry: Chemical Reactions

Key Topic: Acids & bases

- **Activity:** "Cabbage Juice pH Test" (safe household liquids)
- **Outcome:**
 - ✓ Identifies 2 acids/bases
 - ✓ Predicts color changes

Assessment:

- Color chart matching
- Hypothesis vs. result discussion

Physics: Simple Machines

Key Topic: Lever/pulley systems

- **Activity:** "Flagpole Challenge" (raise small flags with pulleys)
- **Outcome:**
 - ✓ Builds working pulley
 - ✓ Explains "easier lifting"

Assessment:

- Engineering design rubric
- Demonstration to peers

Earth/Space: Weather Patterns

Key Topic: Precipitation formation

- **Activity:** "Cloud in a Bottle" (water/alcohol in plastic bottle)
- **Outcome:**
 - ✓ Describes cloud formation
 - ✓ Connects to real weather

Assessment:

- Weather diary entries
- Cloud type flashcards

Botany: Tree Growth

Key Topic: Annual rings

- **Activity:** "Cookie Tree Rings" (decorate cookies with ring patterns)
- **Outcome:**
 - ✓ Counts rings to age trees
 - ✓ Links rings to drought/rain

Assessment:

- Tree cookie examination
- Growth timeline drawing

End-of-Year "I Can" Statements

Chemistry:

- "I can show how water changes states"
- "I know some things dissolve faster in hot water"

Physics:

- "I can make shadows change size"
- "I know magnets have two ends"

Earth/Space:

- "I can name planets near Earth"
- "I know how clouds make rain"

Botany:

- "I can explain what plants need to grow"
- "I know how seeds travel"

Benchmark: Montessori vs. UK Year 1

Skill	Montessori (5-6)	UK Year 1
Investigation	Designs simple controlled tests	Follows teacher-led experiments

Skill	Montessori (5-6)	UK Year 1
Documentation	Maintains science journal	Completes worksheet exercises
Real-World Connection	Links concepts to nature observations	Focus on classroom activities

Key Differences:

1. **Materials:** Montessori uses **authentic tools** (microscopes, pH strips); UK uses **printed resources**.
2. **Depth:** Montessori explores **fewer topics in depth**; UK covers **more topics superficially**.
3. **Assessment:** Montessori values **process over product**; UK emphasizes **written outputs**.

MONTESSORI SCIENCE FOR AGES 6–7

Montessori Science Curriculum for Ages 6–7

Introduction & Overview

At ages 6–7, children in a Montessori environment are in the second plane of development (6–12 years), characterized by a strong reasoning mind, curiosity about the universe, and a desire to understand interconnected systems. Science is taught holistically, integrating **chemistry, physics, botany, and earth/space science** through hands-on exploration, experimentation, and storytelling (Great Lessons). The focus is on **observation, classification, cause-and-effect reasoning, and fostering a love for discovery** rather than rote memorization.

Term-by-Term Breakdown

Term 1: Foundations of Matter & Life

Topics Covered:

- **Chemistry:** States of matter (solid, liquid, gas), simple mixtures, dissolving
- **Physics:** Introduction to forces (push/pull), magnetism, gravity
- **Botany:** Parts of a plant (root, stem, leaf, flower), plant needs
- **Earth/Space:** Layers of the Earth, introduction to rocks/minerals

Key Learning Outcomes:

1. Classify materials by state (solid, liquid, gas).
2. Demonstrate understanding of basic forces (e.g., magnets attract/repel).
3. Identify and describe plant parts and their functions.
4. Recognize Earth's layers and basic rock types.

Example Activities:

- **Chemistry:** Sorting objects by state, dissolving sugar in water experiment.

- **Physics:** Magnet exploration station (predicting attraction/repulsion).
- **Botany:** Dissecting a flower, labeling parts.
- **Earth/Space:** Creating a clay model of Earth's layers.

Assessment Tools:

- **Observation records** (child's ability to classify, predict, explain).
- **Self-assessment drawings** (e.g., labeling plant parts).
- **Simple experiments with guided questions** (e.g., "What happens when we mix oil and water?").

Term 2: Interactions & Systems

Topics Covered:

- **Chemistry:** Simple chemical reactions (vinegar + baking soda), mixtures vs. solutions
- **Physics:** Simple machines (lever, pulley), buoyancy
- **Botany:** Photosynthesis (simplified), seed germination
- **Earth/Space:** Water cycle, weather observations

Key Learning Outcomes:

1. Observe and describe simple chemical reactions.
2. Identify basic simple machines in daily life.
3. Explain how plants make food (sunlight + water + CO₂).
4. Describe the stages of the water cycle.

Example Activities:

- **Chemistry:** Fizzing reaction experiment (vinegar + baking soda).
- **Physics:** Building a lever with a ruler and fulcrum.
- **Botany:** Growing seeds in a jar (observing germination).
- **Earth/Space:** Creating a mini water cycle in a bag.

Assessment Tools:

- **Lab journal entries** (drawing observations).
- **Verbal explanations** ("Tell me how the lever works").
- **Project-based assessment** (e.g., presenting a weather chart).

Term 3: Exploration & Connections

Topics Covered:

- **Chemistry:** Introduction to elements (periodic table with symbols)
- **Physics:** Sound and light waves (vibrations, shadows)
- **Botany:** Types of plants (trees, shrubs, herbs), plant adaptations
- **Earth/Space:** Solar system (planet order), moon phases

Key Learning Outcomes:

1. Recognize common element symbols (O, H, C).
2. Demonstrate how sound travels (e.g., tuning fork in water).
3. Compare different plant types and their adaptations.
4. Name planets in order and describe moon phases.

Example Activities:

- **Chemistry:** Matching element symbols to objects (O for oxygen).
- **Physics:** Making a "string telephone" to explore sound waves.
- **Botany:** Sorting leaves by shape/vein patterns.
- **Earth/Space:** Oreo moon phase activity.

Assessment Tools:

- **Matching games** (symbols to elements).
- **Group discussion** ("Why do some plants have thorns?").
- **Model creation** (e.g., building a solar system mobile).

End-of-Year "I Can" Statements

- **Chemistry:** I can describe solids, liquids, and gases. I know some elements have symbols (O, H).
- **Physics:** I can explain how magnets work. I know levers help lift heavy things.
- **Botany:** I can name plant parts and explain how they grow.
- **Earth/Space:** I can list planets in order. I know the water cycle.

Benchmarking: Montessori vs. UK National Curriculum (Year 2)

Area	Montessori (6–7)	UK National Curriculum (Year 2)
Chemistry	States of matter, elements (symbols)	Materials, simple properties (hard/soft)
Physics	Forces, simple machines, sound/light	Push/pull, basic materials testing
Botany	Plant parts, photosynthesis, adaptations	Plants need water/light, basic growth
Earth/Space	Earth’s layers, solar system, water cycle	Seasons, weather, basic planet names
Skills Emphasized	Hands-on experiments, independent inquiry, classification	Following structured investigations, recording observations

Key Differences:

- **Montessori:** More advanced in **elements, Earth’s layers, and plant adaptations** due to cosmic education.
- **UK Curriculum:** More structured but less exploratory; focuses on **basic properties and recording data**.

- **Montessori Strengths:** Independent thinking, interconnected learning, deeper conceptual understanding.
- **UK Strengths:** Clear progression, standardized assessment, literacy/numeracy integration.

End of Year Summary:

Montessori science at 6–7 fosters **a deeper, more exploratory approach** compared to the UK's structured but narrower curriculum. Children gain **strong reasoning skills, hands-on problem-solving, and a love for scientific inquiry**, while UK students focus more on **meeting set benchmarks with teacher-led activities**.

MONTESSORI SCIENCE FOR AGES 7–8

Montessori Science Curriculum for Ages 7–8

Introduction & Overview

At ages 7–8, children continue to develop their **reasoning abilities, abstract thinking, and curiosity about the interconnectedness of the natural world**. The Montessori science curriculum builds on prior knowledge with **greater depth in experimentation, classification, and scientific reasoning**. The approach remains **hands-on, interdisciplinary, and child-led**, fostering independence and a deep engagement with scientific concepts.

Term-by-Term Breakdown

Term 1: Matter, Energy & Life Processes

Topics Covered:

- **Chemistry:** Properties of matter (density, buoyancy), mixtures & solutions
- **Physics:** Forms of energy (heat, light, sound), simple circuits
- **Botany:** Plant life cycles (seed dispersal, pollination), types of roots
- **Earth/Space:** Rock cycle, fossils, introduction to tectonic plates

Key Learning Outcomes:

1. Compare density of liquids (oil vs. water) and predict buoyancy.
2. Construct a simple circuit and identify conductors/insulators.
3. Explain seed dispersal methods (wind, water, animals).
4. Describe how sedimentary, igneous, and metamorphic rocks form.

Example Activities:

- **Chemistry:** "Liquid layers" experiment (honey, water, oil).
- **Physics:** Building a simple circuit with a battery, wire, and bulb.

- **Botany:** Sorting seeds by dispersal method (maple "helicopters," burrs).
- **Earth/Space:** Simulating sedimentary rock layers with colored sand.

Assessment Tools:

- **Hypothesis testing** (e.g., "Which objects float in saltwater vs. freshwater?").
- **Circuit-building challenge** (can they complete a circuit independently?).
- **Nature journal sketches** (documenting seed types or rock samples).

Term 2: Forces, Reactions & Earth Systems

Topics Covered:

- **Chemistry:** Acids/bases (pH indicators), oxidation (rusting)
- **Physics:** Friction, gears, and pulleys; sound vibrations
- **Botany:** Photosynthesis (advanced), plant adaptations (desert vs. rainforest)
- **Earth/Space:** Atmosphere layers, weather patterns, climate zones

Key Learning Outcomes:

1. Use natural indicators (red cabbage) to test acids/bases.
2. Design a pulley system to lift objects.
3. Model photosynthesis with equations (sunlight + CO₂ → sugar + O₂).
4. Label atmospheric layers and link weather to climate zones.

Example Activities:

- **Chemistry:** Red cabbage pH experiment (testing vinegar, baking soda).
- **Physics:** Creating a pulley with string and weights.
- **Botany:** Starch test on leaves (iodine reveals photosynthesis).
- **Earth/Space:** Painting a "layer cake" model of the atmosphere.

Assessment Tools:

- **Lab report** (recording pH results and observations).

- **Engineering challenge** (e.g., "Can your pulley lift 50g?").
- **Concept maps** (connecting climate zones to plant adaptations).

Term 3: Cosmic Connections & Advanced Exploration

Topics Covered:

- **Chemistry:** Atoms & molecules (introduction to H₂O, CO₂)
- **Physics:** Light refraction, magnetism & electricity connections
- **Botany:** Symbiosis (plants/fungi), human uses of plants
- **Earth/Space:** Solar system scale, constellations, moon's effect on tides

Key Learning Outcomes:

1. Build models of molecules (e.g., water = 2H + O).
2. Demonstrate light bending with prisms or water.
3. Explain mutualism (e.g., bees and flowers).
4. Model planetary orbits and relate tides to the moon's gravity.

Example Activities:

- **Chemistry:** Marshmallow-and-toothpick molecule models.
- **Physics:** "Rainbow maker" (CD spectroscope).
- **Botany:** Fungus hunt (observing mycorrhizae on tree roots).
- **Earth/Space:** Tide simulation with a basin and moon model.

Assessment Tools:

- **Oral presentation** ("Explain how a prism works").
 - **Peer teaching** (children demonstrate molecule models to classmates).
 - **Moon journal** (tracking phases and tides over a month).
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End-of-Year "I Can" Statements

- **Chemistry:** I can test acids/bases and explain density. I know water is H₂O.
- **Physics:** I can build a circuit and explain how pulleys work.
- **Botany:** I can describe photosynthesis and seed dispersal.
- **Earth/Space:** I can name atmosphere layers and explain moon phases.

Benchmarking: Montessori vs. UK National Curriculum (Year 3)

Area	Montessori (7–8)	UK National Curriculum (Year 3)
Chemistry	pH, molecules, density	States of matter, separating mixtures
Physics	Circuits, pulleys, light refraction	Forces/magnets, shadows, basic electricity
Botany	Photosynthesis, symbiosis, adaptations	Plant life cycles, water transport
Earth/Space	Atmosphere layers, tides, tectonic plates	Rocks/fossils, basic solar system
Skills Emphasized	Independent experiments, molecular thinking, systems theory	Following structured investigations, measuring skills

Key Differences:

- **Montessori:**
 - Goes deeper into **chemistry (molecules, pH), physics (circuits, pulleys), and earth systems (tectonics, tides)**.
 - Emphasizes **interconnectedness** (e.g., linking plant adaptations to climate).
 - Child-led **open-ended experiments** (e.g., designing pulley systems).
- **UK Curriculum:**

- More focused on **measurable outcomes** (e.g., "Compare how shadows change").
- Less emphasis on **abstract concepts** (e.g., atoms, symbiosis).
- Tighter alignment with **literacy/numeracy** (e.g., recording data in tables).

End of Year Summary:

By age 7–8, Montessori students **outpace the UK curriculum in conceptual depth** (e.g., molecules, symbiosis) and **scientific reasoning**, while UK students gain stronger **data-recording and procedural skills**. Montessori's **cosmic education** fosters a "big picture" understanding, whereas the UK curriculum ensures **benchmarked progress in core topics**.

MONTESSORI SCIENCE FOR AGES 8–9

Montessori Science Curriculum for Ages 8-9

Simplified & Age-Appropriate Overview

Children at this stage are **concrete thinkers** who learn best through:

- **Tangible experiments** (nothing abstract like chemical bonds)
- **Story-based introductions** (e.g., "The Mountain's Story" for geology)
- **Real-world connections** (e.g., kitchen chemistry)

Term 1: Fun with Matter & Energy

Topics & Activities:

- **Chemistry:**
 - Make "glue" from milk/vinegar (simple separation)
 - Oil-and-water fireworks with food coloring
- **Physics:**
 - Balloon rockets (action/reaction)
 - DIY balance scales to compare densities
- **Botany:**
 - Dissect fruits to find seeds (count/compare)
 - Grow beans in CD cases to see roots
- **Earth Science:**
 - Edible sedimentary rocks (chocolate layers)
 - Volcano model with baking soda

Assessments:

- "Show me" demonstrations (e.g., "Make the rocket go farthest")
- Seed collection with labels

Term 2: Forces & Living Systems

Topics & Activities:

- **Physics:**
 - Marble run challenge (gravity/friction)
 - Magnet fishing game (classify magnetic items)
- **Botany:**
 - Leaf chromatography (separate pigments)
 - Build insect hotels for pollinators
- **Earth Science:**
 - Weather station (measure rain/wind)
 - Erosion tray with sand and water

Assessments:

- Marble run design sketch with labels
- Weather diary (draw clouds daily)

Term 3: Our Amazing Planet

Topics & Activities:

- **Earth/Space:**
 - Bake cookie planets to scale
 - Moon phase Oreo activity
- **Ecology:**
 - Pond dipping (classify creatures)
 - Compost bin observations
- **Practical Chemistry:**
 - Make lemon batteries
 - Test natural cleaners (vinegar vs. soap)

Assessments:

- Planet size comparison chart
- "Cleaner test" results poster

End-of-Year "I Can" Statements

- Mix and separate materials (like oil/water)
- Build simple machines that move
- Explain how seeds travel
- Describe what makes day/night and seasons

Comparison to UK Year 4

Topic	Montessori	UK National Curriculum
Materials	Kitchen chemistry experiments	Group materials by properties
Forces	Balloon rockets, marble runs	Magnet poles, basic friction
Plants	Seed dispersal games	Plant part functions
Earth/Space	Edible solar system	Basic rock types

Key Difference:

Montessori uses **everyday materials** and **child-led exploration**, while the UK curriculum has more **structured "identify and describe" goals**. Both cover similar topics, but Montessori allows deeper sensory investigation.

MONTESSORI SCIENCE FOR AGES 9–10

Montessori Science Curriculum for Ages 9-10

(UK Year 5 Equivalent – Simplified & Hands-On Approach)

Overview:

At **9-10 years old**, children are transitioning from **concrete to more logical thinking** but still need **tangible, engaging experiments** rather than abstract theory.

This curriculum focuses on:

Everyday phenomena (kitchen chemistry, backyard physics)

Minimal terminology (focus on *doing* over memorizing)

Project-based learning (child-led investigations)

Term 1: Kitchen Science & Simple Machines

Topics & Activities:

Chemistry:

- **Lemon Volcanoes** (baking soda + lemon juice – observe reactions)
- **Density Towers** (honey, syrup, water, oil – layer by weight)

Physics:

- **Cardboard Arcade** (build simple games using levers/pulleys)
- **Balloon-Powered Cars** (action/reaction forces)

Earth Science:

- **Edible Soil Layers** (pudding, cookies, gummy worms)
- **Weather Tracking** (make a rain gauge from plastic bottles)

Assessment:

- "Can you explain why the lemon fizzes?" (verbal explanation)
- Sketch and label your simple machine

Term 2: Living Things & Energy

Topics & Activities:

Biology:

- **Seed Bomb Making** (clay, soil, seeds – study germination)
- **Worm Farm Observations** (decomposers in action)

Physics:

- **Solar Oven S'mores** (sunlight → heat energy)
- **DIY Kaleidoscopes** (light reflection)

Ecology:

- **Bird Feeder Engineering** (test different designs)
- **Water Filtration Challenge** (sand, gravel, cotton)

Assessment:

- "What do worms need to survive?" (short written response)
- Compare solar oven temperatures (chart results)

Term 3: Our Planet & Beyond

Topics & Activities:

Earth/Space:

- **Baking Moon Craters** (drop marbles into flour/cocoa mix)
- **Constellation Flashlight Projector** (punch holes in a cup)

Environmental Science:

- **Plastic vs. Biodegradable** (bury items to observe decomposition)
- **Windmill Challenge** (paper blades + fan test)

Assessment:

- "Why do craters look different?" (discussion)
- Keep a **decomposition journal** (weekly sketches)

End-of-Year "I Can" Statements

- Mix safe household chemicals and observe reactions
- Build a simple machine that moves
- Explain how plants and animals depend on each other
- Describe how the moon changes shape

Comparison to UK Year 5 Curriculum

Topic	Montessori (Simplified)	UK National Curriculum
Materials	Kitchen reactions (no equations)	"Compare and group materials"
Forces	Balloon cars, levers in games	"Explain air resistance"

Topic	Montessori (Simplified)	UK National Curriculum
Ecology	Worm farms, seed bombs	"Life cycles of plants/animals"
Earth/Space	Edible moon models	"Phases of the moon" (worksheet)

Key Differences:

- ✓ **Montessori:** More **hands-on building**, less writing
- ✓ **UK Curriculum:** More **vocabulary-based** (e.g., "air resistance")
- ✓ Both cover similar concepts, but Montessori **keeps it playful and experimental**

MONTESSORI SCIENCE FOR AGES 10–11

Montessori Science Curriculum for Ages 10-11

(UK Year 6 Equivalent – Simple, Hands-On & Practical)

Overview:

At **10-11 years old**, children are capable of **more independent investigations** but still need **concrete, real-world science** rather than abstract theory. This curriculum:

- ✓ Uses **everyday materials** (no fancy lab equipment)
- ✓ Focuses on **experiments over memorization**
- ✓ Links science to **real-life problems** (environment, simple tech)

Term 1: Matter & Reactions (Kitchen Science)

Topics & Activities:

Chemistry:

- **Bath Bomb Making** (observe acid-base reactions with citric acid + baking soda)
- **DIY Lava Lamps** (oil, water, food coloring – density & solubility)

Physics:

- **Paper Bridge Challenge** (test different designs for strength)
- **Homemade Electromagnet** (battery, nail, wire – lift paperclips)

Earth Science:

- **Edible Rock Cycle** (chocolate bars: melt, cool, break to show igneous/sedimentary)
- **Ocean Currents Demo** (cold vs. hot water with food coloring in a tub)

Assessment:

- "Why did your bridge hold the most weight?" (verbal explanation)
- Draw and label the steps of your lava lamp reaction

Term 2: Energy & Living Systems

Topics & Activities:

Biology:

- **Decomposition Jars** (compare banana peels in soil vs. plastic bags)
- **Leaf Transpiration Experiment** (plastic bag on a tree branch – observe water)

Physics:

- **Solar-Powered Oven** (pizza box + foil – cook s'mores)
- **CD Hovercraft** (old CD, balloon, bottle cap – air pressure)

Ecology:

- **Local Habitat Survey** (identify 5 plants/animals in your garden)
- **Water Pollution Simulation** (oil, dirt in water – test filtration methods)

Assessment:

- Graph temperature changes in the solar oven
- Present findings from decomposition jars (which broke down fastest?)

Term 3: Earth & Simple Technology

Topics & Activities:

Earth/Space:

- **Cookie Solar System** (decorate cookies to scale for planet sizes)
- **Moon Phase Flipbook** (draw phases on sticky notes)

Environmental Science:

- **Wind Turbine Challenge** (paper blades, fan test – which spins fastest?)
- **"Trash to Treasure" Upcycling** (build something useful from recyclables)

Assessment:

- Explain why some wind turbine designs worked better (oral presentation)
- Sketch and label your upcycled creation

End-of-Year "I Can" Statements

- Conduct safe chemical reactions (like bath bombs)
- Build simple machines that use energy (electromagnet, hovercraft)
- Explain how humans impact ecosystems (decomposition, pollution)
- Model basic Earth systems (rock cycle, solar system)

Comparison to UK Year 6 Curriculum

Topic	Montessori (Hands-On)	UK National Curriculum
Chemistry	Bath bombs (observe reactions)	"Compare reversible changes"
Physics	Paper bridges, hovercrafts	"Understand air resistance"

Topic	Montessori (Hands-On)	UK National Curriculum
Biology	Decomposition experiments	"Classification of living things"
Earth/Space	Edible solar system	"Earth's rotation & shadows"

Key Differences:

- ✓ **Montessori:** More **building and testing** (e.g., wind turbines)
- ✓ **UK Curriculum:** More **written explanations** (e.g., "Describe how shadows change")
- ✓ Both teach similar concepts, but Montessori **prioritizes doing over writing**

MONTESSORI SCIENCE FOR AGES 11–12

Montessori Science Curriculum for Ages 11-12

(Practical Explorations for Early Adolescents)

Guiding Principles:

- **Real-world problem solving** over textbook learning
- **Minimal equipment needed** (uses household/classroom items)
- **Project-based assessments** instead of written tests
- **Emphasis on environmental connections**

Term 1: Everyday Chemistry & Physics

Chemistry in Action:

- **CSI Kitchen Forensics**
 - Test mystery powders (flour, sugar, salt) with vinegar/iodine
 - Fingerprint analysis with graphite and tape
- **Environmental Chemistry**
 - Test water pH from different sources (tap, rain, bottled)
 - Make biodegradable plastic from milk (casein)

Practical Physics:

- **Survival Engineering**
 - Build solar stills for water purification
 - Design earthquake-proof structures with spaghetti/marshmallows

Assessment:

- Present findings as "science detective reports"
- Film a 1-minute explanation of their best engineering solution

Term 2: Living Systems & Technology

Biology Explorations:

- **Backyard Biodiversity**
 - Create insect hotels from recycled materials
 - Track bird migrations using free apps like eBird
- **Body Science**
 - Model joints with cardboard and rubber bands
 - Test reaction times with ruler drop experiments

Green Technology:

- **Upcycling Challenge**
 - Turn e-waste into functional items (old keyboards into art)
 - Design a school waste reduction plan

Assessment:

- Biodiversity scrapbook with photos/sketches
- Pitch their upcycling invention "Shark Tank" style

Term 3: Earth & Space Connections

Planetary Science:

- **Space Exploration DIY**

- Build Galilean telescopes from PVC pipes
- Simulate asteroid impacts using flour and marbles
- **Climate Science**
- Track a month of weather patterns
- Debate: "Should we build cities underground?"

Assessment:

- Create a "space mission" poster for Mars colonization
- Record a podcast episode about a climate solution

End-of-Year "I Can" Demonstrations

- Conduct forensic tests to identify substances
- Design solutions to environmental problems
- Explain how human body systems interact
- Debate the ethics of space exploration

Comparison to UK Year 7 Curriculum

Focus Area	Montessori Approach	Traditional UK Approach
Scientific Method	Learning through trial/error in projects	Structured lab reports
Chemistry	Kitchen forensics, eco-plastics	Introduction to elements
Physics	Survival engineering challenges	Measuring forces
Biology	Local ecosystem interactions	Cell biology basics
Assessment	Presentations, prototypes	Written tests

Key Advantages:

- Develops **problem-solving skills** through authentic challenges
- Makes **adolescent-relevant connections** (CSI, survival tech)
- **No expensive equipment** needed
- Builds **communication skills** through alternative assessments

Suggested Materials Kit:

- Old smartphones (for photography/data collection)
- Kitchen ingredients (vinegar, baking soda)
- Recyclables (cardboard, plastic bottles)
-