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Dear Teacher or Parent,

In simple terms, science is the study of the way things work and the reasons why they work that way. As such, scientific study is second nature to children, who are infinitely curious about the world around them and who, from a very early age, question everything with youthful enthusiasm and an apparently insatiable appetite for knowledge and understanding. Fortunately for these persistently inquisitive little souls, scientific principles underpin everything we see and do in our daily lives. We simply fail to appreciate its omnipresence. I wrote *101 Science Activities for Emerging Einsteins* to bring children face to face with the science that is inherent in their everyday activities.

The format of this book is unique. Although it provides children with the opportunity to explore the main branches of scientific study—life sciences or biology, the study of animals, plants and other living organisms; chemistry, the study of substances (their composition, characteristics and interactions with one another); physics, the exploration of forces, motion, heat and light; Earth sciences such a geology (the study of rocks and the Earth) and meteorology (the study of weather), which examine the Earth's development and its state of constant change; and astronomy, the study of stars, planets and other galactic phenomena—it does so in the context of an everyday science adventure. From waking to dressing to eating to thinking to playing to sleeping, *101 Science Activities for Emerging Einsteins* takes children on an extraordinary scientific journey through an ordinary day.

Each of the 101 activities carves the scientific process into manageable slices. I Spy Science challenges children to question everyday occurrences; Science at Work provides them with straightforward but provocative experiments and the opportunity to observe, hypothesize and deduce; and Simple Science offers an easy-to-understand explanation of what happened and why. Additional experiments are suggested under Science Stuff. Sentimental Science and Suggestive Science link science to the English curriculum by examining the relationship between the language of science and the common vernacular and reinforces the principles of purpose and creative writing by encouraging children to pen their personal experiences. Finally, Science Stunners offers tantalizing tidbits of useful knowledge and fascinating facts.

The tried and tested experiments in this book can be performed at school or at home, in serial or random fashion, using simple materials that can be found around the house or purchased inexpensively at the grocery store or drugstore. Although young scientists can do much of the hands-on experimenting in this book without adult supervision, educators and parents should reinforce some fundamental principles and basic rules before turning students loose in the classroom or kitchen lab:

- Always get permission from an adult in charge before conducting an experiment.
- Be careful! Part of being a scientist is being responsible in your pursuit of knowledge. Make safety—yours and that of others—a top priority.
- Be sure to clean up after an experiment and dispose of materials properly.

- Read all of the instructions and check the "you will need" list before starting an experiment so that you know, up-front, what you need and what you have to do.
- Expect the unexpected. Don't be disappointed if the results of an experiment are not what you thought they would be. That's science. Repeat the experiment. If you are still disappointed, try to determine why things went wrong. Not everything you attempt will be a success, but finding out what doesn't work is just as important as finding out what does.
- Don't be afraid to make minor alterations and slight adjustments. Modify experiments—even create your own—but be sure to keep notes. The "trial and error" approach is at the heart of the scientific process and many of the world's great discoveries.
- Look at the world around you. Try to observe examples of the scientific principles that you have learned during your experimentation.
- Never stop asking why.

You don't have to be a scientist or even know much about science to have fun exploring the world around you and to find wonder in everyday things. All you need is the willingness to see and the desire to know. Writing *101 Science Activities for Emerging Einsteins* changed the way I look at, experience and make sense of my immediate environment. As a result, I am much less likely to take anything for granted and find myself involuntarily searching out the "whats" and "whys" in everything I do. I hope that this book helps you and your children to embrace the adventure and have as much fun discovering the science in your daily lives as did I.

Sincerely,

Tracey Ann Schofield

Activity 2

Breathe in; Breathe Out

I Spy Science

Are you breathing right now? Of course you are. You breathe all the time as air passes in and out of your nose. Like your sleep/wake cycle, your breathing is also controlled by a biological clock. Unless something goes terribly wrong with your body or brain, respiration (breathing) occurs regularly and continuously 24/7.

Science at Work

To simulate the inhale/exhale action of your lungs during breathing, you will need a plastic bottle, a drinking straw, modeling clay, two rubber bands, two balloons, scissors and tape.

Ask an adult to cut the bottom off the plastic bottle. Snip the narrow neck off one balloon. Stretch the balloon over the bottom of the bottle, secure with a rubber band and tape in place. Put the end of the straw into the second balloon and hold it in place with the other rubber band. Again, use tape to hold the straw in place. Wrap some clay around the middle of the straw. Push the clay into the opening of the bottle so that the balloon hangs down inside. (Make sure the clay fits snugly in the opening so that air cannot pass in or out.) Holding the neck of the bottle, pull down on the bottom balloon and then release. What happens to the balloon inside the bottle?

Simple Science

Pulling on the bottom balloon causes the balloon inside the bottle to inflate. The inner balloon deflates when you release the bottom balloon. It is changes in volume (an increase, then a decrease) and pressure (a decrease, then an increase) that cause the air to move in and out of the inner balloon. Your lungs work in a similar fashion.

At rest, your two lungs hold about one-half gallon (2.5 liters) of air (they can hold more than one gallon [5 liters] when the body is very active). To collect oxygen for the body, your diaphragm
(a muscular partition that separates the chest from the abdomen) contracts, becoming shorter and flatter, and your lungs expand, stretching downwards. Your intercostals (the short muscles between each pair of ribs) contract, pulling up your ribs and stretching the lungs forward. All of this increases the volume of your chest cavity and decreases the pressure inside it. Because the air pressure outside of your body is greater than the pressure inside your chest cavity, air rushes in through your nose. When your diaphragm and intercostal muscles relax–pushing up and in–your spongy lungs scrunch together, decreasing the volume of your chest cavity and increasing the pressure inside it. This forces the old, stale air (which has been collected by the blood) out of your lungs and back out through your nose.

Science Stunner

- When you breathe you inhale (along with traces of other gases): nitrogen (78%), oxygen (21%) and carbon dioxide (0.04%) and exhale: nitrogen (79%), oxygen (16%) and carbon dioxide (4%).

Activity 10

Water: Easy Come, Easy Go

I Spy Science

Look at all that rain collecting in puddles on the road. Where does it go after the storm?

Simple Science

Those puddles are part of the water cycle. Once the storm has passed and the sun comes out, the water in the puddles will heat up and evaporate into the air as water vapor. Up in the clouds, the tiny water droplets will start to join together. When the droplets become too heavy, they will fall to the Earth once again as rain, creating fresh puddles in the road.

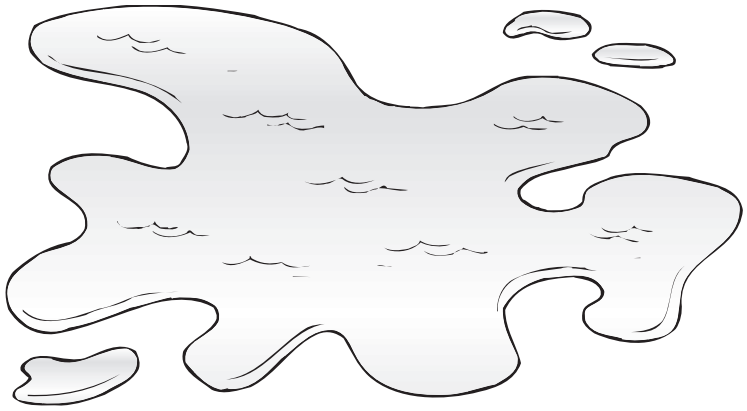
Science at Work

You can observe and track the movement of water through the water cycle by making your own rain–or precipitation/evaporation–gauge. You will need a clear plastic jar or container with straight sides and a flat bottom, a ruler, clear tape, a journal, a pencil and an outdoor space that is open to the rain and sun.

To make your precipitation/evaporation gauge, tape the ruler to the container so that the bottom of the ruler sits on the ground and the numbers rise vertically up the jar. Place your gauge in a suitable outdoor space. (Make sure the jar is secured and will not tip over in the wind.) Record the water level in the jar every couple of days over the course of a season. What happens to the water level when it rains? What happens to the water level during a dry spell?

Science Stunners

- Do you know why it smells so fresh outside after it rains? Because the air is wet and clean, just like laundry when it comes out of the washing machine! The rain washes little bits of dust and soot and pollen out of the air and sort of sticks them to the ground so they don't get in the way of your nose smelling other, nicer things. The wet air carries fresh smells–like earth and grass and trees–to your nose better than dry air does, and the moist air makes the inside of your nose wetter so that it can trap those fresh smells more easily.
- There are as many as 15 million droplets of water vapor in one raindrop.
- Scientists estimate that 40 million gallons of water fall on the Earth every second of every day–in the form of rain, snow or freezing rain.
- One square mile of rain one inch (2.5 cm) thick weighs 72,000 tons.



Activity 27

Moldy Oldies

I Spy Science

Your nose is clear, your taste buds are ready to receive and your mouth is watering at the thought of bread that is toasted to perfection. You've trashed the burnt stuff, and you're about to slip two slices of nice, fresh green bread into the toaster. Hold the phone! GREEN bread? There's something funny—I mean furry—g"r"owing on in your bread bag, buddy.

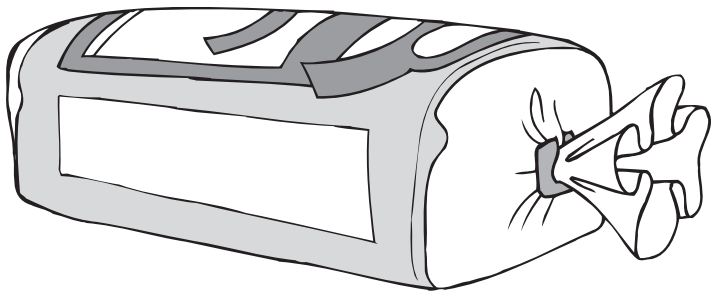
Simple Science

That green stuff on your bread is a kind of fungus called mold. Unlike most plants, fungi can't make their own food. Instead, like humans, they have to eat other plants and animals to survive. But while we eat our food first and then digest it, fungi do the opposite: they secrete enzymes to digest food and turn their future supper into mush—and then absorb the liquid nutrients. Although fungi are hard to live with, you couldn't live without them. People go to a lot of trouble and expense to stop fungi from eating your food before you do. Chemical preservatives help and so does refrigeration (fungi prefer warm temperatures), but hungry fungi eventually prevail and turn good, solid food into oozy, smelly stuff. And fungi are at the "root" of most plant diseases, digesting roots, leaves and stems. Even itchy athlete's foot is the fault of fungi. Without fungi, however, you would be up to your neck in dead plants and animals. Fungi decompose, or break down, plant and animal remains and turn them into rich compost that makes excellent soil and food for plants. And molds are used to make bread, cheese, vinegar and other foods. All that green fur on your bread? That's the mold penicillium, from which we derive penicillin—an antibiotic that has saved more lives than any other medicine in history. And, of course, people all over the world love to load their dinner plates with a steaming pile of delicious fungi: in the form of mushrooms, that is.

Science at Work

When it's not growing on the bread you want to toast for breakfast, mold is both functional and beautiful. To design your own mold mosaic—in something other than your bread bag—you will need a plastic or aluminum container, soil, water, discarded bits of food (not meat), plastic wrap and an elastic band.

Put an inch of soil in the bottom of your container. Place your food bits—bread, orange peels, cheese (anything other than meat that you have ever seen covered in a furry, green blanket)—on top of the soil. Lightly water your mosaic and then cover it tightly with plastic wrap. Use the elastic band to hold the wrap firmly in place. Put your mosaic in a warm, dark place. Check it daily for changes. If nothing happens after a few days, add a little more water. Soon, your mold mosaic will be in full and colorful bloom.



Activity 52

Does Your Garbage Can Have a RE Cycle?

I Spy Science

Doesn't that juice bottle you are about to drop into the trash can have a little triangle on its bottom? And what about that cardboard wrapper and that plastic snack container? Those items are recyclable. Why are you throwing them away with your lunch garbage?

Simple Science

When we recycle products that are no longer useful to us, we reclaim them by using them in the manufacture of new products. This not only helps to decrease our dependence on our diminishing natural resources, but also cuts down dramatically on the amount of garbage we send to our landfill sites every year.

Science at Work

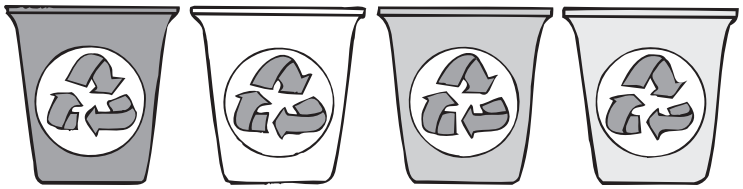
At home and at school over the next week, instead of throwing recyclable items out, put them into a garbage bag. How many bags of recyclable "garbage" did your class collect? If you salvaged this much recyclable material every week, how many trash bags could your class keep out of the local landfill site? What if the kids in every classroom in your school did the same? What if . . . ?

Science Stunners

- Every year, you throw away more than 300 pounds—or two mature trees' worth—of paper products. Recycling just one ton of paper saves 17 trees, 7000 gallons (26,500 liters) of water and enough energy to heat an average home for six months.
- We could heat one billion homes for one year with the amount of wood and paper that Americans throw away every year.
- It takes less energy to make 10 aluminum cans from recycled aluminum than it takes to make one aluminum can from aluminum ore. Almost 100% of an aluminum can can be recycled. This recycled aluminum is identical to the aluminum found in ore.
- The most common pollutant found in our rivers is motor oil which is 100% recyclable.
- If you are an average American, you throw away 4 pounds (2 kg) of garbage every day. That's 1600 pounds (730 kg) of trash every year! Multiply that by 250 million people and you get one billion pounds (one-half million tons) of garbage—every day. And much of that is recyclable.

Sentimental Science

- Make a list of at least 10 things that you threw in the garbage today. How could you cut that list in half?



Activity 69

Pop Goes the Kernel

I Spy Science

How about a little after-school snack before you start studying for that make-up test? Popcorn perhaps?

Science at Work

To find out what puts the pop in popcorn, you will need a handful of popcorn kernels, a marker, a bowl and a hot air popper (or a pot or microwave-safe container).

Pick out about 20 kernels. Make sure some of the kernels are intact and some are cracked or crumpled. (If you can't find any damaged kernels, hit a few lightly with a hammer to split their shells slightly.) Mark the pointed end of the imperfect kernels with the marker. Heat the kernels in the popper and collect the popcorn in a bowl. When the popping has stopped, unplug the popper and look at the contents of the bowl. (Remember, the contents and popper are hot!) Did all the kernels pop?

Simple Science

Popcorn kernels are actually the seeds of a new corn plant. They are hard and dry on the outside, but inside they are tightly packed with soft, moist material. The moisture is sealed inside the kernel to keep the seed alive until conditions are right for growth. When you heat the kernel quickly, the moisture inside the kernel heats up, too. Eventually, it vaporizes and turns to steam. The hot, trapped steam continues to expand, increasing the pressure inside the kernel until the shell splits and the kernel bursts open with tremendous force. When the shell explodes, the material inside expands to its full size.

To pop, popcorn kernels must be reasonably intact and moist. The kernel will not pop if the shell is cracked or the moisture inside has evaporated prior to heating. The imperfect kernels in your experiment didn't pop because the steam could not build up inside them.

Suggestive Science

- Have you ever felt so angry you just wanted to burst? Have you ever needed to blow off some steam? Imagine that you are a popcorn kernel exploding. How does it feel?
- Can you pantomime a kernel of corn popping?

Science Stunners

- Popcorn has been around for centuries. It was used by the Incas as a decoration hundreds of years ago, and was introduced to the Pilgrims by Native Americans at the very first Thanksgiving dinner.
- For a popcorn kernel to pop, the temperature inside the kernel must reach at least 212°F (100°C), the boiling point of water.
- Good popcorn will grow up to 40 times its original size when popped.
- Popcorn is a wise snack choice. It is very low in calories, contains just a trace of protein and fat and is a source of dietary fiber.