



WONDER WIRE

April 2005

ideas to inspire curious children

Vol. 2 No. 2

EVER WONDER . . . HOW METAL CLEANERS WORK?

EXPLORE. With the coming of spring, our thoughts turn to flowers, bunnies, sunshine – and, of course, cleaning! It's time to emerge from the long, dark winter and make everything shiny and new again -- which makes this month the perfect opportunity to explore the chemical solutions and reactions that clean things! We're all familiar with the "scrub until it's clean and/or your arm falls off" method of cleaning; but what about all those fabulous cleaners that allow you to just spray and wipe? Each of those products was carefully formulated in a lab somewhere using all kinds of chemistry. So what's in there? Is it a solvent? An emulsifier? A chelating agent? This month's Wonder Wire focuses on the chemistry of metal cleaners – but take the time this month to read the labels on all of your cleaning products and talk to your kids about how they work. It's okay if you don't know the answer – make some guesses, then try to figure it out together!

DISCOVER.

Experiment 1: Penny (Copper) Cleaner. Materials: Soapy water, 1 T. salt, 1 T. vinegar, cotton swabs, cup, dirty pennies. **Procedure:** Dip a cotton swab into the soapy water, then use it to wipe the penny. After rubbing for 10 seconds or so, do you see any difference? Now measure your vinegar into a cup. Dip a cotton swab in the vinegar and rub over the penny. Do you see any difference in the penny now? Now mix the salt into the vinegar in your cup and use this to wipe the penny. Is there a difference now? Try dipping a penny into the salt and vinegar solution. Which way does the penny get cleaner -- when you dip it or when you wipe it? Can you clean a penny without wiping it at all? Why do you think this is possible?



Other solutions that clean copper (as well as bronze, brass and pewter) include hot sauces (such as Tabasco™), Kool-Aid™, soy sauce, Worcestershire sauce and warmed ketchup. Try and compare each – or even try combining them! It might smell gross, but you could end up with a great cleaner!

Experiment 2: Silver Cleaner. Materials: Aluminum foil, baking soda, salt, hot water, tarnished silver, large glass baking dish. **Procedure:** Place a sheet of aluminum foil in the bottom of the baking dish. Pour in 1 T. baking soda, 1 T. salt and several cups of very hot water (can be boiling if you like, but be very careful!). Place your tarnished silver and silver-plated items in the sink and soak for a few minutes. Watch as the tarnish leaves the silver and appears on the foil! (Can you smell the sulfur being thrown off in the chemical reaction?) Other solutions that will work to clean silver include lemon juice and salt, white toothpaste, and paste made with baking soda and water. Try all of them and decide which one works best!

Experiment 3: Rust (Iron/Steel) Cleaner. Materials: Cloth, Coca-Cola™. **Procedure:** Try wiping the rusty area with a clean cloth. Can you get it clean by just rubbing? Now dip your cloth in the Coca-Cola and wipe the rusty area again. What happens now? (FYI: It is not true that Coca-Cola will dissolve a nail!) Another way to remove rust is to soak the rusty spot for two weeks in a solution of 9 parts water, 1 part molasses.

WORD OF THE MONTH: TARNISH. USE IT IN A SENTENCE AT LEAST ONCE A DAY!

C-ZONE NEWS

Don't miss the
FLIP & FLY!
Open House

Friday,
April 8, 3-7 pm

Hands-on fun
with kites,
airplanes,
magnets & more!

PLUS learn cool
yo-yo tricks from
GUEST STAR
DICK STOHR!

Save 10% on all
toys during the
Flip & Fly

SPRING CLASSES

Ages 2-11

Fab Physics
(April 11-June 19)
If it flies, flips,
flashes or spins,
this class has got
it!

SUMMER CAMPS

Ages 4-11

- ◆ Cooking for Kids
- ◆ Junkyard Builders
- ◆ Artsy Scientists

AMAZING INVENTIONS: GALVANIZED STEEL





Steel is an important metal that is used in building things like bridges and buildings. Steel is made from iron; it is plentiful,

easy to work with, and strong. But it also rusts and corrodes very easily, which could cause bridges or buildings eventually to crumble to the ground. Scientists worked hard to find a way to stop this corrosion. In the 1800s, scientists finally found the answer: they invented a process called “galvanizing” in which a coat of zinc (a metal highly resistant to corrosion) was bonded to steel. Without the zinc protective coating, the steel would have corroded in a year or two, becoming unsafe and ugly. But with the zinc coating, the steel resisted rust without maintenance, year after year. If only the Eiffel Tower had been built with galvanized steel, the French could have saved \$10 million in maintenance costs! Without galvanized steel, we probably could not have the bridges, buildings, farms, power plants, airplanes, trains, and cars that we have today. Thank goodness for creative scientists!

SECRET SCIENCE AGENTS: YOUR MISSION FOR APRIL

Create as many formulas as you can for cleaning pennies (with parental supervision of course!), then use the best ones to restore as many pennies as you can to their original shine. This is your chance to make the world just a little bit brighter! Bring 20 bright shiny pennies to the C-Zone and we'll give you a quarter (can you figure out how much profit that is?) PLUS a sweet treat!

LEARN.

- ◆ The “dirt” on metals is actually the product of corrosive chemical reactions between the surface of the metal and air, water or other elements. For example, silver tarnishes when it undergoes a chemical reaction with sulfur-containing substances in the air. This forms silver sulfide, which is black. Although many chemical reactions occur quickly (for example, iron will rust quickly in water), some chemical reactions occur very slowly over a period of months or years -- for example, tarnish on silver. 
- ◆ Once you have soaked pennies in a vinegar and salt solution, tiny copper atoms will be floating around in the solution. If you remove the pennies and place metal (uncoated) paper clips in the solution, the copper atoms will be attracted to the paper clips and will eventually turn them black! This process is called “electroplating.”
- ◆ Metals can be cleaned either by removing or dissolving the corrosion, or by reversing the chemical reaction. For example, one way to clean the tarnish from silver is to remove the silver sulfide from the surface. This is accomplished using metal polish that is mildly abrasive, or that contains a chemical that can dissolve the tarnish. Another method is to use a chemical reaction to convert the silver sulfide back into silver. Many metals form compounds with sulfur – and some, like aluminum, actually have a greater affinity for sulfur than silver. When silver and aluminum are soaked together in a baking soda solution, as in our experiment, the sulfur transfers from the silver to the aluminum! This is another example of electroplating.
- ◆ Molasses contains “chelating agents” that can clean metals. Chelating agents are made of molecules that are shaped a bit like the claws of a crab. They can surround metal atoms on the surface of an object, trapping them and removing them. Molasses owes its properties to cyclic hydroxamic acids, which will, for example, clean the rust off of iron. The power of chelating agents explains why the insides of tomato tins need to be lacquered. The citric acid in the tomatoes would dissolve the metal of the container if it was not coated! 
- ◆ A small amount of the carbon dioxide in Coca-Cola will react in solution to form carbonic acid, which in turn cleans metals.
- ◆ An acid (e.g., vinegar or lemon juice) combined with salt forms Cl- ions in a solution. When applied to tarnished or corroded metals, these ions attack the oxides without affecting the base metal, leaving a shiny finish. This is why a solution like soy sauce (which contains both acids and salt) can be used to shine metals!

Parents and Teachers: Register to receive the Wonder Wire™ by email each month at www.curiosityzone.com/wonderwire.html

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