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# Colorful Separations

Activity	Recommended Grade Levels					Page
	K-3	4-6	7-9	10-12	Gen	
<b>54 Separating Colors</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	3
<p>How many different colors are in the water-soluble ink of a pen? Try this simple activity that utilizes the technique of chromatography to find out.</p>						
<b>55 Two-Toned Flower</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	9
<p>Have you ever seen a flower that has highlights of one color on one side and a different color on the other side? This activity demonstrates that the stem and/or leaves of a plant contain hair-like tubes (pipelines) that carry liquids, and that liquids can rise up very narrow tubes such as these.</p>						
<b>56 Candy Chromatography</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	13
<p>Is the brown coating on a piece of M&amp;M's® candy really brown, or is it made up of several colors? You can find out by doing Candy Chromatography. The colored coatings of M&amp;M's®, Reece's Pieces®, and Skittles® candies can be analyzed for their component colors using chromatography on ordinary filter paper. (Grocery store food coloring can also be studied in the same manner.)</p>						
<b>57 Chromatography Flowers</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	23
<p>A few black dots ("seeds") on a piece of filter paper bloom into a variety of colorful, flower-like patterns. "Black" ink is most often produced by mixing several pigments of different colors. Radial paper chromatography provides an interesting way to separate the pigments from one another so that it is possible to see which colors were combined to make the black color.</p>						
<b>58 Chromatography T-shirt Designs</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	29
<p>Can you transform a plain white T-shirt into a colorful one using chromatography? Following a procedure similar to the one used for making radial chromatography patterns on filter paper, it is relatively easy to decorate T-shirts (or any other absorbent cloth material) with the same types of patterns.</p>						

# Dyeing Eggs

Activity	Recommended Grade Levels					Page
	K-3	4-6	7-9	10-12	Gen	
<b>59 The Need for Vinegar</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	39
Have you ever colored eggs? Do you remember using vinegar in the dye? Why is it used and how much is needed? This activity investigates the role of vinegar in the coloring of eggs.						
<b>60 Concentration of Dye</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	43
How important is the concentration of the dye in the food coloring solution to the egg dyeing process? This activity investigates the impact of changing the concentration of dye.						
<b>61 The Role of the Egg Cuticle</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	47
What role does the thin coating on the outside surface of an eggshell play in the egg-dyeing process? This activity will demonstrate the importance of the cuticle to the coloring of eggs.						
<b>62 Salt and Sugar</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	51
Salt and sugar are common household chemicals. Have you ever wondered what might happen if you added them to the dye solution when you color eggs? This activity is an investigation of the effects of salt and sugar on egg dyeing.						
<b>63 Time and Temperature</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	55
How does the time eggs are left in a dye solution and the temperature of the solution affect the intensity of color? This activity investigates the effects of changing these two variables.						
<b>64 The Effect of pH</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	61
How important to the egg-dyeing process is the pH of the food coloring solution? This activity investigates how the depth of color varies with the acidity or basicity of the dye solution.						



# Polymers

Activity	Recommended Grade Levels					Page
	K-3	4-6	7-9	10-12	Gen	
<b>65 Make-It-Yourself Slime</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	67
<p>What is make-it-yourself-slime? This activity gives you the opportunity to make and study the properties of a polymer gel similar to the Slime<sup>®</sup> that you find in toy stores.</p>						
<b>66 Making Glue From Milk</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	77
<p>Separating curds from whey can be more than a line from a nursery rhyme—it also leads to interesting chemistry and sticky product. A related activity can be found in Volume 1, Activity #13, "Curdling of Milk."</p>						
<b>67 Gluep</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	81
<p>You and your students can enjoy a fun polymer activity—make gooey Gluep! What is Gluep? It's a stretchy, slimy, crosslinked polymer that is made from white glue and household borax.</p>						
<b>68 Polyurethane Foam</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	89
<p>Making polyurethane foam is a spectacular demonstration of a chemical reaction: two viscous liquids are mixed together in equal proportions, and in about 5 minutes, the mixture expands to approximately 30 times its original volume, gives off heat, and becomes quite rigid.</p>						
<b>69 Superabsorbent Polymer</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	95
<p>Have you ever wondered why disposable diapers hold more water without leaking than regular, cloth diapers do? This fun activity show the material in disposable diapers holds so much liquid without leaking.</p>						
<b>70 Shrinkable Plastics</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	101
<p>Most of us have bought items packaged in form-fitting plastic wrap called "shrink wrap." This plastic is often made of polystyrene that shrinks when heated. In this activity, students will determine the amount of shrinkage in some common plastics products. Shrinky Dinks<sup>®</sup> are a common toy made of polystyrene utilizing this same shrinking process.</p>						

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Activity	Recommended Grade Levels					Page
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<b>71 Identifying Polymers by Density and a Flame Test</b>	K-3 <input type="checkbox"/>	4-6 <input type="checkbox"/>	7-9 <input checked="" type="checkbox"/>	10-12 <input checked="" type="checkbox"/>	Gen <input type="checkbox"/>	107
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What if you needed to recycle an assortment of polymers, but there was no obvious way to distinguish one type from another? This activity shows how to identify polymers using density, an easily measured property of matter, and flame tests.

<b>72 Thermoplastic and Thermoset Polymers</b>	K-3 <input type="checkbox"/>	4-6 <input type="checkbox"/>	7-9 <input checked="" type="checkbox"/>	10-12 <input checked="" type="checkbox"/>	Gen <input checked="" type="checkbox"/>	113
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Do all plastics behave the same way when heated? Anyone who has ever played with Shrinky Dinks<sup>®</sup> knows these plastic sheets shrink when heated and even melt if heated too much. But do all plastics melt when heated? How about the plastic handles on metal cookware? In this activity, students discover the answers to these questions, and use the different thermal properties of plastics to create fun products.

SAMPLE

# Cartesian Divers

Activity	Recommended Grade Levels					Page
	K-3	4-6	7-9	10-12	Gen	
<b>73 Standard Diver</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	123
<p>Can the pressure exerted on an object affect its density? In this activity, you will introduce yourself to an age-old toy: the Cartesian diver. It floats at the top of a bottle of water, but when you squeeze the bottle, the diver mysteriously sinks to the bottom. When you stop squeezing, it rises back to the surface. But how? (A general explanation of Cartesian divers is at the end of this activity.)</p>						
<b>74 Cartesian Counter</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	135
<p>How does the size of the air pocket affect the diving tendency of a Cartesian diver? In this activity, you will put different amounts of water in each of ten numbered divers, place them all in the same bottle, and squeeze. Do the divers know how to count? They seem to, but what starts off as a simple counting game ends up as a test of brute strength.</p>						
<b>75 Density Column Divers</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	141
<p>Can a diver be suspended indefinitely in the middle of a Cartesian diver bottle without squeezing the bottle? In this activity, you will observe the fascinating effects on a diver when two or more liquids of differing densities are layered inside the bottle.</p>						
<b>76 Cartesian Retriever</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	149
<p>Can a Cartesian diver help to retrieve a sunken "treasure" from the ocean floor? In this activity, you will construct a hook on a floating diver and a handle on a sunken one; you will put your eye-hand coordination to the test trying to snag the underwater booty and bring it safely to the surface. An alternative to video games any day!</p>						
<b>77 Closed-System Diver</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	155
<p>Can a Cartesian diver still work if it is sealed shut? With a standard diver, when the bottle is squeezed, water is forced into the diver, making the diver more dense and causing it to sink. If the opening is plugged, the diver won't dive . . .Right? Let's find out.</p>						
<b>78 Underwater Basketball</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	163
<p>Imagine playing underwater basketball inside a 2-L soda bottle. With Cartesian divers, almost anything is possible . . .</p>						



# Physical Properties and Changes

Activity	Recommended Grade Levels					Page
	K-3	4-6	7-9	10-12	Gen	
<b>79 Egg in the Bottle</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	171
<p>Can you push an egg into a bottle with a neck smaller than the diameter of the egg? Once you get the egg in the bottle, can you get it back out in one piece? This activity shows how differences in pressure can make these movements possible.</p>						
<b>80 Powder Glove</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	177
<p>Can you dip your hand into water without getting it wet? In this activity, lycopodium powder is used because it is less dense than water and is very hydrophobic (water-hating), which prevents it from mixing with water.</p>						
<b>81 Nonadditive Volumes</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	181
<p>Is the whole <i>always</i> equal to the sum of its parts? This activity is dramatic proof that when two different liquids are combined, the final volume may not be equal to the sum of the two initial volumes.</p>						
<b>82 Boiling Liquids in a Syringe</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	189
<p>Can liquids boil at temperatures below their normal boiling points? In this activity, a syringe will be used to provide a low-pressure environment so boiling can occur at lower than normal temperatures.</p>						
<b>83 Seeing Through Paper</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	195
<p>Have you ever eaten potato chips while reading a book? Sometimes the oil in the chips gets on your hands and is transferred to the page. If enough grease gets on the page, you may notice an interesting phenomenon—the print from the opposite side of the page begins to show through as the paper becomes somewhat transparent. In this activity, you will examine this interesting phenomenon.</p>						
<b>84 Changing Pressures</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	201
<p>Why do cake mixes have special instructions for baking at altitudes above 3500 feet? You can answer this question by observing how atmospheric pressure affects gas solubility and the boiling point of a liquid. This demonstration explores the relationship between the pressure and volume of a gas.</p>						



# Observing Chemical Changes

Activity	Recommended Grade Levels					Page
	K-3	4-6	7-9	10-12	Gen	
<b>85 Surface Area and Burning</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	211
<p>Does iron burn? How about wood? While you surely know that wood burns, you may be less sure about iron. This activity demonstrates whether or not iron burns, and it also shows the role that surface area plays in burning.</p>						
<b>86 Dust Explosion in a Can</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	217
<p>Can dust burn explosively? This demonstration illustrates a small-scale dust explosion occurring in a can. It serves to introduce students to a potential problem associated with the storage of grain, flour, and other finely divided materials.</p>						
<b>87 Energy Changes with Everyday Materials</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	223
<p>Can the energy changes that accompany chemical and physical processes be observed? In this activity, changes in temperature are measured when various substances are dissolved in water.</p>						
<b>88 Sterno®</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	229
<p>Have you ever wondered how Sterno®, the gelled alcohol fuel used in food warmers or chafing dishes, is made? In this activity, you will mix a saturated calcium acetate solution with ethyl alcohol to make this commercially available gel.</p>						
<b>89 Rate of a Chemical Reaction</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	233
<p>Have you ever seen bubbling in a chemical reaction? The speed at which bubbles form can indicate the rate of reaction. By observing the rate of bubble formation, you will get an idea of how concentration, surface area, and temperature affect reaction rates.</p>						
<b>90 Wooden Splint Test</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	239
<p>You have samples of three colorless and odorless gases—how can you tell which is which? The wooden splint test provides the answer in this activity. You will use three different reactions to produce oxygen, carbon dioxide, and hydrogen. Each gas has a different effect on a glowing or burning wooden splint.</p>						

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Activity	Recommended Grade Levels					Page
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<b>91 Electrochemical Series</b>	K-3 <input type="checkbox"/>	4-6 <input type="checkbox"/>	7-9 <input checked="" type="checkbox"/>	10-12 <input checked="" type="checkbox"/>	Gen <input checked="" type="checkbox"/>	245
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Why do some metals react when placed in acids, forming bubbles of hydrogen, while other metals fail to react? The answer lies in the chemical activity of the different metals. This demonstration compares the chemical activity of several metallic elements.

<b>92 Colorful Catalysis</b>	K-3 <input type="checkbox"/>	4-6 <input type="checkbox"/>	7-9 <input checked="" type="checkbox"/>	10-12 <input checked="" type="checkbox"/>	Gen <input checked="" type="checkbox"/>	253
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Can you observe a catalyst in action? Using dramatic color changes, this activity demonstrates the effect of a catalyst on the rate of a reaction of hydrogen peroxide and potassium sodium tartrate.

<b>93 A Tornado Show</b>	K-3 <input type="checkbox"/>	4-6 <input type="checkbox"/>	7-9 <input checked="" type="checkbox"/>	10-12 <input checked="" type="checkbox"/>	Gen <input checked="" type="checkbox"/>	257
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A tornado that changes color! In this activity, a magnetic stirrer causes a vortex to form in an acidic solution containing universal indicator. As a base is added, color changes occur.

<b>94 Changes in Odor</b>	K-3 <input type="checkbox"/>	4-6 <input type="checkbox"/>	7-9 <input checked="" type="checkbox"/>	10-12 <input checked="" type="checkbox"/>	Gen <input type="checkbox"/>	263
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What makes bananas, pineapples, pears, and wintergreen have the odor they do? In this activity, you will make esters that produce these characteristic odors. By noting the change in odor, you will detect that a chemical change has occurred.

# Crystals

Activity	Recommended Grade Levels					Page
	K-3	4-6	7-9	10-12	Gen	
<b>95 Growing Crystals</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	273
<p>Crystals are solids that have interesting and beautiful geometric patterns. Diamonds, rubies, and other gemstones are examples of crystalline solids. In this activity, you will grow crystals of potassium aluminum sulfate (alum), copper(II) sulfate, magnesium sulfate (Epsom salt), and sodium chloride (table salt).</p>						
<b>96 Crystal Gardens</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	277
<p>What are crystal gardens? This activity shows you how to make crystal flower gardens using charcoal briquettes and a solution of liquid bluing, ammonia, and salt. These gardens became popular during the Depression years and, therefore, have been called "depression flowers."</p>						
<b>97 Eggshell Geodes</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	281
<p>Have you ever seen a geode, a rock with crystals inside? This activity simulates a geode's formation using half an eggshell as a "hollow rock" in which crystals can grow from a saturated solution of a mineral salt.</p>						
<b>98 Crystallization of a Supersaturated Solution</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	287
<p>Have you ever seen a jar of honey crystallize? Honey, like the sodium acetate solution used in this activity, is a supersaturated solution. Supersaturated solutions crystallize upon the addition of a single seed crystal. Try this activity to observe this phenomenon first-hand.</p>						
<b>99 Copper(II) Hydroxide "Stalactites"</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	293
<p>Have you ever been in a cave and seen icicle-like structures hanging from the ceiling? Those structures are called stalactites and are limestone deposits that take many years to form. With this activity, however, you can simulate the process in less than half an hour.</p>						
<b>100 Growing Copper Crystals</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	299
<p>How does the rate of formation of copper crystals affect their overall size? In this activity, iron is used to displace copper ions from solution, resulting in copper crystals. Different rates of formation cause different sizes of copper crystals to develop.</p>						



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**Activity****Recommended Grade Levels Page****101 Silicate "Stalagmites"**K-3 4-6 7-9 10-12 Gen  
    **307**

Have you ever used Magic Rocks®? If you have, you saw an unusual array of colorful "stalagmites" sprout from small rock-like crystals. This activity provides three novel ways of investigating the interesting and unusual chemistry behind Magic Rocks®.

SAMPLE

# Our Everyday World

Activity	Recommended Grade Levels					Page
	K-3	4-6	7-9	10-12	Gen	
<b>102 Tornado in a Bottle</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	319
<p>Can you create your own miniature tornado? This activity allows you to simulate the twisting and swirling motion of a tornado by mixing salt, soap, and water inside a bottle.</p>						
<b>103 Sky Blue–Sunset Red</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	323
<p>During the day, the sun looks whitish-yellow and the sky is blue. As the sun sets, it may appear to turn fiery red, and the sky may become pink, orange or red. Why do the sun and the sky appear to change colors? This activity demonstrates the effect that suspended particles play in this color change.</p>						
<b>104 Cloud in a Jar</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	329
<p>This activity will allow you to make your own cloud from smoke and water vapor. Once made, the cloud can be turned "on" and "off" by raising and lowering a plunger.</p>						
<b>105 Tarnish—Formation and Cleaning</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	333
<p>What causes silver to tarnish? Once it is tarnished, how can you clean and shine it without using costly commercial products? This activity will investigate the tarnishing process and show how to reverse it without any loss of silver.</p>						
<b>106 Investigating a Burning Candle</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	339
<p>Can you light a candle without touching a flame to the wick, or extinguish a candle flame without blowing out or smothering the flame? This activity investigates the properties of a candle flame and the products of its combustion.</p>						
<b>107 Penny Wafers</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	347
<p>Can the inside of a penny be removed, leaving only the copper shell? This activity will demonstrate the difference in activity of copper and zinc using a penny and an acid.</p>						