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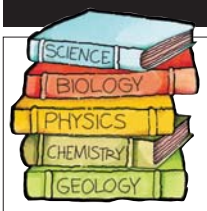

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HEADLINE DISCOVERIES

MAKING SCIENCE MATTER™

TV CRIME SCIENCE EXPOSED

Ever since the first episode of CSI, police science dramas have sparked an unprecedented nationwide curiosity about forensic science. Plot lines revolve around a team of savvy investigators who sweep a crime scene, extract the evidence, run lab tests and crack the case—all in a tidy TV hour.

It's no surprise that a growing number of students, intrigued by the uncanny prowess of these TV detectives, are considering careers in forensic science. But aspiring forensic scientists should not confuse fiction with fact.

Television has glamorized and exaggerated forensic science far beyond reality. Actual forensic science is a painstaking world of backlogged cases, cramped labs and squeezed budgets. Facilities, equipment and staffing are too often inadequate for the workload. The pressures to work quickly and with unerring accuracy are intense, because these labs serve a criminal justice system in which a life can be forever altered by the analysis of a single drop of blood or strand of hair.

TV writers sacrifice technical accuracy for the sake of drama. This frustrates forensic professionals, because TV influences viewers' perceptions. Real world forensics "can be tedious," admits Katharina Babcock, a forensic scientist for the State of New Mexico. "You have to be patient, and you have to pay attention to every detail."

Let's explore the hidden truths of forensic science—and debunk a few TV-inspired myths. Then we'll look at some examples of how schools teach students about forensic science. But first, what exactly does a police scientist do?

A forensic scientist performs two critical roles—as analyst and as witness. The scientist examines physical evidence found on a victim, at a crime scene, or both, and compares it to evidence found on a suspect. He or she also provides expert testimony in a court of law. A forensic scientist must have the skill to examine the tiniest piece of evidence from a crime scene plus the cool and competence to clearly and confidently defend the findings under oath in court.

MYTH NO. 1:

THE DO-IT-ALL SLEUTH

TV crime shows focus on a few central characters that become, in effect, super scientists capable of handling all types of analysis. "They've taken four or five (investigators) and made a composite of them, then dramatized it," says Robert Fraas, director of the forensic science program at Eastern Kentucky University.

In reality, forensics is a specialized realm comprised of half a dozen or more distinct departments. For example, the Sheriff 's Lab in San Diego, CA, consists of 55 employees and nine different departments such as Firearms, Controlled Substances, and Fingerprints. Evidence is typically passed through multiple sections for examination. According to nationally renowned forensic pathologist Dr. Cyril Wecht, "There are no generalists in the world of modern-day forensic science to rival Sherlock Holmes and Quincy."

MYTH NO. 2:

THE COOPERATIVE CRIME SCENE

Whether it's a smudge of dirt, a broken fingernail or something more exotic, TV sleuths always get their evidence, right? With careful fine-tooth combing, the crime scene reveals all.

The truth is, even the most secured crime scene may not surrender its secrets easily, and often the evidence found is unusable. Fingerprints are one example; TV's "lab boys" have been successfully dusting for prints since the days of *Dragnet*. While modern techniques such as computer imaging have made fingerprint analysis more sophisticated, technology cannot create evidence that doesn't exist. Dr. Wecht says, "Finding identifiable fingerprints that can be developed and are of sufficient quality to do an automated search are more the exception than the rule."

The quantity of evidence is often as critical as the quality. Certain lab procedures like gas chromatography require a piece of evidence to be destroyed in order to test it. In those cases, investigators must retrieve a usable amount of evidence from the scene. Too little evidence is as bad as having no evidence at all.

Evidence gathering is an exacting process that cannot be rushed, but even the finest forensic teams find themselves in a never-ending race against the clock. All too often, hard evidence is perishable and can be degraded or even destroyed by weather or other natural forces over time. How soon a crime scene is discovered can be the deciding factor in solving a case.

MYTH NO. 3:

INSTANT RESULTS

To fit a story into one hour, Hollywood writers take liberties with the laws of science, especially the compression of time. TV makes it look fast and easy, but real crime labs don't work so swiftly. First of all, in many labs cases are handled in the order they are received, so it can take weeks or months for evidence to hit a benchtop. When a case reaches the lab, the evidence may be routed through a sequence of specialized labs. For example, a paper document might be analyzed for fingerprints in one lab and later tested for its authenticity in another.

Crime labs work in concert with law enforcement officials to ensure that work is done in a timely manner. There's usually a sizeable backlog of casework, and just one high-profile case can complicate the schedule even further. Cases in which lab results are needed to make an arrest are given priority, as are cases headed to trial. According to Susan Scholl, director of the New Mexico state crime lab, managing the demands of prosecutors "can be a real juggling act."

Unlike on TV, the laws of science don't bend in the crime lab. Analytical physics and chemistry procedures require a set amount of time. Allow for repetitive tests and inconclusive data and it is easy to see how long the process can be before achieving definitive results. (Chemical analysts may take weeks to separate and identify all the compounds in a corpse.)

MYTH NO. 4:

THE FULLY EQUIPPED CRIME LAB

The laboratory set of a TV crime drama is a techno-gadget lover's dream. In reality, crime labs are often underfunded and must compete with police and fire departments for precious budget dollars. Historically, crime labs have toiled in relative obscurity, sometimes relegated to leftover office space, or forced to use worn-out equipment.

THE CHANGING LAB SCENE

New lab design incorporates economy of space, ergonomics, and workflow to meet current and future needs. The goal is improved efficiency as the demands on the forensic lab continue to grow. Ken Mohr, a principal at the design firm of Health, Education + Research Associates, says that, "DNA-driven work, estimated between 10 to 20% today, is on the rise." Mohr adds that to meet this burgeoning caseload, more and more labs are introducing robotic systems to automate procedures in an effort to achieve higher productivity.

A forensic lab faces all of the requirements of a conventional lab plus the elevated standards applied as an adjunct of the judicial system. The lab must meet environmental health and safety regulations and operate efficiently within budget constraints. It bears the added burden to secure and preserve evidence in an uncontaminated state. Accuracy is paramount since test results, presented before a jury, can determine a defendant's fate. As Mohr states, "The technical work performed in forensic labs must withstand evidentiary challenge."

CLASSROOM SHAMUSES

"Kids today think crime scene investigations are cool," said Ann King, a science teacher at Abraham Lincoln Elementary School in Medford, OR. To introduce her class to forensic science, King, in cooperation with Southern Oregon University, arranged a mock homicide scene at the school. Students collected and evaluated evidence in an attempt to determine the nature of the crime.

Lincoln School is just one example of how schools are taking advantage of forensic TV's popularity to kindle students' interest in science. On a wider scale, the National Science Teachers Association (NSTA) has partnered with Court TV to develop free forensic science curriculum units for middle and high school teachers. The units will enable students to learn science by solving mysteries.

"Teachers are always looking for effective ways to help students see how science is relevant to everyday life," observed John Penick, NSTA's president. "The forensic units are powerful new tools we can use to excite students about science and to submerge them in hands-on scientific investigations." The high school unit, called the Cafeteria Caper, challenges students to investigate a vandalized school cafeteria. The module teaches students about DNA analysis, organic chemistry, basic observation and data collection, and methods of scientific inquiry.

Contd. on p.16.

Look for Science Fair Project Ideas where you see this ribbon.

WHAT'S NEW WITH FISHER?

Fisher Science Education to Publish New, Completely Redesigned 7-12 Catalog

Coming in 2005! The new, updated Fisher Science Education catalog will present a fresher look and brand-new product offerings. Geared toward students in grades 7-12, Fisher's 2005-2006 Catalog will bring you an expanded Forensics section and a new focus on Technology. The Featured Products section will feature the latest offerings from the world's top science product suppliers. You'll find over 2000 new items to choose from, across Biology, Biotechnology, Chemistry and Chemicals, Earth Science, Physics, Math & Measurement, Safety, Laboratory Equipment, and Laboratory Furniture.

Our products, references, and classroom support information will inspire your students by relating science to real world issues. Product descriptions will be clearer and easier to read, focusing on the key item features and specifications. Much of the text will be bulleted for easy viewing.

We've added more science fair ideas and materials, too.

Randy Micheletti, Secondary Education Product Manager, says, "This catalog is updated with an incredible number of great products for 7-12 science and math teachers. I think students doing these classroom projects will find science more inspiring once they can connect science to the real world. 'Making Science Matter™' is more than just a motto for Fisher Science Education—it's our goal. We hope you'll find the products and activities useful, and we look forward to serving your science education needs throughout the school year."

1867–1934

PROFILE: MARIE CURIE

Marie Curie was born as Marya Sklodowska in Russian-controlled Poland. With both of her parents being educators, Curie had a strong interest in learning and graduated high school at the top of her class. Curie worked as a private tutor during the day and became associated with the illegal "floating university." These night classes went beyond scientific studies and were attended by students hoping that education would eventually unlock Polish liberation.

Curie knew that to make a significant difference, she would need a degree from a recognized university. In 1891, Curie enrolled at the Sorbonne in Paris and changed her name to Marie. She completed two Master's degrees by 1894 and her first commissioned study was to relate magnetic properties of different steels to their chemical composition.

In her search for laboratory space, Marie was introduced to Pierre Curie who was already a pioneer in the field of magnetism. They were married in 1895 and had two daughters, Irene and Eve. Irene would continue her mother's interests, earning a Nobel Prize with her husband Frederic Joliot for discovering artificial radioactivity.

Curie's doctorate followed the research of a French physicist who reported that uranium compounds emitted rays even if kept in the dark. Curie measured the faint currents that passed through air bombarded with uranium rays. Confirming that electrical effects existed regardless of the uranium's physical condition, she took the research a step farther and proposed that these rays were an atomic property. As she began to test other samples, Curie discovered that thorium and other minerals containing rare elements did have similar results. She called this behavior "radioactivity."

Pierre assisted in her work. They discovered that some uranium ores were more radioactive than pure uranium due to additional, undiscovered elements. As they worked to separate pitchblende into its elements, they came across two new elements that they named polonium and radium. Curie was never successful in isolating polonium because of its short half-life, but the isolated radium glowed and created much intrigue at the first physics conference in Paris, 1900. As they discovered that radioactivity could damage tissue, research began to focus on using radium in the medical industry to fight cancer.

The Curies received a joint Nobel Prize in 1903 for their work with radioactivity. This award was the first Nobel acknowledging a woman's role in the sciences. The discovery of two elements and applying a use for radioactive materials earned Marie a second Nobel Prize in 1911.

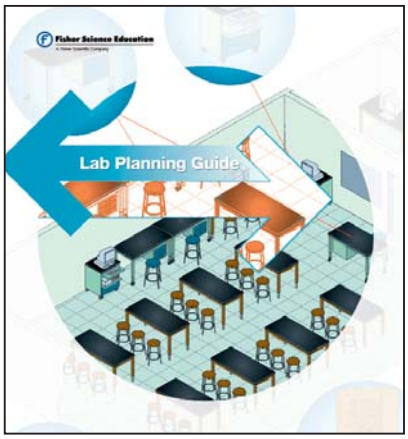
Due to their extensive work with radioactive materials, the Curies' health was on the decline. In 1906, Pierre was fatally hit by a horse-drawn wagon. While upset by the loss of her husband, Marie decided that she must continue her work. Sorbonne University offered her Pierre's position. That position allowed her to continue working and made her the first woman professor at Sorbonne.

Curie desired to leave a permanent memorial to her husband. She established the Radium Institute in 1914—one month after Germany declared war on France. Marie felt a duty to country and helped to design 20 radiological vehicles that would assist doctors in the field by using X-rays to scan for bullets and shrapnel.

The war ended in 1918 and the Radium Institute went back into business. To gather donations for the institute, Curie traveled to lobby for government support of scientific research. With Curie's dedication, the institute in Paris became a world center for radiological studies.

After experiencing several health problems caused by overexposure to radioactive material, Curie died in 1934. Sixty years later, the Curies' remains were moved to the Pantheon in recognition of their work for France.

LAB RENOVATION AND CONSTRUCTION



A Safe Lab—It's Worth Planning For

We know it's necessary to ensure both safe conditions and safe behavior in our laboratories. But, in some of our labs, it's difficult to be as safe as we'd like because of inherent flaws in the room's design.

Here are some considerations when designing—or redesigning—a science classroom.

Space, space—give me more space!

A safe lab needs enough floor and aisle space for teachers and students to move around without bumping walls, furniture or other people. Teachers must be able to see and freely move to all students and respond quickly to emergencies.

- For elementary science classrooms and dedicated science labs, 35 to 40 square feet per student is recommended, with an additional 10 to 15 square feet of storage per room.
- For middle and high school science labs, allow a minimum of 36 square feet per student and 14 square feet per student for lecture areas.
- Prep rooms should be given approximately 100 square feet.
- Allow adequate aisle widths and clear floor space near exits. Refer to ADA recommendations for aisle widths, wheelchair turning clearance, and accessible routes around obstacles.
- Limit classroom size to 28 students whenever possible.

Now, inhale deeply…

It is critical to keep lab air comfortable and safe to breathe. A fume hood is effective for exhausting odors and fumes.

- Integrated hoods are built into the building exhaust system and are engineered to ensure a certain number of room air changes.
- Ductless hoods are an alternative for renovation projects where penetrating walls, floors or ceilings is not possible. Exhaust air is passed through a series of filters and returned to the room. These hoods can be mobile and shared between various labs.

Fixtures make a difference in emergencies

Having lab fixtures located where they are needed and in good condition can make the difference between a "close call" and a terrible accident. Since these fixtures must be in good working order, consider installing vandal-resistant fixtures. Here are some common fixtures:

- An emergency call system or telephone placed in an accessible location.
- Permanently plumbed emergency eyewashes are recommended for every lab and prep room.
- Emergency showers for labs where corrosive chemicals or flammable materials are used.
- A sprinkler for primary fire protection (may be required by code) and fire alarms.
- Fire extinguisher and safety installations.
- Emergency shutoffs for water, gas, and electrical service (located near the instructor and protected from nuisance use).

Plan on emergencies and be prepared when they occur

Regardless of the condition and design of a lab, safety preparations and emergency training will reduce the chances of a harmful accident.

- Advise students where showers and eye washes are located and how they are to be used.
- Provide every student with safety glasses/goggles appropriate for each activity and strictly enforce their use.
- Instruct students how and when to use fume hoods.
- Test safety equipment according to a set schedule.

This information, presented courtesy of Fisher Hamilton, and more can be found in the Lab Planning Guide. This list is by no means exhaustive. Consult a professional experienced in designing these special spaces before you begin. For information on receiving this guide, contact **FSE.NewLab@FisherEdu.com** or call **800-955-1177.**

Safety Checklist

If you are planning or renovating a lab, assemble a list of equipment and supplies to support your safety program. A checklist might look like this:

- ☐ Fume hoods
- ☐ Proper ventilation in chemical/biological classrooms and storage areas
- ☐ Emergency shower heads
- ☐ Eyewash fountains
- ☐ Fire extinguishers
- ☐ Fire blankets
- ☐ Safety goggles
- ☐ First aid cabinets/kits
- ☐ Waterproof electrical outlets in "wash down" areas
- ☐ Two doors for exiting in case of emergency
- ☐ Non-slip floors where water is used
- ☐ Master controls for utilities
- ☐ G.F.I. electrical circuits
- ☐ Rounded corners on furniture
- ☐ Low storage areas
- ☐ Chemical aprons
- ☐ Chemical spill containment
- ☐ Remember to check ADA requirements

Prep Room Checklist

Most K-12 prep rooms include equipment such as listed below. When advising on prep room purchases, consider safety.

- ☐ Desk area (if possible with computer and data jack)
- ☐ Large, deep sink
- ☐ Counters with ample work space
- ☐ Lab and demo carts
- ☐ Refrigerator (undercounter or upright)
- ☐ Dishwasher
- ☐ Acid storage
- ☐ Flammable storage
- ☐ Tall storage cases
- ☐ Reagent racks
- ☐ Shelving
- ☐ Electrical and data jacks
- ☐ Drench hose
- ☐ Fume hood (pass-through)

ALLERGIES: A COMPLEX CHALLENGE FOR DOCTORS AND SCIENTISTS

More than 50 million people in the United States have a serious allergy to something. Whether it's bee stings, pollen, ragweed, mold, pets, shellfish or some other food, you can name just about anything and someone is probably allergic to it. Not all allergies develop in childhood; many adults can and do develop allergies later in life. Although it's still not clear why different people react to different things, researchers are trying to better understand what causes allergies in the hopes of finding better ways of treating and preventing the sometimes life-threatening reactions.

What happens during an allergic reaction?

An allergic reaction starts when the body is exposed to an allergen such as pollen, dust mites, an animal or plant protein, or insect venom. The immune system reacts as if the object is a germ or parasite and produces its own proteins, called antibodies, to combat the foreign invader. Antibodies in turn bind to mast cells in the skin, lungs, and mucus membranes, causing those cells to produce and release histamines and start an influx of inflammatory proteins resulting in the symptoms of allergies that we observe. After the invader is eliminated, the antibodies remain in the bloodstream ready to be reactivated if and when another invasion occurs. Repeated exposure to the same allergen can cause the immune system to kick into overdrive and may result in a sudden, severe reaction known as anaphylactic shock.

Symptoms of allergic reaction vary widely depending on the allergen and the individual, but can include itching, redness, hives, swelling, sneezing, runny nose, low-grade fever, nausea, and fatigue. Anaphylactic shock involves multiple organ systems and can cause all of the above reactions plus swelling of the throat, breathing difficulties, abdominal cramping, vomiting, diarrhea, and irregular heartbeat or shock. People with a history of allergic reactions should wear an ID bracelet, carry injectable epinephrine (adrenaline) and an antihistamine at all times to combat a possible life-threatening reaction.

The infamous peanut allergy

We all know someone who suffers from hay fever or pollen allergies, and we've heard about frightening reactions to insect stings and food allergies. One food that has been getting more and more coverage in the media for causing allergic reactions is peanuts.

More than 1.5 million people in the United States, including more than 600,000 children, are allergic to the protein in peanuts. Supersensitive people can have anaphylactic reactions just from being in the same room with peanut dust. Peanut oil is an unexpected ingredient in foods such as egg rolls and chili, and can even be an ingredient in skin creams, making it hard to avoid accidental exposure. In response to this, there are several groups lobbying for labeling laws to standardize identification of peanuts and their derivatives on all foods and skin care products.

Some researchers are approaching the problem from a novel angle by trying to develop new strains of peanuts that are less likely to provoke an allergic attack. Still others are searching for a vaccine that would prevent the allergy from developing in the first place.

One study in Great Britain that is showing promise involves treatments that expose the allergic person to a genetically engineered antibody that prevents the natural antibodies produced during an allergic reaction from binding with mast cells. These treatments seem to raise the threshold of exposure at which an allergic person reacts and reduces the chance of severe reactions from accidental contact. Scientists predict that a drug such as this could reach the market in two to three years, based on favorable early testing.

Current and future treatments

Scientists at the American College of Allergy, Asthma and Immunology conducted a survey that revealed that 60% of the allergy sufferers who responded were not aware of any treatments other than prescription or over-the-counter medicines.

Over-the-counter drugs are the most common way people combat allergies. Antihistamines, decongestants and bronchodilators do a good job in relieving symptoms such as sneezing, coughing, stuffiness and respiratory difficulties, but these medications only relieve the irritating short-term symptoms of allergies.

A common long-term treatment is called immunotherapy, more commonly referred to as allergy shots. Patients receive a series of injections of increasingly larger amounts of the allergen to trigger the body to build up immunity to it. Over time, the patient becomes desensitized to the allergen, and the body no longer overreacts. Immunotherapy has shown positive results in up to 75% of hay fever sufferers. Treatments generally last from one to three years. The majority of patients receiving allergy shots show long-term relief from their symptoms, but some do relapse when the treatment is stopped. Immunotherapy is also used for people who are allergic to insect stings, and scientists are working on a formula to treat peanut allergy sufferers with this method.

So, if you suffer from allergies, don't assume that over-the-counter medications are your only path to relief. Talk with your doctor about new therapies or medications that may be available to help you manage your allergies and stay symptom-free.

Human Physiology

- How does human weight change with time of day?
- How does exercise affect blood pressure?

IS THE LINK BETWEEN SUN EXPOSURE AND SKIN CANCER FOR REAL?

For years physicians, public health officials, and others have warned us that overexposure to sunlight—in particular the ultraviolet rays of sunlight—is a risk factor for developing skin cancer. Scientists base their warnings, statistical analysis, and assumptions on the epidemiological associations between sun exposure and skin cancer, but haven't provided proof that there are links between the two. Below, we've presented some facts from both sides of the issue for you to discuss with your students.

View 1

Scientists claim that new research being done at the Wistar Institute (University of Pennsylvania) has confirmed that exposure to UV light can trigger melanoma, the deadliest form of skin cancer. If what they claim is true, this is the first direct evidence of a link between overexposure to sunlight and increased risk for skin cancer.

For some people, the warnings based on statistical studies are enough proof for them to cover up at the beach. A recent study done by the American Cancer Society surveyed children aged 11-18 and found that less than a third of them regularly wore sun protective products. (That is a sobering thought considering that we get 80% of our lifetime sun exposure before age eighteen.) The study also found that 72% of these youngsters said they got sunburned at least once during their summer months. The American Academy of Dermatology (AAD) estimates that there will be more than 1 million new cases of skin cancer this year with more than 7000 deaths from advanced skin cancers.

Protecting yourself involves more than just using sunscreen, which only reduces the risk of getting skin cancer. Also, most sunscreens don't absorb the Ultraviolet A (UVA) long-wave solar rays, which are less likely to cause sunburn, but penetrate the skin more deeply. UVAs are also thought to cause photoaging and compound the effects of Ultraviolet (UVB) rays. The UVB short-wave solar rays are the main cause of sunburn. They are also the number one cause of basal and squamous cell skin cancers, and a suspected significant contributor to melanoma. Melanomas account for only 4% of skin cancers, but 79% of skin cancer deaths.

The best advice for protecting yourself against the sun's damaging effects is to avoid sun exposure between the hours of 10:00 a.m. and 4:00 p.m. This is when the sun's rays are at their strongest. It is advised that, if you have to be in the sun during those times, wear protective clothing (long sleeve shirts, pants, and a wide-brimmed hat) and use a sun block.

View 2

Although most dermatologists believe that sun exposure increases your risk for skin cancer, some are questioning the emphasis put on the link and the exclusion of warnings about other causes of the disease. Medical professionals haven't identified all the other causes, but they strongly suspect that there are many risk factors contributing to the increased incidence of skin cancer including: pollution, depletion of the ozone layer, unregulated tanning salons, and longer life expectancies.

Skin cancer, specifically melanoma, does not only occur in areas associated with sunbathing. Curiously, it can occur anyplace there are pigment cells, such as on the genitals, in the anal canal and inside the nose, sinuses and eyeballs. And, there's no explanation as to why African Americans and Asians get melanoma almost exclusively on skin that is not exposed to sunlight: the palms, soles, nails, and mucous membranes.

Some dermatologists argue that the research linking sun exposure to melanoma is inconsistent. For example, doctors warn that blistering sunburns in childhood are precursors to melanoma later in life. But, while some studies show a slight correlation to support this theory, others show none at all.

There is also some question as to the validity of our sudden "epidemic" of melanoma. It has been theorized that the definition of the disease changed over the years and that the numbers actually reflect more accurate and timely diagnoses rather than an actual increased incidence of the disease.

Some doctors still claim that a little bit of sun exposure may actually be beneficial and contributes to our daily requirement of Vitamin D. A few minutes of exposure are needed to get the Vitamin D that is so important in preventing bone problems such as osteoporosis and other serious illness.

In contrast, other doctors cry foul and insist that any amount of UV radiation from the sun is harmful. They point out that most dermatologists recommend that people get their Vitamin D through diet and supplements.

News Flash—The Tanning Drug

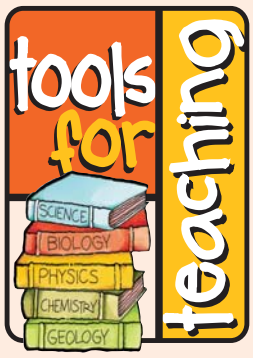
There is no denying the sun's appeal and, in spite of the warnings, many people still seek the bronze glow that only the sun can deliver. Now, researchers may have discovered a safer way to tan: a drug that boosts tanning by speeding up the rate at which skin darkens when exposed to sunlight.

Called Melanotan-I (MT-1), the drug is a synthetic, super-potent version of the hormone that stimulates the release of melanin, the pigment that produces a tan. Tests have shown that people who took the drug had to spend 50% less time in the sun to achieve the same quality of tanning as those who didn't take the drug.

The drug's greatest potential benefit is prevention of skin cancer by reducing sun-bathing time. In addition to creating a tan, higher amounts of melanin will protect the skin from the damaging effects of the sun. Research is in the early stages, but some predict Melanotan could cut the rate of skin cancer.

What Do YOU Think?

Do you feel there enough evidence to prove a link between sun exposure and skin cancer? Should we take the warnings at face value and avoid all unprotected exposure to sunlight? What about people who work outside or athletes who spend hours in the sun training or competing? Should the new tanning drug become standard fare for them? Would you take injections or pills containing MT-1 just so you could still sunbathe?



QUANTIFYING CELL GROWTH RATES

The collection of diseases known as "cancer" all have one thing in common: cell masses that grow at uncontrolled rates. This student activity explores how normal cell growth is affected by differences in temperature.

MATERIALS:

- Sterile agarose plates (HS71693-2)
- Sterile, disposable Inoculating Loops (HS17356A)
- *Lactobacillus acidophilus* culture (HS20921)
- Digital camera or digital video camera (HS67919), optional
- Storage areas of various temperatures

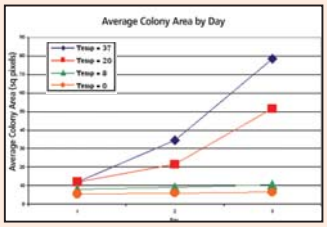
PRE-LAB DISCUSSION:

Ask students which plates will show the most growth and why. Encourage students to think about different situations in which microorganisms grow, such as mold in a refrigerator or basement, fungi in a grassy field or on a rotting log.

ACTIVITY:

Using the "quadrant streaking" method for isolating colonies*, inoculate two agar plates for each temperature. After one day, identify at least 5 isolated colonies (single spots on the plate) to measure throughout the experiment. "Clrcle" those colonies on the bottom of the plate using a permanent marker. Measure the area of each colony and calculate the average colony area for each plate. If a digital camera and photo software are available, capture images of each plate for this purpose. Record the average colony area in a table and have students graph area versus time (days) for each temperature.

Plate #	Temp (C)	No. of Colonies	Avearge Colony Area Day1	Day 2	Day 3
1	0	5	5	5	6
2	0	5	6	7	7
3	8	6	8	8	10
4	8	5	8	10	11
5	20	7	12	20	47
6	20	5	12	23	56
7	37	4	10	31	74
8	37	6	14	38	83



A MONSTER OF A STORM!

Understanding the Monster

The tornado is one of the most violent storms nature has to offer. With winds in excess of 300mph, the potential of obliterating everything in its path is very high. The swath of destruction can be over a mile wide and dozens of miles long. Nationwide, there are approximately 80 deaths and 1500 injuries annually as a result of 800 to 1000 tornadoes per year.

Although tornadoes can occur anywhere in the world, they are most common in the United States, east of the Rocky Mountains. Tornadoes are most common in the spring months in the southern states and summer months in the northeast. Tornadoes can form in the fall and winter as well, but they are not as common.

Birth of a monster

According to the National Severe Storms Laboratory (NSSL), tornadoes form in the eastern U.S. as an eastward-moving cold front meets up with warm, moist air. In the central plains, tornadoes are the result of convergence of a hot, dry front from the west and a very warm, moist front in the east. Tornadoes can also form as tropical storms and hurricanes move inland.

As fronts merge, a zone of low pressure is created. The wind direction may shift, creating a rotating horizontal cylinder of air. As air within the storm rises, the cylinder may be moved to a vertical plane. Tornadoes can then form in the cylinder and begin their destructive path along the ground.

Feeding the monster

Since a tornado is merely wind, it is nearly transparent. As it touches the ground and begins to pull debris up into the funnel, the familiar shape appears. The more powerful the tornado, the more debris is brought into the funnel.

Tornadoes are classified according to the Fujita scale (see inset). The scale was developed in 1971 by T. Theodore Fujita of the University of Chicago. The scale has six rankings and details the typical destruction that occurs during tornadoes of that strength.

Unlike hurricanes, tornadoes are not classified until after the storm has passed and the damage has been assessed. Some homes may receive light damage to their siding during an F0 tornado, or they may be destroyed without a trace during an F5 storm.

Myths about the monster

There are many myths about tornadoes and safety measures during the storm. Scientists and researchers, as well as years of statistics, have proven many of these theories to be false. Most importantly, no location is tornado-free. They have occurred in valleys and on mountains, near bodies of water and in major cities, and they can occur during any season of the year.

Another old theory was that houses could be spared destruction if windows were opened prior to the arrival of a storm. It was thought that closed windows would create a tremendous pressure difference between the storm and the house, resulting in the structure exploding. Research and experience has shown that the debris and high winds are what destroy houses during a tornado. On top of that, time spent opening windows is better spent seeking shelter.

One of the most recent myths to be disproved is the idea of hiding under a highway overpass during a tornado. Because of the horizontal motion of the winds of a tornado, the debris can still strike the people taking shelter. Also, the narrow space under an overpass can actually accelerate the debris as a high volume of wind is forced into a smaller space.

Preparing for the monster

Research and modern technology has enabled scientists to understand the formation of tornadoes and increase public warning times. Instead of a few minutes, the public is now offered notices well before an approaching storm.

When a tornado warning is issued, it is strongly advised to take shelter immediately. The best location to ride out the storm is in the basement of a home or underground storm shelter. If the home has no basement, the best location is by an interior wall, preferably under a piece of heavy furniture, such as a desk. Windows should be avoided. Flying debris kills more people than any other aspect of a tornado.

Mobile homes and automobiles offer very little protection from a tornado. Tornadoes can move as fast as 70mph, so it is unwise to try to outrun one in a vehicle.

Fujita Tornado Damage Scale

Courtesy of National Oceanic and Atmospheric Administration (NOAA)

Category F0: Light Damage (<73mph); Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.

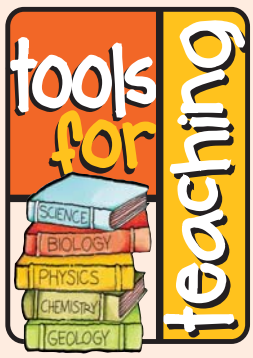
Category F1: Moderate Damage (73–112mph); Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off road.

Category F2: Considerable Damage (113–157mph); Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.

Category F3: Severe Damage (158–206mph); Roofs and some walls torn off well-constructed houses, trains overturned; most trees in forest uprooted; heavy cars lifted off ground and thrown.

Category F4: Devastating Damage (207–260mph); Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.

Category F5: Incredible Damage (261–318mph); Strong frame houses lifted off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters (109 yards); trees debarked; incredible phenomena will occur.



TORNADO IN THE CLASSROOM

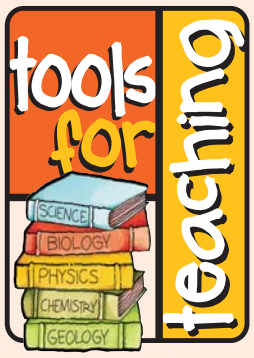
Did you know that tornadoes and ice skaters have a lot in common?

Both illustrate conservation of angular momentum. When an ice skater is spinning, he extends his arms to slow his rotation. To spin faster, he will bring his arms in tight. Similarly, a thin tornado tends to have higher wind speeds than wide tornadoes. Energy spreads across a wider area and reduces the wind's momentum.

To demonstrate, have a student sit on a stool with a rotating seat. In each hand, the student will hold a 2kg mass. Spin the student (carefully!) and ask her to slowly bring her hands in and extend them out again. The difference in her speed of rotation (angular momentum) can be clearly seen.

FAST FACTS ABOUT TORNADOES:

- Tornadoes are the result of localized low pressure zones from rising, warm air. The drop in pressure causes the humid air to condense, resulting in the visible funnel cloud. If the air is too dry for this condensation to occur, the funnel cloud is not visible—but it's still a tornado.
- Most tornadoes only last about five minutes, moving just a few miles along the ground in that time.
- Tornadoes typically occur in the afternoon and evening when the air is most unstable.
- In 1987, a strong tornado left a path of destruction up and down a 10,000-foot mountain in Yellowstone National Park, Wyoming.



LIGHTNING

With a peak current of 30,000 amps, lightning bolts can reach temperatures of 50,000 degrees Fahrenheit—about 40,000 degrees hotter than the sun's surface! Tapping into students' natural curiosity about nature's unpredictable events provides the perfect platform for developing science and math skills.

MATERIALS:

- Wimshurst Machine (HS68550)
- Wooden or plastic ruler, metric (HS40641P)
- Calculator (HS40689)

PRE-LAB DISCUSSION:

Lightning, at its most basic form, is a static discharge between two oppositely charged objects. Charge separation within a cloud is likely caused by the friction generated from the millions of collisions between microscopic ice particles within it. Positively charged ice crystals move to the top of the cloud, while the negatively charged ice particles sink to the bottom. Moving storm fronts develop a positively charged area on the earth's surface. When the electric potential between the ground and the cloud is great enough: BOOM!

ACTIVITY:

Have students first vary the distance separating the steel spheres to qualitatively describe the effect on the size of the resulting spark. Then ask students to calculate the voltage for at least six separation distances. Challenge groups to compete for the highest voltage.

Voltage =
(Distance in meters) x (3,000,000 volts/meter)

SCIENTIFIC BACKGROUND:

Van de Graaf Generators and Wimshurst Machines both use friction to separate positive and negative charges. When the electric potential between the opposite charges exceeds the limit of the medium separating those charges (typically air), the electric potential quickly snaps back to equilibrium—we see this as a spark or arc of electricity.

So what's the difference between a Wimshurst Machine discharge and lightning? Amperage. The "power" of the spark differs drastically between a Wimshurst Machine and a lightning bolt. While lightning discharges can reach 30,000 amps, a Wimshurst Machine produces currents of only about 30 microamps, a mere 1/100,000,000th the power of natural lightning. (Safety Note: Improper use of high voltage apparatus is never wise. While fatalities from Wimshurst Machine use have not been reported, heart rhythms can be disrupted from small electrical currents. Heart failure can be induced at 50 milliamps. Take particular caution with young students and those with pacemakers or other heart rhythm monitors or devices.)

HURRICANES

Destruction on a Massive Scale

Approximately five hurricanes bear down on the U.S. every three years, causing tremendous destruction and, occasionally, loss of life. Along with the heavy winds, hurricanes can produce large waves known as storm surges, hail, lightning, and even tornadoes.

These violent storms begin as mild, moist winds over a warm ocean. Over time, they may turn into tropical depressions, with winds less than 39mph. If they develop further, they become a tropical storm, packing winds up to 73mph. Once winds reach 74mph, a storm is classified as a hurricane. Based on increasing wind speed, hurricanes are broken into five categories, as defined by the Saffir/Simpson scale (see insert, courtesy of the NOAA National Hurricane Center).

Each of the 23 hurricanes that reached the mainland of the United States in the 20th century has caused over $1 billion (adjusted for inflation) in damage. Hurricane Andrew (1992) destroyed more than $25 billion worth of property in South Florida and Louisiana and is still considered the costliest natural disaster in U.S. history.

Category Definition and Effects

1 **Winds: 74–95mph**—No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Some coastal flooding and minor pier damage.

2 **Winds: 96–110mph**—Some roofing material, door, and window damage. Considerable damage to vegetation, mobile homes, etc. Flooding damages piers and unprotected small craft may break their moorings.

3 **Winds: 111–130mph**—Some structural damage to small residences, with a minor amount of curtainwall failures. Mobile homes are destroyed. Flooding near the coast destroys smaller structures with larger structures damaged by floating debris. Terrain may be flooded well inland.

4 **Winds: 131–155mph**—More extensive curtainwall failures with some complete roof structure failure on small residences. Major erosion of beach areas. Terrain may be flooded well inland.

5 **Winds: 155+mph**—Complete roof failure on many residences and industrial buildings. Some complete building failures. Flooding causes major damage to lower floors of all structures near the shoreline. Massive evacuation of residential areas may be required.

LABORATORY SAFETY GUIDELINES

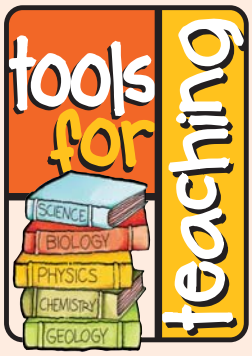
In another article in this Issue of Headline Discoveries (page 3), we looked at how certain room designs can minimize lab accidents. But even the best planned and designed lab will be the site of accidents if safety precautions aren't widely known and practiced. The following Safety Guidelines address these other safety practices.

1. Your school should have a safety committee composed of members of the faculty, the administration, students, and parents.
2. Develop a safety plan for your school that covers all areas presenting hazards to students and teachers. Include the science, art, and vocational programs, as well as the custodial and cafeteria programs.
3. Develop a safety orientation for all new science teachers and review the school's safety plan with the entire science faculty at the end of the school year. Use the findings to make corrections before the next school year begins.
4. Require all science teachers to participate in a NIOSH-approved safety course every five years.
5. Conduct a safety walkthrough of all laboratory/classrooms, preparation rooms, and stockrooms at the beginning of each school year. Make the administration aware of any deficiencies in writing and take steps to correct them.
6. Develop an appropriate safety unit for each science course and present the lesson during the first week of school. The unit should include a safety contract. All students and their parents read and sign the safety contract before they participate in any laboratory activities.
7. When planning a laboratory activity, ask yourself the following questions:
   - —Is there another investigation that would teach the same concept more safely?
   - —What precautions must be taken to ensure a safe activity?
   - —Does the investigation support the National Science Education Standards?
8. Make the first step in every activity a review of necessary safety precautions, including the Materials Safety Data Sheets (MSDS) for each chemical to be used. Document all the safety precautions reviewed in your lesson plan book.
9. Require everyone (including visitors) to wear appropriate safety equipment while in the laboratory during an investigation.
10. Preplan steps to be taken in the event of each probable kind of accident.
11. Forbid students from entering or working in preparation rooms or stockrooms.
12. Do not allow anyone, including teachers, to work alone in a laboratory or preparation room.
13. Lock science classroom/laboratories and preparation rooms when they are not in use. Store all chemicals in a secured appropriate stockroom when they are not in use.
14. Test all safety systems at least once each month.
15. Test every safety shower, eyewash, or drench hose once each week and record results.
16. Forbid eating or drinking in all laboratories and preparation rooms.
17. Do not allow food to be stored in science refrigerators.
18. Reduce chemical inventories to minimum amounts of each chemical. Keep only those chemicals being used as part of your school's instructional program.
19. Shelve chemicals using the Fisher Chemical Shelving System.
20. Maintain a clean environment in all science work spaces.

Some of these guidelines may seem daunting. Instituting a safety program may not be easy, but it will give safety the attention it needs for you to create and maintain safe labs in your school.

Absorption

- How does the size of a sponge affect the amount of water absorbed?
- How does the size of the holes in a sponge change the amount of water it can absorb?
- How does the material from which a sponge is made affect the amount of water absorbed?
- Is the amount absorbed by a sponge affected by the type of fluid being absorbed?



STOCKROOM SAFETY

Handling and storing chemicals is integral to the "hands-on" approach to chemistry. Here are some guidelines for keeping your stockroom safe.

- Maintain an MSDS library for all chemicals that are kept in the laboratory. These can be categorized by CAS number or alphabetically.
- Follow the storage codes that are provided to you in Section 7 of an ANSI formatted MSDS sheet.
- Keep acids and bases in separate storage cabinets.
- Keep flammable liquids in a grounded storage cabinet.
- Keep an accurate record of shelf-life of all chemicals stored in the lab and dispose of them according to local, state, and federal guidelines.

If you require MSDS sheets or have questions on hazards or storage codes, visit our Web site at **www.fishersci.com.**

PREP ROOM CHECKLIST:

K-12 prep rooms generally include equipment such as listed below. When advising on prep rooms purchases, consider safety.

- ☐ Desk area (if possible with computer and data jack)
- ☐ Large, deep sink
- ☐ Counters with ample work space
- ☐ Lab and demo carts
- ☐ Refrigerator (undercounter or upright)
- ☐ Dishwasher
- ☐ Acid storage
- ☐ Flammable storage
- ☐ Tall storage cases
- ☐ Reagent racks
- ☐ Shelving
- ☐ Electrical and data jacks
- ☐ Drench hose
- ☐ Fume hood (pass-through)

THE CHEMALERT SYSTEM (HS47564)

A very effective way to remind users how to work with chemicals is to refer to a Fisher ChemAlert label. At a glance, you will see how to store the chemical and what to do in an emergency. Each label includes the chemical name, precautionary information, properties and formulas, DOT information, safety code, storage code, and NFPA (National Fire Protection Association) Hazard code.

We use the codes that are standard throughout the industry, so your students will become familiar with the labeling convention they will see on chemicals in their college labs.

NEW ANSWERS TO CLASSROOM/LABORATORY SAFETY CONCERNS

Safety should be a primary concern in everything we do in our laboratories and classrooms. During the past decade, safety efforts have increased across the country. As part of that effort, Fisher Science Education is updating the safety products in our catalog.

CHEMICAL STORAGE:

The Fisher ChemAlert System on chemical labels uses five colors to divide the chemicals into safe storage categories. Every chemical package or bottle label includes an extensive list of safety information, as well as a colored storage code indicator.

EYE PROTECTION:

Goggles should be worn by students, teachers, and visitors whenever liquids are in use or when there is danger of flying particles. All goggles should be vented in a manner that will prevent fluids from reaching the eye. Fisherbrand Chemical Splash Goggles **(HS68660)** protect the user from chemical splash dangers. The vents are adjustable and can be completely closed to comply with new regulations for contact lens wearers.

EYEWASH STATIONS AND SHOWERS:

ANSI standard Z358.1-1998 requires that every laboratory be equipped with an eyewash that provides 15 minutes of water at a rate of 0.4 gallons per minute at a temperature of 60˚ to 90˚F. The eyewash should be no more than 10 seconds away from any person working in the laboratory. Chemical safety showers must provide 20 gallons of water per minute for 15 minutes with a 20" diameter spray. A practical unit providing both eyewash and shower functions is the Deck Mount Eyewash/Drench Hose **(HS47711).** The unit's 6' hose will allow an injured student's eyes to be flushed or spill diluted.

HEAT SOURCES:

While open-coil hotplates are inexpensive, they represent a fire or burn hazard due to the glowing red implements. Ceramic or aluminum hotplates **(HS50462C)** represent a safer alternative, and pressure sensor-equipped closed-coil hotplates **(HS50426)** represent an inexpensive replacement for open-coil units.

Portable butane and propane burners, because they contain less gas and can be locked in a flammable storage cabinet, provide a much safer alternative to alcohol burners. The new Butane Micro Burner **(HS65148)** features a low center of gravity and rubber ring base, providing excellent stability and heat control.

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Merit Water Still—Combining economy and high performance with a host of additional features that comparable stills cannot match.

- Simple to install
- Compact size
- Fast output
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DESCRIPTION	CAT. NO.	PRICE
Merit Water Still	**HS509231**	1065.00

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BALANCE MODEL	PAN SIZE	CAT. NO.	PRICE
120g x 1mg	3.6" dia. (9cm)	HS67073	409.00
200g x 0.01g	4.7" dia. (12cm)	HS67074	309.00
400g x 0.01g	4.7" dia. (12cm)	HS67075	435.00
400g x 0.1g	4.7" dia. (12cm)	HS67076	168.00
600g x 0.1g	6.5 x 5.6" (16.5 x 14cm)	HS67077	237.00
2000g x 0.1g	6.5 x 5.6" (16.5 x 14cm)	HS67078	309.00
4000g x 0.1g	6.5 x 5.6" (16.5 x 14cm)	HS67079	435.00
6000g x 1.0g	6.5 x 5.6" (16.5 x 14cm)	HS67080	237.00

OHAUS

THE SCENT OF NEW TECHNOLOGY

We all know about the five senses: sight, sound, smell, touch, and taste. However, you might not realize that electronic engineers have been trying to develop technologies that mimic human senses, and they've come up with some pretty clever devices. One of them, the electronic nose, or e-nose, can actually mimic the functions of the human nose.

What are electronic noses?

The human nose detects odors using up to 650 receptors found on cells in the nasal passages. Although scientists are not sure how it happens, these receptors generate "smell prints" of odors and pass them on to the brain for recognition. An electronic nose works in much the same way, but it uses specialized sensors as receptors and a microprocessor for a brain.

There are two main types of technologies currently being used in electronic noses. One type uses an array of sensors comprised of or coated with different polymers that allow the device to distinguish different types of odors. This type of sensor emerged from research being done to create an environmental monitoring system for the International Space Station. Unfortunately, the multiple sensors suffer from overlap in chemical responses, and the sensitivity is not good.

A newer type of electronic nose, called the zNose™, incorporates fast chromatography and a single, uncoated acoustic wave resonator. It's an improvement on the technology of earlier electronic noses because its single sensor eliminates overlap, it has picogram sensitivity, and is much faster, returning results in 10 seconds or less.

zNose works by sending a stream of helium gas, which acts as a carrier for the vapor to be measured, through a heated column. The chemical constituents of the vapor separate and leave the column at different velocities. As they emerge, the components of the vapor absorb and desorb onto the surface of the acoustic detector at different rates, changing its vibration frequency. The detector then serially polls a virtual sensor array or spectrum of retention times to identify the component and generate a visual image of the odor.

Not only can electronic noses detect and identify the constituents of an odor, they can also provide a quantitative measurement for quality control or research purposes. These unique new technologies are used in many different industries including: food, beverages, cosmetics, plastic containers, agriculture, environmental, currency, narcotics, explosives, nerve agents, molds and fungus, healthcare, biomedical, and petrochemical products.

Some Promising Applications

Some electronic noses have been created for very specific applications. One such device was developed by an intensive care doctor to detect pneumonia in patients on respirators. Electronic noses being developed for diagnostic purposes are based on the premise that illness causes chemical changes in the body which can be detected by comparing the breath from a sick person with that of a well person and mapping the chemical characteristics of each.

Other uses in health care may one day include early diagnosis of diseases such as lung cancer and leukemia to make earlier treatment possible. It also could potentially allow physicians to detect many diseases without the need for expensive and invasive procedures.

Scientists are also using the technology in robots that can detect drugs, explosives, landmines and gas leaks in buildings. Development is ongoing, and these robots may one day replace sniffing dogs and their handlers in dangerous situations. Additional research is being done to develop sensors that can be used to detect chemical and bacteriological warfare agents in water as well as nerve agents in buildings and subway tunnels.

An Important Law Enforcement/Crime Prevention Tool

Electronic noses are quickly becoming the best new weapon against drunk driving. Concealed in a flashlight, a handheld alcohol-detection device is helping officers identify an estimated 20 to 30% more drunken drivers than traditional police procedures. The device will give an estimate of blood-alcohol content from just four seconds of conversation with the driver.

In Iowa, the Department of Transportation has conducted random drug and alcohol testing of truck drivers. This has outraged many trucking companies who claim the testing is an unwarranted invasion of privacy. But, officials claim that it's helping rid the highways of dangerous truckers and decreasing the number of accidents involving trucks.

Also in Iowa, the state's corrections department has been using the technology to test prison visitors. The practice is controversial with critics worrying that the scanners are too sensitive to be used in this way. Indeed, the technology is so sensitive that an innocent person can become contaminated with enough molecules to test positive after unknowingly touching or handling something a drug user previously touched, such as money, faucets or gas pumps. But, prison officials contend that it protects visitors because it stops drugs from entering the prison and prevents the guards from having to conduct more invasive searches.

Heat and Light

- Can infrared energy be detected in a spectrum? If yes, how?
- How does the color of a surface affect the rate at which it absorbs or releases heat?
- How does the texture of a colored surface affect the rate at which it absorbs or releases heat?

Consider The Evidence:

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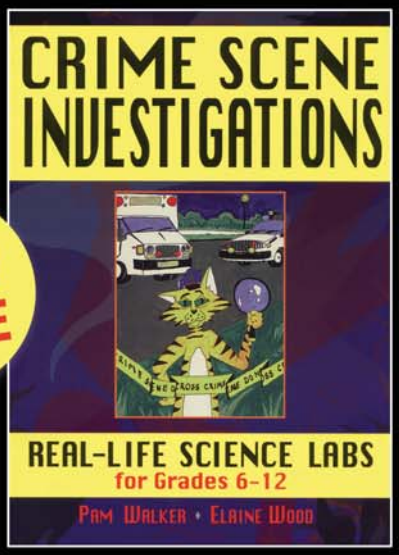
MODEL	CAT. NO.	SALE PRICE	SAVINGS
M3501DF	HS19617-5ND	399.00	141.00
M2251C	HS67300-ND	249.00	42.67

M2251C (HS67300-ND)

M3501DF (HS19617-5-ND)



Paperback; 2002; 288 pages.

DETECTION TECHNOLOGY IS COMING IN WAVES

In a world that is "on the lookout" for potential terrorist behavior, the news often reports on increases in security personnel and the more visible security presence. However, these significant security steps often include measures that we never see.

Many facilities that require government protection are ramping up on these unseen security measures. New advances in technology are creating machines that can "see" numerous wavelengths such as gamma rays, x-rays, radio waves, and terahertz radiation.

Traditionally, when traveling through the airport, we would put our bags on the conveyer belt and walk through a metal detector. The conveyer belt takes our bags into an x-ray machine and a security guard sees an image of the bag's contents. This tried-and-true method of detection is being supplemented with x-ray diffraction technology to produce 3-D images and reduce the current number of false positives.

Keeping prevention in the forefront, the x-ray machine may not be the first time that the airport visitor has been scanned. Detection can start as early as pulling into the parking lot. As a driver pushes a red button for a parking ticket, a device underneath the car can quickly flood the car's trunk with invisible neutrons. The trunk's contents will then emit gamma rays that could correspond to chemical signatures of explosives. Security forces are notified if such a match occurs.

While walking through the airport entrance doors, you are hit by a blast of air. Molecules from your clothes, skin, and hair are propelled toward sensors. These electronic noses act much like bomb detecting dogs. To find out more, see p. 10.

Advances in technology are looking to see more detail in a faster time with safer wavelengths. Using radio waves, quadruple resonance (QR) looks at the molecular structure of targeted items to identify explosives or narcotics. In the future, security forces hope to combine x-ray scanning with QR to not only see the objects in a carry-on bag, but also identify any unrecognizable objects without opening a bag. The largest limitation to QR is that it may be more sensitive toward certain explosives than others.

A new alternative technology in progress is terahertz imaging. Terahertz radiation, or t-rays, occupies the far-infrared portion of the electromagnetic spectrum. T-rays could be used to scan people for biological agents and explosives since they can "see" through plastics, clothing, and other non-metals. These portable scanners would be an ideal replacement for x-rays since these wavelengths have lower energy levels and don't damage tissue.

Experts believe that for the best security results, several different technologies will have to be combined. As more advanced scanning technology is developed, the need for large numbers of patrolling officers and dogs may decrease.

The Electromagnetic Spectrum

Longest to shortest wavelength:

- Gamma Rays
- X-rays
- Ultraviolet
- Visible
- Infrared
- T-rays
- Microwaves
- Radio

The Scent of New Technology

Contd. from page 10.

Alcohol and Drug Testing in Our Schools

As drug and alcohol abuse among our children increases, we have an increasingly compelling need to provide safe, drug-free learning environments.

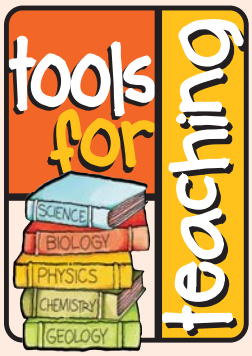
Many school districts looking for an easy and reliable tool to screen students have chosen electronic noses. These are popular because they're easy to use, allow the operator to screen a person's breath, and can also detect alcohol in an open container or an enclosed space like a car or a locker.

One school in Pennsylvania uses the devices to screen students attending dances and other after school events. The principal says that since implementing the screening, they have not had one incidence of a student appearing at an event under the influence of alcohol. He also says that the student body, parents, and teachers fully accept and support the screening.

Constitutional Questions

Some civil liberties groups view this kind of testing as a serious invasion of personal privacy. These samples are taken and analyzed without a person's consent or knowledge and seem to imply an assumption of guilt, not innocence. These groups also argue that this sampling and testing may violate the Fourth Amendment's ban on unreasonable searches.

No doubt, as the use of this technology by law enforcement increases, there will be repeated challenges to its constitutionality; but, whatever the future holds for electronic noses, it's certainly not a technology to be sniffed at.



FOOT-TO-HEIGHT RATIO

This activity provides students a highly visual way to collect data, display the data on a graph, and extrapolate the experimental data to answer a question. In forensic analysis, investigators can estimate a person's height based on footprints found at a crime scene.

MATERIALS:

- Metric tape measure (HS40654T)
- Ruler, metric (HS40637)
- Calculator (HS40689)

PRE-LAB DISCUSSION:

Have students brainstorm several ways in which a suspect's guilt can be confirmed.

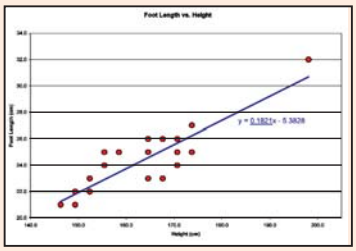
ACTIVITY:

Use a washable black inkpad to create a shoe print on a piece of paper for students to measure. Create a graph with Foot Length (cm) on the y-axis and Height (cm) on the x-axis. Have students each measure their own foot length (in cm) and their height (also in cm) and plot the data on the graph. Calculate a line of best fit or use a graphing software program to do so. The slope of this line represents the average foot length for each of your students, expressed as a percentage of that student's height.

Finally, have students measure the mystery shoeprint and extrapolate a probable height range from the graph.

SCIENTIFIC BACKGROUND:

The range of data for your particular graph will depend on the age of your students. In general, a person's foot length is 15% of his or her height, although this is a very loose association that is less accurate for especially young students.



Synthetics

- How does exposure to sunlight cause nylon to deteriorate?
- How do changes in temperature and/or humidity affect the strength of nylon?
- How does exposure to sunlight cause rayon to deteriorate?
- How do changes in temperature and/or humidity affect the strength of rayon?
- Do woven mixtures of nylon, rayon, etc. withstand sunlight and weather better than pure nylon or rayon? Which woven mixture withstands sunlight and weather best?

Music

- How does music affect the respiration rate of fish?
- How does music affect the activity of fish?
- How does the pitch of a bottle change when the volume of water in the bottle is changed?
- How do different kinds of string material affect the pitch of a guitar?
- How does the length of a pitch pipe affect its pitch?
- How does the speed of a passing car affect the change in pitch demonstrated by the Doppler effect?

Forensic Science Project Ideas

Sometimes the hardest part of starting a science project is finding the right topic. Here's a list of science projects related to forensics:

- How does an individual's foot length relate to his/her height? (See above.)
- How can the life cycles of insects be used to establish timelines?
- How can insects and microscopic species be used to establish the location of a crime?
- How does heredity influence fingerprint patterns?
- How can handwriting be used to identify an individual?
- If a subject writes with his or her opposite hand, will the handwriting be effectively disguised?
- How can bones be used to determine the age, gender, and ethnic background of a crime victim?
- What is the best surface for lifting fingerprints?
- How does hair dye affect microscopic characteristics of human hair?
- How do lie detectors work? Why are results from lie detector tests not used in legal proceedings?
- How can specific tools be identified from scratch marks left on a surface?

Math Products

These helpful products can be used in many math-related activities, such as the Foot-to-Height Ratio activity on this page. Look for our new Math & Measurements Section in the upcoming 7–12 2005/06 catalog.

DESCRIPTION	CAT. NO.	PRICE
Retractable Measuring Tape	HS40654T	7.30
Digitape™ Electronic Measuring Tape	HS43035	32.35
Scientific Calc-U-Vue™	HS40689	19.95
Overhead Scientific Calc-U-Vue	HS40685	75.00

CLICK IT, MAESTRO: TECHNOLOGY AND MODERN MUSIC

Beethoven's *Symphony No. 5,* Ravel's *Bolero,* Gershwin's *Rhapsody in Blue.*

What do these familiar masterpieces share? All were composed the way music had been written for centuries—by hand.

Picture yourself in Beethoven's studio circa 1807, as the master wrote *Symphony No. 5.* Beethoven keyed a few notes at a time—Da da da daaah!—on a piano or harpsichord and carefully transcribed them onto paper. Repeating each step with methodical precision, measure for measure, Beethoven added the parts for various instruments, revising and editing until the day he finished the work.

Imagine the time and the exhausting attention to detail required to make the music flow. Beethoven's composition tools were simple—piano, pen and paper, and the "record-and-playback" precision of his own memory. Music writing remained much the same way well into the 20th century until an inspired Frenchman altered the course of music technology forever.

Vive la technologie!

In 1948, Paris radio engineer Pierre Schaeffer, working for Radiodiffusion-Television Francaise, created the first electronic music studio using the latest newfangled gadgets—microphones, phonographs, and variable-speed tape recorders. Schaeffer's ingenuity spawned the world's first form of electronic music. Called "musique concrete," it took sounds found in nature and modified them electronically into a musical piece.

Ever since Schaeffer's breakthrough, music and technology have blended in near-perfect harmony. Technology's impact on modern music has been both sweeping and dramatic.

Technology has:

- Helped to make music writing faster and more efficient
- Allowed musicians more creativity in utilizing natural and artificial sounds
- Spawned new genres of music, including computer-generated music that uses no traditional instruments at all
- Evolved traditional instruments into high-tech forms
- Spurred the meteoric growth of the commercial recording industry
- Made recorded music portable
- Given the masses access to music composition tools
- Expanded music education beyond traditional instruction

Artificial music

Perhaps the most immediate impact of technology on music was efficiency. Automatic recording and playback devices saved time. The ability to listen to audiotape simplified editing and transcribing for the songwriter; one recorded "take" gave the artist a work in progress without the added burden of actually playing the same piece over and over.

Progressive composers readily used new technology to compose music beyond the capabilities of traditional instruments. Born of electronic analog computers and laboratory test equipment in the 1950s, the synthesizer allowed musicians to produce an unlimited array of artificial sounds. Synthesizers create sound by manipulating either electric currents (analog) or mathematical values (digital) to cause vibrations in the loudspeaker or headphones. By the 1970s, microelectronics enabled synthesizers to be self-contained and portable; within a few years every prominent orchestra and upstart garage band had one.

Dubbing and mixing equipment made the impossible a reality. In 1991, singer Natalie Cole released "Unforgettable," a virtual duet with her late father, Nat King Cole. The arrangement mixed Natalie's vocals with her father's 1951 version to create a hauntingly beautiful song.

Music today embraces genres that were unimaginable half a century ago. Just take a stroll around your local music store. Club music, metal, disco and rap have heavy electronic influences. Hear those "relaxation" CDs with the sounds of whales, wolves or songbirds mixed into the music? Those are contemporary examples of musique concrete. In the electronic music section, we find the powerful sound of Mannheim Steamroller—music produced entirely with computers and electronics hardware but without any traditional instruments.

Notice how huge that music store has become, too, since the days of vinyl to 8-tracks to cassettes to CDs and DVDs. Now there's a sound for every listener—and a boom box, personal CD player, or car stereo to take the music wherever we go. Technology even fine-tunes the golden oldies; witness the label mark that says "Digitally Remastered" on your favorite classic album.

Technology can give a new sound to an old instrument. Take the venerable acoustic guitar, which dates back to 16th century Spain. Add a little current, plug in an amplifier, and you have the electric guitar, a fixture in bands today. The electric guitar uses electromagnetic pickups that convert the vibrations of the steel strings into electrical currents, which are fed into the amplifier.

Contd. on next page.

Click It, Maestro

Contd. from previous page.

Electronic composition: Music by PC

Technology has opened the gateway to songwriting for millions of people without access to so much as a piano. Today, an aspiring composer with a personal computer can write music. Software programs like *Sibelius* and *Finale* make composition tools equally accessible to the novice and the professional. *Finale*, for example, is so comprehensive it transforms the PC into a virtual recording studio. It comes with composition and arranging tools, note entry, editing, notation, playback, and a tutorial—everything a composer needs—and it's available in six languages!

High schools and universities

Today's school music rooms incorporate technology into the traditional music curriculum. Mt. Lebanon High School in Pittsburgh, PA, offers two courses in music technology: a group-centered entry-level course using software and keyboards, and an advanced course focused on computer-assisted theory, composition, and music notation. Established in 1993, Torrington (CT) High School's music technology program won acclaim from Roland Corporation, a leading musical instrument manufacturer, for "introducing students to the way music is made in the working world." In 2003, West Islip (NY) High School purchased a music technology facility complete with a network of 10 Macintosh computers using *Finale, Freestyle, Music Practica* and *Digital Performer software.*

College campuses are natural hotbeds of music technology. In the late 1970s, the University of Miami established the first music engineering degree programs in the United States. This curriculum merges the art and science of recording and sound engineering with traditional music studies in performance and theory. Indiana University offers a Master's degree in computer music composition.

Music technology even breeds specialization. At Duquesne University, undergrad Music Technology majors choose from performance, composition or sound recording tracks. Duquesne also offers summer programs in music technology to help music educators integrate the tools of technology into their classrooms.

Final Note

Recording and playback. Electric instruments. Electronic music. Composing by computer. How far music has come in less than a century, thanks to technology. What might Beethoven say if he could behold all the techno-driven advancements in music today? Bravo!

ROVERS ROLL-OVER LIFE EXPECTANCY

The Mars Exploration Rover

In a mission that was only expected to last for 90 sols ("days" on another planet), the Mars rovers have continued to send data back to scientists at NASA for almost three times as long. The original mission was to analyze the soil and look for evidence that water once existed on the planet. Now, with a goal of reaching 240 sols, the rovers are scouting for future landing locations and gathering geological data before the Martian winter comes.

Spirit Rover

On January 3, 2004, the Spirit Rover landed in the Gustov Crater—believed to be a former lake. Despite a few technical difficulties, Spirit was soon up and digging. The rocky crater surface did not initially yield any clues to the existence of water. Packing up its instruments and heading for the Columbia Hills, Spirit found evidence of water along the way. The Columbia Hills contain older rocks than the volcanic rocks within the Gustov Crater. By digging through the layers, scientists continue to look for clues to Mars' history.

With an odometer reading of more than 2 miles, Spirit has traveled six times farther than was ever expected. The rover's travel has been hindered by the right, front wheel. An increased internal resistance is forcing the rover to drive in reverse and redistribute its weight on only five wheels. The sixth wheel is used sparingly for the more difficult maneuvering.

Spirit is also noted for taking the first pictures of Earth from the surface of another planet.

Opportunity Rover

On January 25, 2004, the Opportunity Rover landed on the opposite side of the planet at Meridiani Planum where hematite mineral deposits existed. By studying the chemical composition of the hematite, scientists determined that these deposits were formed from rusted iron exposed to oxygen and water.

Opportunity drove to a large crater called Endurance. Before driving into the crater, the rover navigated around the edge—all the while taking pictures and samples to determine if a descent into the crater could be possible. After doing several simulated test studies on Earth, NASA decided to send the rover into the crater and to examine an interesting rock region called Karetepe.

Opportunity has functioned at a very strong level since landing, and the descent into the crater went, for the most part, as planned. The rover took samples along the descent and slipped only minimal distances. While the rover headed toward a sandy dune tendril, NASA continued to photograph the landscape and moved toward new locations for study. On sol 203, scientists determined that the ground between the rover and the dune tendril was too sandy and would cause significant problems for traction. They have begun to turn the rover back toward rock samples that were skipped over.

Is the end near?

Ultimately, the rovers' capabilities will decrease to a point where they can no longer function or send data. Several factors will be their undoing: distance between the Earth and Mars, dust on the solar panels, batteries losing capacity, or the winter becoming too dark and cold for the rovers to power-up. Until that time, NASA scientists will continue to gather as much information as the rovers will send.

MARS ACTIVITIES FOR THE CLASSROOM

Dan Malerbo
Buhl Planetarium, Carnegie Science Center
Pittsburgh, PA

The success of the twin robotic geologists, Spirit and Opportunity, has generated excitement in solar system exploration not seen since Pathfinder traversed the surface of Mars in 1997. Below are some classroom activities found on the NASA Johnson Space Center Web site that can help bring that excitement to your students.

Making and Mapping Volcanoes

http://ares.jsc.nasa.gov/Education/index.html
Students are introduced to lava layering as they construct a volcano. Then they investigate an "unknown" volcano to record its history.

(**NOTE:** In workshops, this is often divided into two activities using the first part to introduce planetary processes and the second part when studying plane surface exploration.)

Tricky Terrain

http://ares.jsc.nasa.gov/Education/index.html
Students read descriptions of soil samples and record information. Then they identify unknown samples by examination and testing. Mars soil simulant is used.

Searching for Life on Mars

http://ares.jsc.nasa.gov/Education/index.html
Imaginary Martians—Students draw creatures based on literary readings.
Looking for Life—Students develop an operational definition of life. They use their definition to look for evidence of life in samples. This experiment is based on a 1976 Viking Lander experiment.

How Does Flowing Water Shape a Planet's Surface?

http://marsprogram.jpl.nasa.gov/education/modules/webpages/activity5.htm

Comparisons of Water Flowing on Mars and Earth

Using a stream table set at various inclinations, students develop an eye for features associated with flowing water. They compare shapes made by the flowing water and landforms on Mars to determine whether water could have flowed across the Martian surface.

CAN'T WE GO ANY FASTER?

The design of the althetic shoe can be highly specialized depending on the ultimate result that the athletes or general consumer wants. This is why many of the top-name shoe companies research athletes running, jumping, turning, and twisting.

Cushioning the blow

By reviewing videotaped footage frame by frame, researchers can begin to pinpoint which part of the foot takes the most impact, which part needs the most flexiblity, and how the foot reacts to different surfaces such as turf verses hardwood floors.

Each foot will bear your body's entire weight every time you move. For a distance runner, this force can be up to three times his body weight. When a distance runner is not wearing proper shoes, this impact could also affect his legs, hips, or back.

Designing the perfect shoe can take years of research and testing. With different materials being created to use in shoe design, shoes can become more rigid or flexible as the need demands.

And the demands are greatly varied. For example, marathon runners want lightweight footwear with plenty of cushioning. Sprinting shoes often sacrifice cushioning for flexibility. Basketball shoes need to be sturdy enough to deal with lots of twisting and jumping.

The XXVIII Olympics have just come to a close and many records, such as the women's pole vault and the men's 10,000m marathon, have been broken. It may only be another few years until we see these records left in the dust. The question remains: How do we keep getting faster or higher?

The obvious answers deal with talent, training, and dedication. But the proper equipment plays a key role in allowing athletes to push their bodies farther than ever before.

Consider for a moment...the shoe. It's most basic function is to protect the foot—which it does if it is a steel-toe leather boot, rubber-soled sneaker, or simple flip flop. When asked to run a marathon, however, which shoe will you choose?

Jumping over Jordan

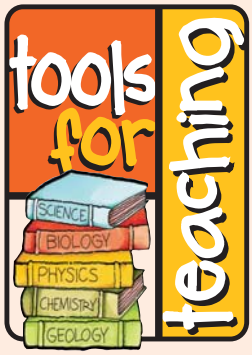
Choosing the right shoe can be difficult with all of the sizes, colors, and designs available. Basketball and tennis shoes are some of the most popular consumer shoes. A flatter surface and thin grooves provide greater contact between the foot and the smooth court surface. This increased traction and friction stop these athletes from sliding.

The sport doesn't have to be the only way to choose the right shoe. Sometimes, the shape of your foot has already made the decision for you. *Runner's World* magazine evaluates shoes as either motion-control, stability, or cushioned. Well-cushioned shoes are often best for people with high arches. Motion-control shoes are better for low arches or flat-foot. People with average arches, straight legs, and no mechanical flaws in their stride often do best with stability shoes.

Bringing sneaker science technology to the average person can help him lead a more active healthy life with fewer aches and pains. No shoe is going to slam dunk a basketball or run 26.2 miles for you. To be an outstanding athlete, continue to work on talents, training, and dedication.

Fast running involves the right form.

First, your heel strikes the ground. You roll along the side of the foot toward your toes. Your foot becomes rigid to launch you forward, like a springboard...A slight variation in this ideal running form can end up causing you all sorts of injuries.



MEASURING BOUNCE

MATERIALS:

- Elasticity Collision Demonstration (HS40977)
- Meter stick, metric (HS32052)
- Calculator (HS40689)

PRE-LAB DISCUSSION:

Have students identify objects in the classroom that contain polymers.

ACTIVITY:

Students will drop two polymer spheres and measure their rebound (Restitution Elasticity). The Neoprene™ sphere rebounds as expected, but the polynorbornene sphere seems to stick to the table. The Neoprene sphere has the higher restitution elasticity and less stress-absorbing capacity, giving it greater rebound; while the polynorbornene sphere has 50% more stress-absorbing capacity, reducing the observed "bounce".

Restitution Elasticity = Rebound Height / Initial Drop Height x 100

Example, 150cm drop height/47cm rebound height yields a restitution elasticity value of 31.3%.

TV Crime Science Exposed,
Contd. from page 1.

CAREERS IN FORENSICS

Aspiring lab detectives take note: Qualified forensic scientists are in demand. Labs compete fiercely to hire and retain experienced professionals. Relatively few universities provide structured forensic science curricula, but the field has attracted a majority of female students at many schools—80% at Michigan State and 70% at West Virginia (1999). Aside from a formal forensic program, newcomers enter the field from a wide range of scientific disciplines.

ANATOMY OF A CRIME LAB

Crime labs typically consist of a number of separate labs, each devoted to a different branch of forensic science. Here's a look at the San Diego Sheriff's Crime Lab:

SECTION	PURPOSE	COMMON SAMPLES OR SAMPLE SOURCES
Trace Evidence	Examine small samples for unique characteristics	Fibers, hair, flammables
Controlled Substances	Identify suspected illegal drugs for type and amount present	Pills, powders, vials, syringes
Forensic Biology	Examine physiological fluids/stains for genetically determining factors: blood type, species	Blood, saliva, other body fluids and tissues
Forensic Alcohol	Analysis for alcohol in DUI cases	Blood, breath or urine samples from arrestees
Forensic Toxicology	Analysis of blood and urine samples for presence of drugs or poisons	DUI and controlled substance arrests
Firearms	Examination of firearms for class or individual characteristics	Handguns, rifles, shotguns, shell casings, bullets
Fingerprints	Examination of latent (not visible) fingerprint impressions for characterization and ID	Any evidence with a surface that can accept a fingerprint impression
Automated Fingerprint Retrieval	Compares unknown prints from a crime scene to database of known prints	Same as above
Questioned Documents	Resolves questions concerning age, content or authenticity of documents	Counterfeit documents, forged checks, anonymous letters, suicide notes

WHAT'S NEW WITH FISHER?

K-6 Teachers...Have you Heard?

Did you know that Fisher Science Education launched a new Elementary Science Catalog this year? It's loaded with products and activities that are appropriate for introducing basic science concepts to elementary students. This new catalog is designed to provide you with the tools you need to overcome the challenges facing today's educators. It features essential science education products, selected specifically to help you present enriching learning experiences for your students—experiences that lead your students to a greater understanding of science.

Throughout the catalog you will find relevant information and understandable explanations that provide you with the foundation you need to help students make meaningful connections to the concepts you teach. You will also find many standards correlations, "Tools for Teaching," and in-depth, practical activities that suggest ways to interconnect lessons across disciplines, creating ways to engage your students in active, consistent learning experiences.

To receive your personal copy of the 2005 Fisher Elementary Science Education catalog, or for multiple copies for your school district, send an e-mail to **FSE.Elementary@FisherSci.com,** or call **(800) 955-1177.**

Soap

- What kind or brand of soap makes the most bubbles?
- What kind or brand of soap bubbles last the longest?
- What kind or brand of soap or detergent cuts grease best?
- How do soap bubbles react to additives in the water?

Precipitation

- How does precipitation vary from place to place within a storm?
- Does precipitation contain solid particles? If yes, what types of solid particles does it contain?
- How does the acidity of precipitation vary with the amount that falls?
- How does the acidity of precipitation vary with the seasons?

I'll take "New Products from Fisher" for 300, Alex.

In cooperation with the producers of the award-winning *Jeopardy* television series, **Classroom Jeopardy** brings the lights, sounds, and action of the TV show into the school. Create your own questions or use preprogrammed games to quiz students on any subject from single-digit subtraction to molecular biochemistry.

Easy to use! A player or team selects a category and value. The "host" uses a special remote controller and the clue is instantly displayed on the TV screen. When players/teams signal with their remote controllers, the host presses "Correct" or "Incorrect" and the electronic scoreboard updates automatically.

Includes:

- Scoreboard/Base Unit
- 3 Erasable Player/Team Name Cards
- 1 Detachable Keyboard
- 3 Wireless Player Remote Controllers
- 1 Wireless Host Remote Controller
- 1 "Sampler Games" Cartridge with blank storage space
- 1 Cable and an easy-to-follow Guide

Purchase Now and Save $60!

Visit **www.fisheredu.com** for additional cartridges and scoreboards.

DESCRIPTION	CAT. NO.	PRICE
Classroom Jeopardy	**HS69056-ND**	339.00

Promotional price ends December 31, 2004. No other discounts may be used in conjunction with this offer.

MENTION THIS AD AND GET 20% OFF!

Introducing...

Neo/SCI's Elementary Science Curriculum Modules

Standards-Based, Modular Learning System for Grades 2-5

Finally, an inquiry-based elementary science program specifically designed to meet the National Science Education Standards (NSES)! Neo/SCI's Elementary Science Curriculum Modules can be easily implemented by both novice and expert teachers alike—even without any prior knowledge of science. Each Elementary Module features:

- Curriculum-based Activities
- Complete Materials for 32 Students
- Teacher's Guide
- Student Worksheet Copymasters
- Professional Development Video
- Elementary Assessment CD-ROM

Developed and tested in the classroom by experienced teachers, including Lynn Gatto, New York State's 2003 Teacher of the Year!

SEE FISHER SCIENCE EDUCATION'S 2004 K-6 CATALOG OR VISIT WWW.FISHEREDU.COM FOR COMPLETE INFORMATION ON NEO/SCI'S ELEMENTARY SCIENCE CURRICULUM MODULES.

DESCRIPTION	CAT. NO.	PRICE
Physical Science 3-Module Set	**HS79141-ND**	569.95
Earth Science 3-Module Set	**HS79140-ND**	569.95
Life Science 3-Module Set	**HS79138-ND**	569.95
Complete 9-Module Set	**HS79142-ND**	1699.95

NEO SCI
New ideas for teaching science

PLASTIC POLLUTION GOES MICROSCOPIC

Seals trapped and killed in fishing nets. Photo courtesy of Ocean Conservancy.

Striking new scientific observations show that the plastic pollution of the oceans is a bigger problem than previously thought. Not only does visible marine plastic debris harm marine birds, mammals, turtles and fish, the increasing amounts of microscopic plastic particles suggest even more problems to come.

Plastic litter is by no means innocuous. There have been hundreds, maybe thousands, of reports of marine organisms being killed by plastic debris floating on the ocean surface. Observations suggested that plastic bags are mistaken for jellyfish or squid, and smaller pieces of plastic can be mistakenly eaten as food sources like fish eggs. These small plastic pieces eaten as food can fill up an organism's stomach, but provide no nutrition. As part of the 2004 World Environment Day, U.N. Secretary General Kofi Annan reported that marine trash, mostly plastic, is killing more than 100,000 mammals and sea turtles each year. In 2003, Dutch scientists reported that fulmars (a type of seagull) had an average of 30 pieces of plastic in their stomachs.

Other reports highlight another means by which plastic kills in the ocean: entanglement. Six-pack rings have been so widely observed to lead to marine deaths that 16 states in the U.S. have legislation mandating that these rings be biodegradable. Fishing lines and nets are culprits as well.

When the pros become cons

Plastics were created to resist degradation—and that they do very well. Sadly, the creatures that are killed by plastic ingestion or entanglement will decompose, but the plastic will remain in the ecosystem to kill again. The size of plastic debris may decrease in size as a result of photodegradation and physical forces, but the plastic does not disappear. So, the total burden of plastic in the oceans is ever increasing. Even now, rafts of plastic debris, from small clumps to immense mats, ride the waves carrying "alien organisms" from one part of the oceans into others, with unpredictable results for the native flora and fauna.

To get an idea of the magnitude of plastic the marine environment is collecting, consider this: it is estimated that our society produces 60 billion tons of plastic each year. If other estimates are correct, each of us uses 190 pounds of plastic annually, which may be disposed of by landfilling, incineration, or being washed away, frequently into watercourses. As more products are made of plastic, the number of potential culprits increases. Currently, the lineup includes plastic bags, six-pack rings, milk jugs, water bottles, Styrofoam cups, plastic utensils, cigarette lighters, jar lids, fishing lines and nets, foam shipping products, and industrial plastic pellets. As for the source of the problem, the new polluters draw from diverse ranks: beach-goers, fisherman, cruise liners, industries that accidentally spill the plastic pellets that form larger plastic items—and each of us who drops plastic waste, even candy wrappers, where they will be carried into a storm sewer and thence into the aquatic environment.

Microscopic plastic emerges as a new problem

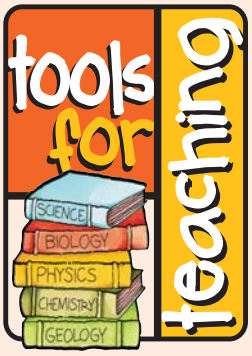
Considering that most plastics are not biodegradable and even those that are called "biodegradable" are generally made of biodegradable cornstarch binding together non-biodegradable plastic particles, it's not surprising that minute particles of plastic would be found in the ocean. It is surprising, however, how thoroughly they have spread through the seas and beaches. Researchers in the U.K. have reported that, in the sediments of various beaches, estuaries and shallow waters, about $^1/_3$ of the debris that was not clearly natural organic material was synthetic polymers from plastics. The open oceans are affected, also. Scientists examining plankton samples have reported that small plastic is there, too. Investigation of the water column shows three times more plastic during the 1990s than was present in the 1960s. Other studies have found that the mass of plastic fragments in certain areas of the ocean outweighs the plankton—by about six times!

The potential for harm by microscopic-sized plastic particles to organisms is suggested by both the organisms' physical and chemical natures. From a size perspective alone, materials of these small sizes can cause invertebrates' feeding apparatus and digestive tract to fill up—with fatal consequences.

While large pieces of plastic might not easily leach chemicals, when the particles are extremely small and the surface area increases, chemicals can be extracted in an organism's gut. These chemicals include plasticizers to keep plastics "plastic" (malleable, flexible), colorings to make the plastics attractive, and biocides to keep the plastic surfaces free of colonizers.

Even toxics from other sources can make their way into organisms: plastic particles may have chemicals like PCB and DDE clinging to their surfaces. These chemicals are endocrine receptors or "gender benders" that "confuse" the endocrine systems and can masculinize females, disrupting healthy reproduction and egg development. Spontaneous abortions are also associated with endocrine receptors. Abortions and population declines have been observed in seal populations, perhaps related to the abundance of leachable plastic particles.

It's hard to imagine linkages from the Styrofoam cup we leave at the beach to the microscopic agents of toxicity and gender confusion thousands of miles away. That's the nature of ecosystems. It reminds us that we should never take lightly the environmental consequences of small things we may do without thinking. Since the major contributors to the plastic polluters are people like us having fun on a beach, there are actions, even on our level, that we can take...like keeping that Styrofoam cup in hand until we can dispose of it properly!



MORE THAN CHAPTERS IN A BOOK

Science competitions, most often Science Fairs, have become increasingly interesting...and rewarding...to young science students. A Google search on the term Science Fair yields 615,000 hits, and variations on that theme give hundreds of thousands more relevant references. These fairs have gathered strength because corporate sponsors give support to these activities by financial gifts, in-kind gifts of time and services, and of course, because of teachers who recognize the value of these programs.

Science Fairs connect with students more deeply than traditional approaches because working on a science fair project is so much more than just reading chapters in a book or studying lessons in a class. This may be the first time a student breaks from traditional study practices and actually works hands-on to creatively develop his or her own idea. A student has freedom to generate an idea and see it through to a finish, working alone or with help from a consultant—usually but not always a dedicated teacher.

At the Pittsburgh Regional Science & Engineering Fair, we have seen some incredible student projects. One young student devised a path through his school that a robot could follow. The robot carried mail and correspondence from room to room with stops at teachers' desks. Another young girl created a device that her younger sister, living in a wheelchair, could use to turn lights on or off. Still another student connected a carbon monoxide detector to his garage door; if the CO level reached alarm limits a signal was sent to the door opener to automatically raise the door and reduce levels of toxic fumes, and one young lady worked with a dolphin at the zoo to establish the creature's ability to distinguish colors. (He could!)

The American Junior Academies of Science **(http://www.amjas.org)** and Science Service **(http://www.sciserv.org/)** are two leading sponsors of Science Competitions. A visit to their Web sites can provide further information about the details of their competitions.

The International Science and Engineering Fair is held in a different city each year and provides enormous prestige to the competitors. Each year, a large number of Nobel Prize winners attend to chat with the students representing 40 countries. This is truly a Science Olympics for high school students who have a unique opportunity to meet with the top science students of the world.
It's an experience from which your students can benefit.

Submitted by Joe Bosco, Director of Judges, Pittsburgh Regional Science and Engineering Fair

VIDEO REVIEW

Discovery School DVD: *Motion, Forces, Energy, and Electricity*

This exciting DVD presents physics concepts in short (4.5 to 6 minute) segments that give real-world examples of how the concept is applied in industry. Geared for students in grades 3-6, the DVD uses examples that are familiar to young students to help them relate to and understand the concepts presented.

Segment One: "Monster Masses in Motion" follows two teams of engineers who build dune buggies from spare junkyard parts in an attempt to race to the top of a steep, sandy incline in the fastest time. Formulas for acceleration and average speed are used to determine the winner of the competition.

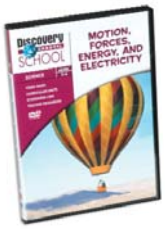
Segment Two: "Coasting Through Roller Coaster Physics" explains the forces that act on passengers of roller coasters. Discusses why roller coasters don't fall off loops and how acceleration and deceleration are achieved through the coaster's design.

Segment Three: "Bridges: A Heated Issue" examines the importance of tempered steel in bridge building. It also covers the effects of heat and cold on the materials that bridges are made of and why these factors must be taken into consideration when designing a bridge.

Segment Four: "Exploring Lightning" explains the phenomena of lightning and the atmospheric conditions that are most favorable to produce it.

A question for students to consider while watching the program is given at the beginning of each segment. Another question is given at the end of each segment to spur discussion of the central theme of the segment.

The included curriculum guide gives suggestions for integrating the DVD with classroom instruction. It also provides examples of how the program could be used for interdisciplinary learning and outlines the disciplines to which it would apply.



Vivid imagery taken from full-length Discovery Channel programs will capture students' attention as the concise narrative guides them through the basics of each concept.

DVD Running time: 26 minutes; **HS68554DVD;** 69.95
Also available on VHS video; **HS68554;** 59.95

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Great science fair projects need great science fair products

SCIENCE FAIR RIBBONS

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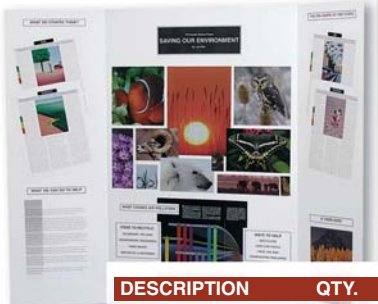

PROJECT BOARD

These one-ply, white, project boards measure 36 x 48". Sold in packs of 24.

DESCRIPTION	QTY.	CAT. NO.	PRICE
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BOOK REVIEW

The Complete Handbook of Science Fair Projects

By: Julianne Blair Bochinski, John Wiley & Sons, 1996, 240 pp.

More Award-Winning Science Fair Projects

By: Julianne Blair Bochinski, John Wiley & Sons, 2003, 228 pp.

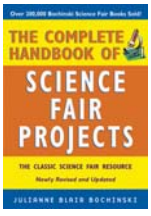
These two complementary books contain up-to-date rules on science and engineering fairs. These books feature black-and-white photographs and are divided into three parts—*Complete Guide to Science Fair Projects, Award-Winning Projects, and Appendixes.*

Part I examines the science fair itself. Chapters include general information on science fairs and projects, how to choose a topic, conducting the experiment, organizing and presenting data, displaying the information, and what to expect on the day of the fair.

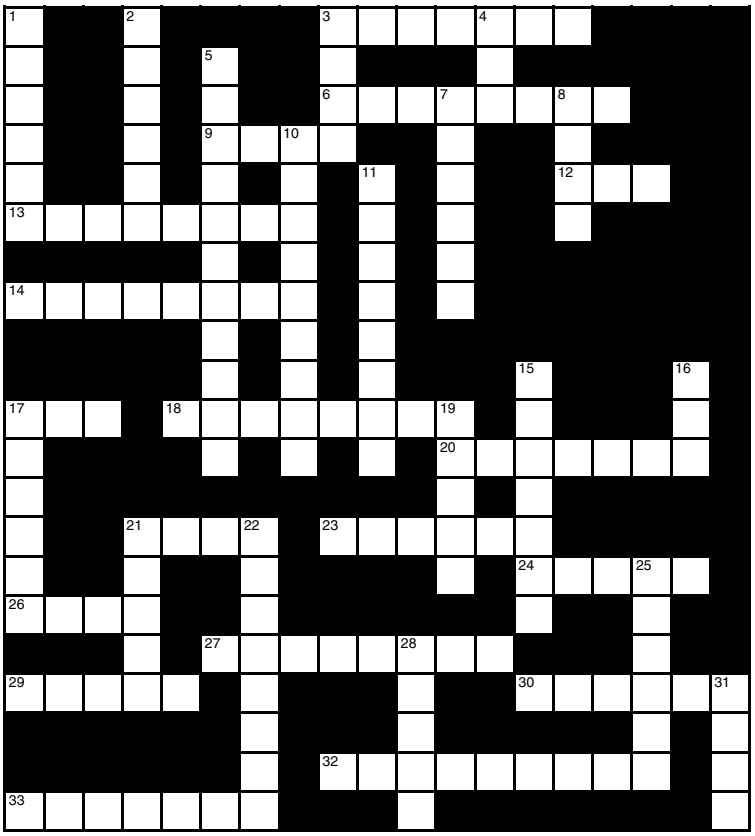
Part II contains highly detailed outlines of science fair projects that have already proven themselves as award-winning. With step-by-step explanations of how to apply the scientific method, these experiments are for students ready to take the science project to the next level. Some examples include: Are dogs colorblind? Are rodents territorial? How does saltwater mix in an estuary? The *Complete Handbook* contains 50 experiments and *More Award-Winning* contains 35 experiments.

Part III contains an appendix with a combined total of more than 800 more experiment ideas that students can use to generate projects. Also includes appendixes for Scientific Supply Companies, Science and Engineering Fairs, and Alternative Science Competitions.

To order:
The Complete Handbook of Science Fair Projects **(HS79332, 14.95)** or *More Award-Winning Science Fair Projects* **(HS79333, 14.95)**, visit **www.fisheredu.com** or call **1-800-955-1177.**



CROSSWORD PUZZLE



Find the completed crossword puzzle at *www.fisheredu.com* listed in the LITERATURE section.

Across

3. Tornado nickname and movie title (p. 6)
6. Form of skin cancer (p. 5)
9. New electronic sensor (p. 10)
12. First security sniffers (p. 12)
13. 26.2 miles (p. 16)
14. Police science (p. 1)
17. An endocrine receptor or "gender bender" (p. 18)
18. Identifies components of an odor (p. 10)
20. Detected by device in flashlight (p. 10)
21. Fourth planet from sun (p. 15)
23. This year's summer Olympics (p. 16)
24. Curie received two of these (p. 2)
26. Home of the National Hurricane Center (p. 7)
27. The ____ of evidence is often as critical as the quality (p. 1)
29. Radioactive studies laboratory location (p. 2)
30. One of the twin rovers (p. 15)
32. Type of shoe for average arches (p. 16)
33. The body's reaction to foreign invader (p. 4)

Down

1. Element on the Periodic Table (p. 2)
2. Founder of Tornado Damage Scale (p. 6)
3. TV writers compress this to fit a story into one hour (p. 1)
4. Desirable result of sun exposure (p. 5)
5. Electronic device used to create artificial sounds (p. 14)
7. Costliest hurricane (p. 7)
8. Chemical information sheets (p. 8)
10. Helps prevent sunburns (p. 5)
11. Musique _____, a type of electronic music (p. 14)
15. Preventative medicine (p. 4)
16. One Martian day (p. 15)
17. Airborne allergen from flowers and trees (p. 4)
19. Quadruple resistance uses this type of wavelengths (p. 12)
21. First American university to offer music engineering degree (p. 14)
22. Airports use technology to increase this (p. 12)
25. Force with the potential to power (p. 19)
28. Used to start a science fair project (p. 19)
31. Terahertz Radiation, abbreviated (p. 12)