National Chemistry Week-2004 Poster Contest
“Health and Wellness!” Educator Guide

As part of the National Chemistry Week 2004 celebration and in recognition of its theme, "Health and Wellness", the American Chemical Society is sponsoring a poster contest for students in Kindergarten – Grade 12.

Students are invited to create a poster that will serve as a public service announcement stressing chemistry’s role in keeping people healthy and well. Participants may create a poster that has a health and wellness message for their peers or any other age group.

ACS recognizes that the alignment of curriculum to content standards has been an important objective for schools in recent years. This year’s poster competition has been designed with the National Science Education Standards (NSES) in mind. The contest complies with the spirit of the Science in Personal and Social Perspective (Content Standard F), with emphasis on “Personal Health” in the NSES.

Judging:
Participant entries will be evaluated on how well the message in the poster promotes health and wellness through chemistry.

Three criteria will be used to determine the top entry for each age group:

1. Artistic merit
2. Poster Message (related to chemistry’s role in keeping people healthy and well)
3. Originality and Neatness

An electronic version of this document may be found at http://chemistry.org/ncw. The entire NSES document is available online at http://www.nap.edu/readingroom/books/neses/html.
The NSES is a comprehensive document covering many aspects of science education. This handout contains the NSES list of content topics that fit most closely with the NCW 2004 theme “Health and Wellness!” Under each highlight, several chemistry connections are suggested. Following each set of highlights there is a short discussion from NSES of how those highlights might be applied at a particular grade level.

**K – 2nd Grade & 3rd – 4th Grades**

**Highlights: Personal Health**

- Safety and security are basic needs of humans. Safety involves freedom from danger, risk, or injury. Security involves feelings of confidence and lack of anxiety and fear. Student understandings include following safety rules for home and school, preventing abuse and neglect, avoiding injury, knowing whom to ask for help, and when and how to say no.

  **Chemistry Connections:** Protecting the body in athletics (e.g. the materials used to make bicycle helmets, life vests, football and ski gear), how antiseptics disinfect and clean cuts (e.g. isopropyl alcohol, iodine, hydrogen peroxide), how to identify substances in the household that may be dangerous (e.g. cleaners, paint thinner, gasoline), how new synthetic materials in winter clothing keep you warm and dry in the winter and others keep you cool and dry in the summer (e.g. Thinsulate, CoolMax, GoreTex).

- Individuals have some responsibility for their own health. Students should engage in personal care--dental hygiene, cleanliness, and exercise--that will maintain and improve health. Understandings include how communicable diseases, such as colds, are transmitted and some of the body's defense mechanisms that prevent or overcome illness.

  **Chemistry Connections:** Prevention of tooth decay (e.g. plastic coatings for teeth, use of fluoride), importance of hand-washing (e.g. how to best wash, what to use, elimination of germs), how exercise keeps the body healthy (e.g. basic metabolism), causes of colds and flu (e.g. contact with others, not washing hands, poor hygiene), how does the body’s immune system work (e.g. antibodies).

- Nutrition is essential to health. Students should understand how the body uses food and how various foods contribute to health. Recommendations for good nutrition include eating a variety of foods, eating less sugar, and eating less fat.

  **Chemistry Connections:** The chemistry of a balanced diet (e.g. sources of basic nutrients), substances in food (proteins, carbohydrates, and fats), basics of reading food labels (e.g. percent daily values, caloric content, identifying sugars in foods by –ose ending), how food helps the body grow, basic metabolism (e.g. digestion) and common disorders associated with malnutrition (e.g. vitamin deficiencies, scurvy, anemia).
Different substances can damage the body and how it functions. Such substances include tobacco, alcohol, over-the-counter medicines, and illicit drugs. Students should understand that some substances, such as prescription drugs, can be beneficial, but that any substance can be harmful if used inappropriately.

**Chemistry Connections:** The harmful effects of tobacco smoke (e.g. lung cancer, breathing disorders), how to read labels (look for icons that indicate danger), the harmful effects of alcohol (e.g. damage to liver and the brain), sicknesses due to prolonged alcohol and drug use, the dangers of illegal drugs (e.g. interference with and degradation of the nervous system), how medicine can be helpful (e.g. proper use of medications, how accidental discoveries or observations can lead to important advances in medicine—aspirin, insulin).

**Discussion:** *Science in Personal and Social Perspectives for K - Grade 4*

Students in elementary school should have a variety of experiences that provide initial understandings for various science-related personal and societal challenges. Central ideas related to health, populations, resources, and environments provide the foundations for students' eventual understandings and actions as citizens. Although the emphasis in grades K-4 should be on initial understandings, students can engage in some personal actions in local challenges related to science and technology.

Teachers should be aware of the concepts that elementary school students have about health. Most children use the word "germs" for all microbes; they do not generally use the words "virus" or "bacteria," and when they do, they do not understand the difference between the two. Children generally attribute all illnesses to germs without distinction between contagious and noncontagious diseases and without understanding of organic, functional, or dietary diseases. Teachers can expect students to exhibit little understanding of ideas, such as different origins of disease, resistance to infection, and prevention and cure of disease.

Children link eating with growth, health, strength, and energy, but they do not understand these ideas in detail. They understand connections between diet and health and that some foods are nutritionally better than others, but they do not necessarily know the reasons for these conclusions.

By grades 3 and 4, students regard pollution as something sensed by people and know that it might have bad effects on people and animals. Children at this age usually do not consider harm to plants as part of environmental problems; however, recent media attention might have increased students’ awareness of the importance of trees in the environment. In most cases, students recognize pollution as an environmental issue, scarcity as a resource issue, and crowded classrooms or schools as population problems. Most young students conceive of these problems as isolated issues that can be solved by dealing with them individually. For example, pollution can be solved by cleaning up the environment and producing less waste, scarcity can be solved by using less, and crowding can be solved by having fewer students in class or school. However, understanding the interrelationships is not the priority in elementary school.
As students expand their conceptual horizons across grades K-12, they will eventually develop a view that is not centered exclusively on humans and begin to recognize that individual actions accumulate into societal actions. Eventually, students must recognize that society cannot afford to deal only with symptoms: The causes of the problems must be the focus of personal and societal actions.

5th – 8th Grades

Highlights: Personal Health

- Regular exercise is important to the maintenance and improvement of health. The benefits of physical fitness include maintaining healthy weight, having energy and strength for routine activities, good muscle tone, bone strength, strong heart/lung systems, and improved mental health. Personal exercise, especially developing cardiovascular endurance, is the foundation of physical fitness.

  Chemistry Connections: Substances in food (e.g. best sources of proteins, fats, and carbohydrates and their role in health), how overeating leads to chemical changes in the body (e.g. deposition of fat, lethargy), nutrients needed for proper development of bone, muscle and body tissues (e.g. uses of proteins, importance of calcium, potassium and B vitamins), how exercise affects the body (e.g. burning calories, stimulating muscle development and mental activity), how to prevent dehydration (e.g. water intake, electrolyte balance).

- The potential for accidents and the existence of hazards imposes the need for injury prevention. Safe living involves the development and use of safety precautions and the recognition of risk in personal decisions. Injury prevention has personal and social dimensions.

  Chemistry Connections: The composition, construction and use of personal safety equipment (e.g. plastics, foams and polymers used in bicycle helmets, body pads, gloves) composition, structure and limitations of the skeletal system (e.g. need for calcium intake, water intake, exercise and avoiding injury), how sunscreen works (e.g. prevention of sunburn and skin cancer), recognizing and reading warning labels, the chemistry of frostbite and heat stroke (e.g. temperature regulation in the body, homeostasis).

- The use of tobacco increases the risk of illness. Students should understand the influence of short-term social and psychological factors that lead to tobacco use, and the possible long-term detrimental effects of smoking and chewing tobacco.
Chemistry Connections: The short-term effects of tobacco use (e.g. addiction to nicotine, decreased physical stamina), long-term effects of tobacco use (e.g. difficulty breathing, lung and throat cancer, staining of teeth), indirect effects of smoking and breathing second-hand smoke (e.g. lowered immunity, increased susceptibility to respiratory illness, connections to all forms of cancer, heart disease).

- Alcohol and other drugs are often abused substances. Such drugs change how the body functions and can lead to addiction.

Chemistry Connections: Short-term effects of alcohol use (e.g. increased reaction time, decreased motor skills, lapses in judgment), long-term effects of alcohol use (e.g. decreased brain function, liver failure, kidney failure), addiction effects on friends, family and co-workers (e.g. fetal alcohol syndrome, loss of life and injury from auto accidents, neglect of responsibilities).

- Food provides energy and nutrients for growth and development. Nutrition requirements vary with body weight, age, sex, activity, and body functioning.

Chemistry Connections: Food sources for common nutrients (e.g. protein, carbohydrates, fats, vitamins and minerals), composition of a balanced diet (e.g. meats, vegetables, fruits, grains and dairy), importance of vitamins and minerals to development (e.g. deficiency symptoms, requirements for children and adults for nutrients and calories), effects of unbalanced diet (e.g. high sugar and high fat causing weight gain and fat deposition).

- Natural environments may contain substances (for example, radon and lead) that are harmful to human beings. Maintaining environmental health involves establishing or monitoring quality standards related to use of soil, water, and air.

Chemistry Connections: Proper and responsible use of chemicals (e.g. fertilizer, pesticides, herbicides), identification of hazardous materials (e.g. how to recognize and read warning labels), proper disposal methods for motor oil, batteries, paint and other household chemicals (e.g. county and city collection programs, recycling).

Discussion: Science in Personal and Social Perspectives for Grades 5 -8

Due to their developmental levels and expanded understanding, students in grades 5-8 can undertake sophisticated study of personal and societal challenges. Building on the foundation established in grades K-4, students can expand their study of health and establish linkages among populations, resources, and environments; they can develop an understanding of natural hazards, the role of technology in relation to personal and societal issues, and learn about risks and personal decisions. Challenges emerge from the knowledge that the products, processes, technologies and inventions of a society can result in pollution and environmental degradation and can involve some level of risk to human health or to the survival of other species.
The study of science-related personal and societal challenges is an important endeavor for science education at the middle level. By middle school, students begin to realize that illness can be caused by various factors, such as microorganisms, genetic predispositions, malfunctioning of organs and organ-systems, health habits, and environmental conditions. Students in grades 5-8 tend to focus on physical more than mental health. They associate health with food and fitness more than with other factors such as safety and substance use. One very important issue for teachers in grades 5-8 is overcoming students' perceptions that most factors related to health are beyond their control.

Students often have the vocabulary for many aspects of health, but they often do not understand the science related to the terminology. Developing a scientific understanding of health is a focus of this standard. Healthy behaviors and other aspects of health education are introduced in other parts of school programs.

By grades 5-8, students begin to develop a more conceptual understanding of ecological crises. For example, they begin to realize the cumulative ecological effects of pollution. By this age, students can study environmental issues of a large and abstract nature, for example, acid rain or global ozone depletion. However, teachers should challenge several important misconceptions, such as anything natural is not a pollutant, oceans are limitless resources, and humans are indestructible as a species.

**9th – 12th Grades**

**Highlights: Personal and Community Health**

-Hazards and the potential for accidents exist. Regardless of the environment, the possibility of injury, illness, disability, or death may be present. Humans have a variety of mechanisms--sensory, motor, emotional, social, and technological--that can reduce and modify hazards.

**Chemistry Connections:** The chemistry of perception (e.g. nerves, neurotransmitters, vision and response of the eye to light), how the body protects and heals itself (e.g. response to injury, swelling of tissue, blood clot formation, skin), construction and use of personal safety equipment (e.g. plastics, foams and polymers used in bicycle equipment, body pads, gloves), immune system (e.g. how the body fights infection, antigen-antibody interaction, leukocytes), safety in the science classroom (e.g. laboratory safety rules, use of protective gear), smog alerts (e.g. reasons for implementation, chemicals involved), hazard warning labels (e.g. what to look for on a label), materials used highway or airline safety (flame retardant materials, fire suppression systems, inflation of airbags, use of foams and polymers to reduce severity of impact), materials used in medicine (e.g. wounds dressings, liquid bandages, tissue glue, casts for broken bones, implants and synthetic tissues).

-The severity of disease symptoms is dependent on many factors, such as human resistance and the virulence of the disease-producing organism. Many diseases can be prevented, controlled, or cured. Some diseases, such as cancer, result from specific body dysfunctions and cannot be transmitted.
Chemistry Connections: Preventing the spread of communicable diseases (e.g. hand-washing, use antibacterial soaps, detergents and washes), hereditary diseases (e.g. DNA, meiosis, errors in transcription or translation, genetic screening), common diseases involving chemical pathways or changes to chemical structure of molecules involved and the frequency differences in certain groups of people (e.g. diabetes, phenylketonuria, sickle cell anemia, Tay Sachs disease) benefits of medicine (e.g. chemotherapy, aspirin, the field of pharmacology), proper food handling (packaging, temperature, decontamination, purification).

- Personal choice concerning fitness and health involves multiple factors. Personal goals, peer and social pressures, ethnic and religious beliefs, and understanding of biological consequences can all influence decisions about health practices.

Chemistry Connections: Health benefits of exercise (e.g. increased metabolism, endorphins, adrenaline, muscle growth, bone density), health risks associated with obesity (e.g. cardiovascular disease, lethargy, type 2 diabetes, susceptibility to illnesses), osteoporosis (e.g. causes and prevention).

- An individual's mood and behavior may be modified by substances. The modification may be beneficial or detrimental depending on the motives, type of substance, duration of use, pattern of use, level of influence, and short- and long-term effects. Students should understand that drugs can result in physical dependence and can increase the risk of injury, accidents, and death.

Chemistry Connections: Dangers of drug use (e.g. short-term and long-term effects on brain and body functions, addiction, neural pathways), insulin (e.g. benefits and risks over the long-term), drugs used to treat mental illness (e.g. structure, pathways and function), how combinations of drugs or other substances can be a health hazard (e.g. importance of talking to pharmacist), short-term and long-term effects of alcohol and/or tobacco use, drug withdrawal, caffeine and its impact on health.

- Selection of foods and eating patterns determine nutritional balance. Nutritional balance has a direct effect on growth and development and personal well-being. Personal and social factors--such as habits, family income, ethnic heritage, body size, advertising, and peer pressure--influence nutritional choices.

Chemistry Connections: Importance of food selection and sources (e.g. common sources of proteins, fats, and carbohydrates, vitamins and minerals), meaning of the term “fortified” in foods (e.g. addition of vitamins and minerals), definitions of terms used in food packaging (e.g. all-natural, organic, fat-free, cholesterol-free, sugar-free), Recommended Daily Allowance (relationship to self), evaluation of diet (nutrition facts labels, food ingredients, caloric intake).
Discussion: Science in Personal and Social Perspectives for Grades 9 - 12

The organizing principles for this standard do not identify specific personal and societal challenges, rather they form a set of conceptual organizers, fundamental understandings, and implied actions for most contemporary issues. The organizing principles apply to local as well as global phenomena and represent challenges that occur on scales that vary from quite short—for example, natural hazards—to very long—for example, the potential result of global changes.

By grades 9-12, many students have a fairly sound understanding of the overall functioning of some human systems, such as the digestive, respiratory, and circulatory systems. They might not have a clear understanding of others, such as the human nervous, endocrine, and immune systems. Therefore, students may have difficulty with specific mechanisms and processes related to health issues.

Students may exhibit a general idea of cycling matter in ecosystems, but they may center on short chains of the cyclical process and express the misconception that matter is created and destroyed at each step of the cycle rather than undergoing continuous transformation. Instruction using charts of the flow of matter through an ecosystem and emphasizing the reasoning involved with the entire process may enable students to develop more accurate conceptions.

Many high-school students hold the view that science should inform society about various issues and society should set policy about what research is important. In general, students have rather simple and naive ideas about the interactions between science and society. There is some research supporting the idea that S-T-S (science, technology, and society) curriculum helps improve student understanding of various aspects of science- and technology-related societal challenges.