

# Information and Media Literacy

# SCIENCE

Accessing and managing information. Integrating and creating information. Evaluating and analyzing information.

## 21st Century Tools for: Communication, Information Processing, and Research

## SAMPLE Student Outcomes for: Accessing, Processing, Managing, Integrating and Communicating Information



### 4th Grade

Internet, sciLINKS, Online resources, Print resources (Newspapers, Books, Newspapers, Magazines), PDA's, Web Databases (NASA, EPA, NOAA, USGS, etc) Observational and Measurement Tools (microscopes, telescopes, probes) TV programs (NASA, Discovery, National Geographic), Multimedia Applications Videos, DVD's CD ROMs), calculators, telecommunications, spreadsheets, word-processing.

1. Access information from a variety of media sources (i.e. Internet, CD-ROM programs, print resources). **E.G.** Research characteristics of beaks, feet, websites, legs, wings, and coloration to compare adaptations in various species of birds.
2. Use appropriate tools to measure and graph data. **E.G.** Measure and graph indoor and outdoor temperatures at different times of the year to identify patterns of change.
3. Analyze and compare data from a variety of age-appropriate sources such as newspapers and websites. **E.G.** Analyze and compare seasonal changes in temperature and rainfall for different regions.



### 8th Grade

Internet, sciLINKS, Online resources, Print resources (Newspapers, Books, Newspapers, Magazines), PDA's, Web Databases (NASA, EPA, NOAA, USGS, etc) Observational and Measurement Tools (microscopes, telescopes, probes) TV programs (NASA, Discovery, National Geographic), Multimedia Applications Videos, DVD's CD ROMs), calculators, telecommunications, spreadsheets, word-processing.

1. Use a variety of information access tools to locate, gather, and organize potential sources of scientific information to answer questions. **E.G.** Answer the question: How does the range of sounds that humans can hear compare with the range of sounds that other animals can hear?
2. Collect real-time observations and data synthesizing and building upon existing information (e.g., online databases NOAA, EPA, USGS) to solve problems. **E.G.** Collect data and search print and electronic resources to gather and record past data on the change in the turbidity of a river after a rainfall and its effect on the plants and animals living in this habitat.
3. Use appropriate tools to analyze and synthesize information (e.g., diagrams, flow charts, frequency tables, bar graphs, line graphs, and stem-and-leaf plots) to draw conclusions and implications based on investigations of an issue or question. **E.G.** Compile qualitative and quantitative data gathered through an investigation of past and current earthquake epicenters and regions of volcanic activity in order to identify needs and problems arising from events relating to the earth's crust.



### 12th Grade

Internet, sciLINKS, Online resources, Print resources (Newspapers, Books, Newspapers, Magazines), PDA's, Web Databases (NASA, EPA, NOAA, USGS, etc) Observational and Measurement Tools (microscopes, telescopes, probes) TV programs (NASA, Discovery, National Geographic), Multimedia Applications Videos, DVD's CD ROMs), calculators, telecommunications, spreadsheets, word-processing.

1. Select and analyze information from various sources, including electronic and print resources, community resources, and personally collected data, to answer questions being investigated. **E.G.** Answer the question: What effect does ultraviolet radiation, carcinogens, water pollution, toxins, or nuclear radiation have on developing organisms?
2. Collect and use qualitative and quantitative data and information, seek evidence and sources of information to identify flaws such as errors and bias and explain how the evidence gathered supports or refutes an initial hypothesis. **E.G.** Explain possible sources of error when predicting weather.
3. Analyze data and information gathered to clarify problems or issues identifying costs and benefits from a social, cultural, and/or environmental perspective; predicting the consequences of action or inaction; and proposing possible solutions. **E.G.** Articulate issues concerning the impact of developments in space research and technology in agriculture, navigation, and telecommunications.



# Communication Skills

# SCIENCE

Understanding, managing, and creating effective communications: (a) orally, (b) written, (c) using multimedia.

## 21st Century Tools for: Communication, Information Processing, and Research

## SAMPLE Student Outcomes for: Accessing, Processing, Managing, Integrating and Communicating Information



### 4th Grade

Video and audio recording devices, microphones, audio enhancement devices, assistive devices, digital recorders, computers, PDAs, word processing, spreadsheets, presentation software, email.

- Use a variety of tools and formats (oral presentations, journals, and multimedia presentations) to summarize and communicate the results of observations.

#### E.G

- Explain, using a model constructed of modeling clay and a tree branch, how a caterpillar eats.
- Prepare a poster illustrating the components of a local habitat; trace a food chain in an illustrated chart.
- Use simple media instruments to create a clearly labeled chart of organisms observed and identified during a study of the school yard.



### 8th Grade

Video and audio recording devices, microphones, audio enhancement devices, assistive devices, digital recorders, computers, PDAs, word processing, spreadsheets, presentation software, email.

- Use a wide range of tools and a variety of oral, written, and graphic formats (e.g., diagrams, flow charts, simulations, graphs) to share information and results of observations and investigations.

#### E.G

- Explain the effects on plants and animals of the loss of their natural habitat.
- Develop a chronological model or time scale of major events in the formation of the earth.
- Design a multimedia presentation explaining the interrelationships of biotic and abiotic elements in a specific ecosystem.



### 12th Grade

Video and audio recording devices, microphones, audio enhancement devices, assistive devices, digital recorders, computers, PDAs, word processing, spreadsheets, presentation software, email.

- Select and use appropriate scientific vocabulary to orally share and communicate scientific ideas, plans, results, and conclusions resulting from observations and investigations.

**E.G.** Use historical and current weather data to support a position on future weather patterns.

- Create written reports and journals to share and communicate scientific ideas, plans, results, and conclusions resulting from observations and investigations.

**E.G.** Graph sunrise and sunset data from observations and investigations and relate them to the motions of the Earth.

- Create a multimedia presentation incorporating numeric, symbolic and/or graphic modes of representation to share scientific ideas, plans, results, and conclusions.

**E.G.** Present data on different chemical substances in a table using appropriate headings such as compound, element, chemical and physical property.



# Critical Thinking and Systems Thinking

# SCIENCE

1. Exercising sound reasoning. 2. Making complex choices. 3. Understanding the interconnections among systems.

## 21st Century Tools for: Thinking and Problem Solving

## SAMPLE Student Outcomes for: Thinking and Problem Solving



### 4th Grade

Drawing, graphing, and concept mapping software, observational and measurement tools (microscopes, telescopes, probes), digital cameras, digital recording devices, PDAs, calculators, computers, databases, print materials.

1. Apply a variety of age-appropriate strategies to address real-life issues.  
**E.G.** Identify factors that affect plants and animals in a specific habitat and research the effects on plants and animals of the loss of their natural habitat.
2. Build a concept map to understand a complex problem.  
**E.G.** Illustrate each of the three states of matter and how changes among them are interrelated.
3. Appropriately organize observations and data into tables, charts and graphs for interpretation of interconnections.  
**E.G.** Display data gathered in a population-simulation exercise, using a labeled graph; classify species of insects in the neighborhood according to habitat, using a chart or table.



### 8th Grade

Drawing, graphing, and concept mapping software, observational and measurement tools (microscopes, telescopes, probes), digital cameras, digital recording devices, PDAs, calculators, computers, databases, print materials.

1. Execute the steps of scientific inquiry to engage in the problem-solving and decision making processes.  
**E.G.** Make qualitative and quantitative observations; classify objects and phenomena.
2. Apply new and unusual applications of existing knowledge to new and different situations.  
**E.G.** Identify factors to be considered in making informed decisions about land use.
3. Make sketches, graphs, and diagrams to explain ideas and to demonstrate the interconnections between systems.  
**E.G.** Create a simulation to demonstrate the movement of water and nutrients between cells and through various organs and systems.



### 12th Grade

Drawing, graphing, and concept mapping software, observational and measurement tools (microscopes, telescopes, probes), digital cameras, digital recording devices, PDAs, calculators, computers, databases, print materials.

1. Pursue scientific inquiry such as observation and measurement, hypothesis formulation and analysis, and value the scientific “habits of mind” such as persistence, accuracy and collaboration.  
**E.G.** Identify local environmental factors that may lead to a change in a cell’s genetic information or an organism’s development and investigate the consequences such factors have on human development.
2. Generate solutions to scientific questions and challenges through developing, modeling and revising investigations.  
**E.G.** Demonstrate various methods which can be used to control the conditions of plant growth (e.g., how conditions are controlled in a greenhouse, nursery, or hydroponic installation).
3. Apply scientific knowledge and skills to make reasoned decisions about the use of science and scientific innovations.  
**E.G.** Investigate the impact of genetic engineering of crops on global and local food production, and populations.

# Problem Identification, Formulation and Solution

*1. Ability to frame, analyze and solve problems.*

## 21st Century Tools for: Thinking and Problem Solving

## SAMPLE Student Outcomes for: Thinking and Problem Solving



### 4th Grade

Computers, observational and measurement tools (microscopes, telescopes, probes), PDAs, spreadsheets, graphing tools, modeling software, word processing, Internet, databases, print materials.

1a. Ask questions and plan investigations to find answers and solutions.

**E.G.** Predict, test, and draw conclusions about the removal of a part from a series circuit made with wires, battery, light bulb, and socket.

1b. Compile data gathered through observations in order to record and present results, using tally charts, tables, and graphs.

**E.G.** Compile and display data gathered from a study of electric circuits to demonstrate the function of their component parts (e.g., switches, power source).

1c. Use evidence to construct explanations.

**E.G.** Design and construct a simple circuit that will operate a device such as a light bulb.



### 8th Grade

Computers, observational and measurement tools (microscopes, telescopes, probes), PDAs, spreadsheets, graphing tools, modeling software, word processing, Internet, databases, print materials.

1a. Formulate a scientific question about phenomena, a problem, or an issue and using a broad range of tools and techniques; plan and conduct an inquiry to address the question.

**E.G.** Investigate how local recycling efforts help conserve energy and natural resources.

2. Use evidence collected from observations or other sources (e.g., Internet, databases, print materials) and use them to create models and explanations.

**E.G.** Compile data gathered from to record and present results of local recycling effort.



### 12th Grade

Computers, observational and measurement tools (microscopes, telescopes, probes), PDAs, spreadsheets, graphing tools, modeling software, word processing, Internet, databases, print materials.

1. Formulate scientific questions about an issue and define experimental procedures for finding answers.

**E.G.** Research the use of fertilizers and pesticides on soil.

2. Plan and conduct practical tests to solve problems or answer a question, collect and analyze data using appropriate instruments and techniques safely and accurately.

**E.G.** Test water quality, air quality, and/or soil composition.

3. Develop models and explanations to fit evidence obtained from investigations.

**E.G.** Develop a flowchart graphic to illustrate the flow of fertilizers and pesticides through a local ecosystem.



# Creativity and Intellectual Curiosity

# SCIENCE

I. Develop, implement and communicate new ideas to others.

## 21st Century Tools for: Thinking and Problem Solving

## SAMPLE Student Outcomes for: Thinking and Problem Solving

### 4th Grade



Brainstorming software, collaboration software (including web-based collaborative network software), telecommunications, presentation software, digital cameras, projectors.

I. Use a variety of equipment and software packages to enter, process, display, and communicate information in different forms using text, tables, pictures, and sound.

**E.G.** Create a shade chart of a selected color; make a spinning color wheel to demonstrate how “white” light is composed of all the colors.

### 8th Grade



Brainstorming software, collaboration software (including web-based collaborative network software), telecommunications, presentation software, digital cameras, projectors.

I. Use a variety of media tools to make oral and written presentations, which include written notes and descriptions, drawings, photos, and charts to communicate the procedures and results of investigations.

**E.G.** Communicate the procedures and results of an investigation that evaluates and compares the quality of water from different sources by performing simple tests (e.g., for pH, salinity, hardness, temperature, turbidity).

### 12th Grade



Brainstorming software, collaboration software (including web-based collaborative network software), telecommunications, presentation software, digital cameras, projectors.

I. Prepare multimedia presentations to share results of investigations, demonstrating a clear sense of audience and purpose.

**E.G.** Use a multi media presentation to describe the factors determining the quality of a water source.

2. Use electronic networks (e.g., chat rooms) to share information.

**E.G.** Share the results of an investigation of water quality with neighboring communities.

3. Model solutions to a range of problems in science and technology using computer simulation software.

**E.G.** Create a simulation illustrating the movement of water and nutrients between cells and through various organs and systems.

## Interpersonal and Collaborative Skills

1. Demonstrating teamwork and working productively with others. 2. Demonstrating and the ability to adapt to varied roles and responsibilities. 3. Exercise empathy and respecting diverse perspectives.

### 21st Century Tools for: Interpersonal and Self-Directional Skills

### SAMPLE Student Outcomes for: Interpersonal and Self-Directional Skills



#### 4th Grade

Brainstorming software, collaboration software (including web-based collaborative network software), calculators, newspapers, Internet, spreadsheet programs, presentation software, video equipment, computers, team competitions (e.g. Science Olympics, Exploravision).

1. Plan and conduct scientific investigations in group settings.  
**E.G.** Work in teams to design and construct a boat that holds paper clips, and moves through water using a magnet.
2. Engage in group decision making activities.  
**E.G.** Collaborate on the design and construction of a boat that holds paper clips, and moves through water using a magnet.
3. Role-play different points of view on an issue  
**E.G.** Role-play various viewpoints on maintaining a healthy environment.



#### 8th Grade

Brainstorming software, collaboration software (including web-based collaborative network software), calculators, newspapers, Internet, spreadsheet programs, presentation software, video equipment, computers, team competitions (e.g. Science Olympics, Exploravision).

1. Work in diverse pairs/teams to answer questions, solve problems and make decisions.  
**E.G.** Participate in NSTA's ExploraVision, state-based Science Olympiads).
2. Plan and develop team science projects.  
**E.G.** Design a project which will address the factors that must be considered in making informed decisions about land use (e.g., environmental impact, jobs, present and future values of natural resources).
3. Articulate understanding of content through personal interaction and sharing with peers.  
**E.G.** Create a table to show peers the relationship between the buoyant forces and the size of objects.



#### 12th Grade

Brainstorming software, collaboration software (including web-based collaborative network software), calculators, newspapers, Internet, spreadsheet programs, presentation software, video equipment, computers, team competitions (e.g. Science Olympics, Exploravision).

1. Create a culminating team project that demonstrates content knowledge and conceptual understanding and shows connections between science content and real-world settings.  
**E.G.** Construct and test a simple loudspeaker; construct, test, and demonstrate a simple audio amplifier.
2. Collect, synthesize and report information from a variety of points of view (e.g., debates, discussions, presentations).  
**E.G.** Create a report for local authorities highlighting the pros and cons (E.G. economic, personal, and scientific factors) of long term storage of radioactive waste materials.



# Self-Direction

# SCIENCE

*1. Monitoring one's own understanding and learning needs, locating resources, and transferring learning from one domain to another.*



### 4th Grade

Planning, scheduling and evaluation tools (personal digital, computer, and web-based resources), calculators, computers, books, newspapers.

1. Keep a journal record of observations, recognizing patterns, summarizing findings, and reflecting on the observations.

**E.G.** Maintain a journal describing changes in the characteristics, behavior, and location of living things that occur in seasonal cycles E.G. trees shed their leaves, birds migrate, humans change clothing, do different activities.



### 8th Grade

Planning, scheduling and evaluation tools (personal digital, computer, and web-based resources), calculators, computers, books, newspapers.

1. Keep a journal of observations and investigations, and periodically evaluate entries to assess progress toward achieving the understanding of key ideas.

**E.G.** Maintain a journal describing changes to a specific habit over extended periods of time.



### 12th Grade

Planning, scheduling and evaluation tools (personal digital, computer, and web-based resources), calculators, computers, books, newspapers.

1. Use key ideas of science to document and explain through an investigation the relationship between science concepts

**E.G.** Investigate the complex interconnectedness of physical, chemical, and biological processes as they apply to the Earth.

2. Self-assess progress toward a predetermined outcome and decide what needs to be done to meet the goal.

**E.G.** Maintain a journal highlighting understandings of various science concepts and questions still needing to be addressed.

**21st Century Tools for: Interpersonal and Self-Directional Skills**

**SAMPLE Student Outcomes for: Interpersonal and Self-Directional Skills**



## Accountability and Adaptability

1. Exercising personal responsibility and flexibility in personal, workplace and community contexts. 2. Setting and meeting high standards and goals for one's self and others.

### 21st Century Tools for: Interpersonal and Self-Directional Skills

### SAMPLE Student Outcomes for: Interpersonal and Self-Directional Skills



#### 4th Grade

Planning, scheduling and evaluation tools (personal digital, computer and web-based resources), Internet, presentation software, word processing.

1. Establish ongoing communication with students from other communities or countries to share and compare data.

**E.G.**

- Use letters, email, or electronic bulletin boards to share and compare data on rainfall, temperatures, migrations, etc.
- Write a letter to an electronic pen pal highlighting progress in a specific investigation.



#### 8th Grade

Planning, scheduling and evaluation tools (personal digital, computer and web-based resources), Internet, presentation software, word processing.

1. Develop and execute a plan to collect and record accurate and complete data from various sources to solve a problem or answer a question. Gather and critically analyze data from a variety of sources.

**E.G.** Participate in an electronic project such as NASA's "Globe" initiative.

2. Participate in science competitions, where students are responsible for creating a product or participating in an event.

**E.G.** Design a device or participate in the Science Olympics.



#### 12th Grade

Planning, scheduling and evaluation tools (personal digital, computer and web-based resources), Internet, presentation software, word processing.

1. Identify the reputable and appropriate communities of learners to whom research findings should be reported, compare data, and adapt it as needed.

**E.G.** Identify key decision makers in the community who are responsible for determining the site of a landfill, share class research and obtain feedback.

2. Use science learned to create a personal action plan on a community issue.

**E.G.** Use technological solutions to address local transportation needs and use scientific principles to explain the way they function.



# Social Responsibility

# SCIENCE

1. Acting responsibly with the interests of the larger community in mind. 2. Demonstrating ethical behavior in personal, workplace and community contexts.

## 21st Century Tools for: Interpersonal and Self-Directional Skills

### SAMPLE Student Outcomes for: Interpersonal and Self-Directional Skills



#### 4th Grade

Web-based forums, online communities of learners.

1. Collaborate with other learners by letter, phone, or online.  
**E.G.** Use letters, email, or electronic bulletin boards to share and compare data on rainfall, temperatures, migrations, etc.
2. Participate in simulation or role-playing activities.  
**E.G.** Wear appropriate protective equipment and select and apply appropriate techniques for handling, storing, and disposing of laboratory materials when doing science investigations.



#### 8th Grade

Web-based forums, online communities of learners.

1. Collaborate with a network of learners by phone, video, virtual classroom platform.  
**E.G.** Use letters, email, or electronic bulletin boards to share and compare data on rainfall, temperatures, migrations, etc.
2. Participate in simulation or role-playing activities in which students grapple with the ethics of complex issues.  
**E.G.** Debate the pros and cons of stem-cell research.



#### 12th Grade

Web-based forums, online communities of learners.

1. Collaborate with interested learners using appropriate web resources and publication media such as journals (print and electronic).  
**E.G.** Use a variety of information sources to conduct a cost-benefit analysis of the environmental impact of a particular technology.