# Ciphers and Codes:
## Keeping Information Safe

**IEEE ARIZONA SCIENCE LAB**
**www.arizonasciencelab.org**

### Workshop Focus:

Workshop focuses on what ciphers and codes are, the history of ciphers and codes, how they are used, and how they work. Students work to complete an Activities Handout that requires completing information keyed to the ongoing animated presentation. A project is included in which four-person teams solve a puzzle using encrypted clues.

### Workshop Synopsis:

- Students learn how information is represented and protected, in the context of what ciphers and codes are, how they work, and how to create them
- The presentation, activities, and project can be adjusted to fit the grade level
- Students work to complete an Activities Handout that requires completing information keyed to the ongoing animated presentation--*small* steps, such as partial codings and decodings
- A project is included in which four-person teams solve a puzzle using encrypted clues

### Age Levels:

8 – 15 years (grades 4 – 8).

### Objectives:

1. Learn what ciphers and codes are.
2. See how they work.

3. Make and use some well-known codes.

## Anticipated Learner Outcomes:

As a result of this activity, students should develop an understanding of:

- how information is represented and protected, in the context of what ciphers and codes are
- how ciphers and codes work
- how to create ciphers and codes
- the impact of engineering and technology on society
- engineering problem solving
- teamwork

## Workshop Activities:

Students learn about how computer coding systems have impacted everyday life, including distribution of products, management of inventory, the use of credit and debit cards, and pricing at retail outlets and online websites. Students learn what codes are, the history of codes, how and why codes are used, and how codes work. The presentation, activities, and project can be adjusted to fit the grade level. Students work to complete an Activities Handout that requires completing information keyed to the ongoing animated presentation — *small* steps, such as partial codings and decodings. A project is included in which four-person teams solve a puzzle using encrypted clues.

## Alignment to Curriculum Frameworks:

*Note: All Arizona Science Lab workshops are aligned to the National Science Education Standards which were produced by the National Research Council and endorsed by the National Science Teachers Association, and if applicable, also to the International Technology Education Association's Standards for Technological Literacy or the National Council of Teachers of Mathematics' Principals and Standards for School Mathematics. They will also be modified as necessary to be aligned to the Next Generation Science Standards (NGSS) when they are released.*

- **National Science Education Standards Grades K-4 (ages 4-9)**

CONTENT STANDARD E: Science and Technology
As a result of activities in grades 5-8, all students should develop

- Abilities of technological design
- Understandings about science and technology

CONTENT STANDARD F: Science in Personal and Social Perspectives
As a result of activities, all students should develop understanding of

- Risks and benefits

- Science and technology in society

CONTENT STANDARD G: History and Nature of Science
As a result of activities, all students should develop understanding of
- History of science

- **National Science Education Standards Grades 5-8 (ages 10-14)**

CONTENT STANDARD E: Science and Technology
As a result of activities in grades 5-8, all students should develop
- Abilities of technological design
- Understandings about science and technology

CONTENT STANDARD F: Science in Personal and Social Perspectives As a result of activities, all students should develop understanding of
- Risks and benefits
- Science and technology in society

CONTENT STANDARD G: History and Nature of Science
As a result of activities, all students should develop understanding of
- Nature of science
- History of science

- **National Science Education Standards Grades 9-12 (ages 14-18)**

CONTENT STANDARD E: Science and Technology
As a result of activities, all students should develop
- Abilities of technological design
- Understandings about science and technology

CONTENT STANDARD F: Science in Personal and Social Perspectives As a result of activities, all students should develop understanding of
- Science and technology in local, national, and global challenges

CONTENT STANDARD G: History and Nature of Science
As a result of activities, all students should develop understanding of
- Nature of scientific knowledge
- Historical perspectives

- **Standards for Technological Literacy - All Ages**

The Nature of Technology
- Standard 1: Students will develop an understanding of the characteristics and scope of

technology
- Standard 3: Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study

Technology and Society
- Standard 4: Students will develop an understanding of the cultural, social, economic, and political effects of technology
- Standard 6: Students will develop an understanding of the role of society in the development and use of technology
- Standard 7: Students will develop an understanding of the influence of technology on history

Design
- Standard 10: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

Abilities for a Technological World
- Standard 13: Students will develop abilities to assess the impact of products and systems.

The Designed World
- Standard 17: Students will develop an understanding of and be able to select and use information and communication technologies.

- **Principles and Standards for School Mathematics**

Understand meanings of operations and how they relate to one another
- understand the effects of multiplying and dividing whole numbers
- identify and use relationships between operations

Data Analysis and Probability Standard
- select, create, and use appropriate graphical representations of data, including histograms, box plots, and scatterplots

Problem Solving
- Solve problems that arise in mathematics and in other contexts

Connections
- Recognize and apply mathematics in contexts outside of mathematics

## Internet Connections:

- TryEngineering (www.tryengineering.org )

- McREL Compendium of Standards and Benchmarks (www.mcrel.org/standards-benchmarks
    - A compilation of content standards for K-12 curriculum in both searchable and browsable formats.
- National Science Education Standards (www.nsta.org/standards )
- Principals and Standards for School Mathematics (http://standards.nctm.org )

## Recommended Reading:

- Code: The Hidden Language of Computer Hardware and Software, by Charles Petzold (ISBN: 0735611319)

## Materials and Tools:

All materials and tools required for this workshop are provided by the Arizona Science Lab

## Time Needed:

One four-five hour workshop (inclusive of lunch and restroom breaks).

## ASL Staff Responsibilities:

The ASL staff is responsible for the conduct of the workshop:

- Setting up the workshop
- Presenting the lecture and teaching the science
- Performing the demonstrations
- Provisioning the materials and equipment to the student teams
- Supervising the construction project
- Supporting the students during the construction project
- Supervising the project testing
- Answering student questions about the science, the workshop, or any other related topic
- Cleaning up the workshop after the students have left

## School Teacher Responsibilities:

- **Managing the students during the class and the lunch and restroom breaks, and imposing discipline as necessary**
    - The ASL staff is NOT responsible for the class management or for student discipline!
    - **The restroom breaks will require at least one male and one female teacher be present from the school**
- Assisting the ASL staff in the teaching of the science
    - This could comprise asking the students questions about what had just been explained, presenting what had just been explained in another fashion, and so on

    - The ASL staff are not necessarily trained teachers and the school teachers know their students very well, so they can provide valuable insights and help to the ASL staff
- Assisting the ASL staff during the project construction and testing