

Appendix 1. National Science Education Standards addressed by the microarray unit.

Content Standard A - Science as Inquiry: “As a result of activities in grades 9-12, all students should develop abilities necessary to do science inquiry and understandings about scientific inquiry. For students to develop the abilities that characterize science as inquiry, they must actively participate in scientific investigations, and they must actually use the cognitive and manipulative skills associated with the formulation of scientific explanations.”

Abilities necessary to do scientific inquiry:

- **Identify** questions and concepts that guide scientific investigations.
- **Design** and **conduct** scientific investigations.
- **Use technology** and mathematics to improve investigations and communications.
- **Formulate** and revise scientific explanations and models using logic and evidence.
- **Recognize and analyze** alternative explanations and models.
- **Communicate** and defend a scientific argument.

Content Standard C - Life Sciences: As a result of their activities in grades 9-12, all students should develop understanding of:

The cell

- Cells store and use information to guide their functions.
- The genetic information stored in DNA is used to direct synthesis of the thousands of proteins each cell requires.
- Cell functions are **regulated**. Regulation occurs both through changes in the activity of the functions performed by proteins and **through the selective expression of individual genes**. This regulation allows cells to respond to their environment and to control and

coordinate cell growth and division.

The Molecular Basis Of Heredity

- In all organisms, the instructions for specifying the characteristics of the organism are carried in the DNA, a large polymer formed of subunits of four kinds (A, G, C, and T). The chemical and structural properties of DNA explain how the genetic information that underlies heredity is encoded in genes (as a string of molecular “letters”).
- Changes in DNA (mutations) occur spontaneously at low rates. Some of these changes make no difference to the organisms, whereas others can change cells and organisms.

Content Standard E - Science and Technology: “As a result of their activities in grades 9-12, all students should develop abilities of technological design and understandings about science and technology.”

- Communicate the problem, process, and solution.
- Many scientific investigations require the contributions of individuals from different disciplines, including engineering.
- Science often advances with the introduction of new technologies. New technologies often extend the current levels of scientific understanding and introduce new areas of research
- Technological solutions may create new problems. Sometimes scientific advances challenge people’s beliefs and practical explanation concerning various aspects of the world

Content Standard F - Science in Personal and Social Perspectives: “As a result of their activities in grades 9-12, all students should develop an understanding of science and technology in local, national, and global challenges.”

- The severity of disease symptoms is dependent on many factors.
- Science and technology are social enterprises, but alone they can only indicate what can happen – the latter involves human decisions about the use of knowledge.
- Understanding basic concepts and principles of science and technology should precede active debate about economics, policies, politics, and ethics of various science and technology related challenges.
- Progress in science and technology can be affected by social issues and challenges.
- Individual and society must decide on proposals involving new research and the introduction of new technologies into society. Decisions involve assessment of alternatives, risks, costs, and benefits and consideration of who benefits and who suffers, who pays and who gains, and what the risks are and who bears them.

Content Standard G – History and Nature of Science: “As a result of their activities in grades 9-12, all students should develop an understanding of science as a human endeavor, the nature of scientific knowledge, and historical perspectives.”

- Individuals and teams have contributed and will continue to contribute to the scientific enterprise. Pursuing science as a career or hobby can be both fascinating and intellectually rewarding.
- Science distinguishes itself from other ways of knowing through the use of empirical standards, logical arguments, and skepticism.
- Scientific explanations must be consistent with experimental and observational evidence, and must make accurate predictions about systems being studied. They should also be logical, respect the rules of evidence, be open to criticism, report methods and procedures, and make knowledge public.