

# NATIONAL SCIENCE EDUCATION STANDARDS

## The Chemistry of Vat Dyes

GRADE	CATEGORY	SUB-CATEGORY	STANDARD
9-12	Physical Science	Chemical Reactions	A large number of important reactions involve the transfer of either electrons (oxidation/reduction reactions) or hydrogen ions (acid/base reactions) between reacting ions, molecules, or atoms.
9-12	Physical Science	Chemical Reactions	Chemical reactions can take place in time periods ranging from the few femtoseconds ( $10^{-15}$ seconds) required for an atom to move a fraction of a chemical bond distance to geologic time scales of billions of years.
9-12	Physical Science	Chemical Reactions	Chemical reactions occur all around us, for example in health care, cooking, cosmetics, and automobiles.
9-12	Physical Science	Structure and Properties of Matter	Carbon atoms can bond to one another in chains, rings, and branching networks to form a variety of structures, including synthetic polymers, oils, and the large molecules essential to life.
9-12	Physical Science	Structure and Properties of Matter	The physical properties of compounds reflect the nature of the interactions among its molecules.
9-12	Science and Technology	Abilities of Technological Design	Communicate the Problem, Process, and Solution
9-12	Science and Technology	Abilities of Technological Design	Propose designs and choose between alternative solutions.
9-12	Science and Technology	Understandings About Science and Technology	Creativity, imagination, and a good knowledge base are all required in the work of science and engineering.
9-12	Science as Inquiry	Abilities Necessary To Do Scientific Inquiry	Communicate and defend a scientific argument.
9-12	Science as Inquiry	Abilities Necessary To Do Scientific Inquiry	Design and conduct scientific investigations.
9-12	Science as Inquiry	Abilities Necessary To Do Scientific Inquiry	Formulate and revise scientific explanations and models using logic and evidence.
9-12	Science as Inquiry	Abilities Necessary To Do Scientific Inquiry	Recognize and analyze alternative explanations and models.

9-12	Science as Inquiry	Understandings about scientific inquiry	Scientific explanations must adhere to criteria such as; a proposed explanation must be logically consistent; it must abide by the rules of evidence; it must be open to questions and possible modification; and it must be based on historical and current scientific knowledge.
9-12	Science as Inquiry	Understandings about scientific inquiry	Scientists conduct investigations for a wide variety of reasons.
9-12	Science as Inquiry	Understandings about scientific inquiry	Scientists usually inquire about how physical, living, or designed systems function.