

## MATHEMATICS STANDARDS FOR AIR QUALITY CURRICULUM

The Curriculum and Evaluation Standards for School Mathematics (National Council of Teachers of Mathematics, 1989) and the Professional Standards for Teaching Mathematics (National Council of Teachers of Mathematics, 1991) provide the basic framework for many state and local standards in mathematics.

These documents set benchmarks for student achievement and address the goals of educational practice in the a number of areas, including:

1. Math Teaching
2. Math Content
3. Evaluation

Using problem-based learning (PBL) with the Air Quality Curriculum materials provides educators with the opportunity to address these goals. A sampling of the applicable standards is listed below.

### 1. ***Math Teaching*** – Teachers of mathematics...

***Standard 1:*** pose worthwhile mathematical tasks that are based on knowledge of students' understandings, interests, and experiences; knowledge of the range of ways that diverse students learn mathematics; and that stimulate students to make connections and develop a coherent framework for mathematical ideas; call for problem formulation, problem solving, and mathematical reasoning; promote communication about mathematics; represent mathematics as an ongoing human activity.

***Standard 2:*** should orchestrate discourse by posing questions and tasks that elicit, engage, and challenge each student's thinking; deciding when and how to attach mathematical notation and language to students' ideas; deciding when to provide information, when to clarify an issue, when to model, when to lead, and when to let a student struggle with a difficulty; monitoring students' participation in discussions and deciding when and how to encourage each student to participate.

***Standard 3:*** should promote classroom discourse in which students use a variety of tools to reason, make connections, solve problems, and communicate; initiate problems and questions; make conjectures and present solutions; rely on mathematical evidence and argument to determine validity.

***Standard 4:*** in order to enhance discourse, should encourage and accept the use of computers, calculators, and other technology; concrete materials used as models; pictures, diagrams, tables, and graphs; invented and conventional terms and symbols; metaphors, analogies, and stories; written hypotheses, explanation, and arguments; oral presentations and dramatizations.

***Standard 5:*** should create a learning environment that fosters the development of each student's mathematical power by providing a context that encourages the development of mathematical skill and proficiency; and by consistently expecting and encouraging students to work independently or collaboratively to make sense of

mathematics; display a sense of mathematical competence by validating and supporting ideas with mathematical argument.

**Standard 6:** should engage in ongoing analysis of teaching and learning by examining effects of tasks, discourse, and learning environment on students' mathematical knowledge, skills, and dispositions; in order to challenge and extend students' ideas; adapt or change activities while teaching; describe and comment on each student's learning to parents and administrators, as well as to the students themselves.

**2. Math Content** – There are 13 general curriculum standards for mathematics in grades K – 12. In investigating PBL problems, an understanding of mathematics, including measurement, statistics, and probabilities, may be critical to evaluating data that is collected during research. Of additional importance are the following standards:

The study of mathematics should...

**Standard 1:** emphasize problem solving so that students can formulate problems from everyday situations within and outside mathematics; develop and apply strategies to solve a wide variety of problems; verify and interpret results with respect to the problem; acquire confidence in using mathematics meaningfully.

**Standard 2:** include opportunities to communicate so that students can model situations using oral, written, concrete, pictorial, graphical, and numerical methods; read written presentations of mathematics with understanding.

**Standard 3:** emphasize reasoning so that students can draw logical conclusions about mathematics; judge the validity of arguments; construct simple valid arguments; use models, known facts, properties, and relationships to explain their thinking; justify their answers and solutions processes; use patterns and relationships to analyze mathematical situations.

**Standard 4:** include opportunities to make connections so that students can use mathematics in other curriculum areas and in their daily lives, in our culture and society.

### **3. Evaluation**

**Standard 2:** Decisions concerning students' learning should be made on the basis of a convergence of information obtained from a variety of sources. These sources should encompass tasks that demand different kinds of mathematical thinking.

**Standard 4:** The assessment of students' mathematical knowledge should yield information about their ability to apply their knowledge to solve problems within mathematics and in other disciplines; ability to use mathematical language to communicate ideas; ability to reason and analyze.

**Standard 5:** The assessment of students' ability to use mathematics in solving problems should provide evidence that they can formulate problems; apply a variety of strategies to solve problems; verify and interpret results; generalize solutions.

**Standard 6:** The assessment of students' ability to communicate mathematics should provide evidence that they can express mathematical ideas by speaking, writing, demonstrating, and depicting them visually; understand, interpret, and evaluate

mathematical ideas that are presented in written, oral, or visual forms; use mathematical vocabulary, notation, and structure to represent ideas, describe relationships, and model situations.

**Standard 7:** The assessment of students' ability to reason mathematically should provide evidence that they can use inductive reasoning to recognize patterns and form conjectures; use proportional and spatial reasoning to solve problems; use deductive reasoning to verify conclusions, judge the validity of arguments, and construct valid arguments; analyze situations to determine common properties and structures.

**Standard 8:** The assessment of students' knowledge and understanding of mathematical concepts should provide evidence that they can label, verbalize, and define concepts; use models, diagrams, and symbols to represent concepts; translate from one mode of representation to another.

**Standard 10:** *The assessment of students' mathematical disposition should seek information about their valuing of the application of mathematics to situations arising in other disciplines and everyday experiences; appreciation of the role of mathematics in our culture and its value as a tool and as a language.*