Standards
Grades K - 5

Overview:

This packet contains an overview of standards used in the sample middle school STEM lesson. Please visit the corresponding websites to view standards in greater detail.

Standard	Website	Page Numbers
Maryland Science Skills and Processes Standards	http://www.mdk12.org/	2 - 7
Common Core Standard for Mathematical Practice	http://www.corestandards.org/the-standards	8 - 11
International Technology Education Association (ITEA) Standard for Technological Literacy (STL)	http://www.iteaconnect.org/TAA/PDFs/ListingofSTLContentStandards.pdf	12 -13
Reading Standards for Literacy in Science and Technical Subjects	http://www.corestandards.org/the-standards	
Writing Standards for Literacy in History/Social Studies, Science and Technical Subjects	http://www.corestandards.org/the-standards	

State Curriculum – Science

Grade 2

Standard 1.0 Skills and Processes: Students will demonstrate the thinking and acting inherent in the practice of science.

A. Constructing Knowledge

1. Raise questions about the world around them and be willing to seek answers to some of them by making careful observations and trying things out.

a. Describe what can be learned about things by just observing those things carefully and adding information by sometimes doing something to the things and noting what happens.

b. Seek information through reading, observation, exploration, and investigations.

c. Use tools such as thermometers, magnifiers, rulers, or balances to extend their senses and gather data.

d. Explain that when a science investigation is done the way it was done before, we expect to get a very similar result.

e. Participate in multiple experiences to verify that science investigations generally work the same way in different places.

f. Suggest things that you could do to find answers to questions raised by observing objects and/or phenomena (events such as, water disappearing from the classroom aquarium or a pet's water bowl).

g. Use whole numbers and simple, everyday fractions in ordering, counting, identifying, measuring, and describing things and experiences.

B. Applying Evidence and Reasoning

1. People are more likely to believe your ideas if you can give good reasons for them.

a. Provide reasons for accepting or rejecting ideas examined.

b. Develop reasonable explanations for observations made, investigations completed, and information gained by sharing ideas and listening to others' ideas.

c. Explain why it is important to make some fresh observations when people give different descriptions of the same thing.

C. Communicating Scientific Information

1. Ask, "How do you know?" in appropriate situations and attempt reasonable answers when others ask them the same question.

a. Describe things as accurately as possible and compare observations with those of others.

b. Describe and compare things in terms of number, shape, texture, size, weight, color, and motion.

c. Draw pictures that correctly portray at least some features of the thing being described and sequence events (seasons, seed growth).

d. Have opportunities to work with a team, share findings with others, and recognize that all team members should reach their own conclusions about what the findings mean.

e. Recognize that everybody can do science and invent things and ideas.

D. Technology

1. Design and make things with simple tools and a variety of materials.

a. Make something out of paper, cardboard, wood, plastic, metal, or existing objects that can actually be used to perform a task.

b. Recognize that tools are used to do things better or more easily and to do some things that could not otherwise be done at all.

c. Assemble, describe, take apart and reassemble constructions using interlocking blocks, erector sets and the like.

d. Recognize that some kinds of materials are better than others for making any particular thing, for example, materials that are better in some ways (such as stronger and cheaper) may be worse in other ways (such as heavier and harder to cut).

e. Explain that sometimes it is not possible to make or do everything that is designed.

2. Practice identifying the parts of things and how one part connects to and affects another.

a. Investigate a variety of objects to identify that most things are made of parts

b. Explain that something may not work if some of its parts are missing.

c. Explain that when parts are put together, they can do things that they couldn't do by themselves.

3. Examine a variety of physical models and describe what they teach about the real things they are meant to resemble.

a. Explain that a model of something is different from the real thing but can be used to learn something about the real thing.

b. Realize that one way to describe something is to say how it is like something else.

E. History of Science

Grade 5

Standard 1.0 Skills and Processes: Students will demonstrate the thinking and acting inherent in the practice of science.

A. Constructing Knowledge

1. Gather and question data from many different forms of scientific investigations which include reviewing appropriate print resources, observing what things are like or what is happening somewhere, collecting specimens for analysis, and doing experiments.

a. Support investigative findings with data found in books, articles, and databases, and identify the sources used and expect others to do the same.

b. Select and use appropriate tools hand lens or microscope (magnifiers), centimeter ruler (length), spring scale (weight), balance (mass), Celsius thermometer (temperature), graduated cylinder (liquid volume), and stopwatch (elapsed time) to augment observations of objects, events, and processes.

c. Explain that comparisons of data might not be fair because some conditions are not kept the same.

d. Recognize that the results of scientific investigations are seldom exactly the same, and when the differences are large, it is important to try to figure out why.

e. Follow directions carefully and keep accurate records of one's work in order to compare data gathered.

f. Identify possible reasons for differences in results from investigations including unexpected differences in the methods used or in the circumstances in which the investigation is carried out, and sometimes just because of uncertainties in observations.

g. Judge whether measurements and computations of quantities are reasonable in a familiar context by comparing them to typical values when measured to the nearest:

- Millimeter - length
- Square centimeter - area
- Milliliter - volume
- Newton - weight
- Gram - mass
- Second - time
- Degree C - temperature

B. Applying Evidence and Reasoning

1. Seek better reasons for believing something than "Everybody knows that..." or "I just know" and discount such reasons when given by others.

a. Develop explanations using knowledge possessed and evidence from observations, reliable print resources, and investigations.

b. Offer reasons for their findings and consider reasons suggested by others.

c. Review different explanations for the same set of observations and make more observations to resolve the differences.

d. Keep a notebook that describes observations made, carefully distinguishes actual observations from ideas and speculations about what was observed, and is understandable weeks or months later.

C. Communicating Scientific Information

1. Recognize that clear communication is an essential part of doing science because it enables scientists to inform others about their work, expose their ideas to criticism by other scientists, and stay informed about scientific discoveries around the world.

a. Make use of and analyze models, such as tables and graphs to summarize and interpret data.

b. Avoid choosing and reporting only the data that show what is expected by the person doing the choosing.

c. Submit work to the critique of others which involves discussing findings, posing questions, and challenging statements to clarify ideas.

d. Construct and share reasonable explanations for questions asked.

e. Recognize that doing science involves many different kinds of work and engages men and women of all ages and backgrounds.

D. Technology

1. DESIGN CONSTRAINTS: Develop designs and analyze the products: "Does it work?" "Could I make it work better?" "Could I have used better materials?"

a. Choose appropriate common materials for making simple mechanical constructions and repairing things.

b. Realize that there is no perfect design and that usually some features have to be sacrificed to get others, for example, designs that are best in one respect (safety or ease of use) may be inferior in other ways (cost or appearance).

c. Identify factors that must be considered in any technological design-cost, safety, environmental impact, and what will happen if the solution fails.

1. DESIGNED SYSTEMS: Investigate a variety of mechanical systems and analyze the relationship among the parts.

a. Realize that in something that consists of many parts, the parts usually influence one another.

b. Explain that something may not work as well (or at all) if a part of it is missing, broken, worn out, mismatched, or misconnected.

1. MAKING MODELS: Examine and modify models and discuss their limitations.

a. Explain that a model is a simplified imitation of something and that a model's value lies in suggesting how the thing modeled works.

b. Investigate and describe that seeing how a model works after changes are made to it may suggest how the real thing would work if the same were done to it.

c. Explain that models, such as geometric figures, number sequences, graphs, diagrams, sketches, number lines, maps, and stories can be used to represent objects, events, and processes in the real world, although such representations can never be exact in every detail.

d. Realize that one way to make sense of something is to think how it is like something more familiar.

E. History of Science

*Note: Highlighting identifies assessment limits. All highlighted Indicators will be tested on the **Grades 5 and 8** MSA. The highlighted Objectives under each highlighted Indicator identify the limit to which MSA items can be written. Although all content standards are tested on MSA, not all Indicators and Objectives are tested. Objectives that are not highlighted will not be tested on MSA, however are an integral part of Instruction.*

MSDE has developed a toolkit for these standards which can be found online at: http://mdk12.org/instruction/curriculum/science/vsc_toolkit.html.

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Standards for Mathematical Practice

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. These practices rest on important "processes and proficiencies" with longstanding importance in mathematics education. The first of these are the NCTM process standards of problem solving, reasoning and proof, communication, representation, and connections. The second are the strands of mathematical proficiency specified in the National Research Council's report *Adding It Up*: adaptive reasoning, strategic competence, conceptual understanding (comprehension of mathematical concepts, operations and relations), procedural fluency (skill in carrying out procedures flexibly, accurately, efficiently and appropriately), and productive disposition (habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy).

1. Make sense of problems and persevere in solving them.
Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, "Does this make sense?" They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

2. Reason abstractly and quantitatively.
Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to *decontextualize*—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to *contextualize*, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.

3. Construct viable arguments and critique the reasoning of others.
Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.

4. Model with mathematics.
Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

5. Use appropriate tools strategically.
Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions

with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.

6. Attend to precision.

Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

7. Look for and make use of structure.

Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Later, students will see 7 × 8 equals the well remembered 7 × 5 + 7 × 3, in preparation for learning about the distributive property. In the expression x2+ 9x + 14, older students can see the 14 as 2 × 7 and the 9 as 2 + 7. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see 5 – 3(x – y)2 as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers x and y.

8. Look for and express regularity in repeated reasoning.

Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts. Upper elementary students might notice when dividing 25 by 11 that they are repeating the same calculations over and over again, and conclude they have a repeating decimal. By paying attention to the calculation of slope as they repeatedly check whether points are on the line through (1, 2) with slope 3, middle school students might abstract the equation $(y - 2)/(x - 1) = 3$. Noticing the regularity in the way terms cancel when expanding $(x - 1)(x + 1)$, $(x - 1)(x2+ x + 1)$, and $(x - 1)(x3+ x2+ x + 1)$ might lead them to the general formula for the sum of a geometric series. As they work to solve a problem, mathematically proficient students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.

Listing of STL Content Standards

The Nature of Technology

Standard 1. Students will develop an understanding of the characteristics and scope of technology.

Standard 2. Students will develop an understanding of the core concepts 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 5. Students will develop an understanding of the effects of technology on the environment.

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 8. Students will develop an understanding of the attributes of design.

Standard 9. Students will develop an understanding of engineering 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 11. Students will develop abilities to apply the design process.

Standard 12. Students will develop abilities to use and maintain technological products and systems.

Standard 13. Students will develop abilities to assess the impact of products and systems.

The Designed World

Standard 14. Students will develop an understanding of and be able to select and use medical technologies.

Standard 15. Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

Standard 16. Students will develop an understanding of and be able to select and use energy and power technologies.

Standard 17. Students will develop an understanding of and be able to select and use information and communication technologies.

Standard 18. Students will develop an understanding of and be able to select and use transportation technologies.

Standard 19. Students will develop an understanding of and be able to select and use manufacturing technologies.

Standard 20. Students will develop an understanding of and be able to select and use construction technologies.