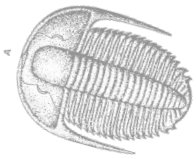
THE LYME SCHOOL
SCIENCE

Inquiry BASED Science PROGRAM

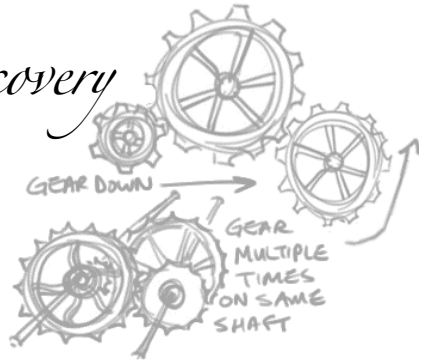


Children are natural scientists because they posses an abundance of its greatest characteristic... *Curiosity*

Inquiry based science begins with engaging students' innate curiosity for the world around them, encouraging them to develop questions and build the skills which allow them to pursue their answers through the process of discovery.

SCIENCE IS GREATER THAN THE ACCUMULATION OF ANSWERS; IT IS THE DESIRE TO PURSUE MORE QUESTIONS.

Curiosity & Discovery



Connections...

LOCAL
LYME SCHOOL'S PRINCIPLES OF LEARNING

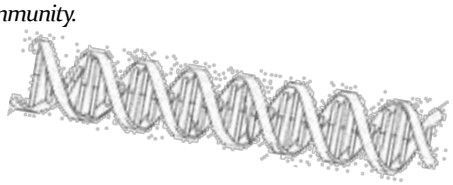
The Lyme School provides an environment rich with opportunities to discover and explore possibilities, that promotes and encourages students to be engaged, dynamic and creative thinkers. To develop students who are...

INFORMED & REFLECTIVE LEARNERS *who can....*
•Acquire a core body of knowledge to prepare for life and further learning. • •Apply knowledge across academic disciplines and outside of the classroom. •Assume a personal investment in the process of learning through curiosity, exploration, and discovery. •Understand what they need as learners and advocate for themselves.

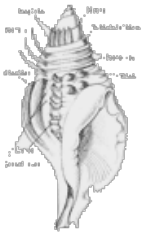
CLEAR & EFFECTIVE COMMUNICATORS *who can....*
•Use written, oral, and visual expression in a variety of settings to convey thoughts, feelings, and perspectives. •Read, listen to, and interpret messages from multiple sources. •Understand, organize, reflect upon, and present information to a specific audience.

CREATIVE PROBLEM SOLVER & ANALYTICAL THINKERS *who can....*
•Use observation, analysis, and creativity to identify problems and formulate practical and / or innovative solutions. •Recognize the role of context, perspective, facts, and opinion in critical thinking. •Understand problem-solving to be a process that involves persistence, logic, and trial and error. •Organize information, make connections, formulate meaning, and reflect upon the process.

INVOLVED & COOPERATIVE COMMUNITY MEMBERS *who can...*
•Recognize that personal and group participation is essential to learning. •Engage in activities that demonstrate the ability to work with others in an ethical and responsible manner. •Accomplish group tasks by listening, contributing, valuing and integrating multiple points of view and skills. •Understand their role in the larger community.



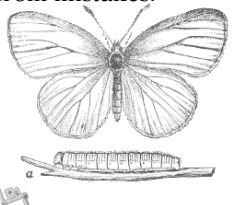
HISTORICAL
DAVINCI'S SEVEN PRINCIPLES



ARTE/SCIENZA - The development of the balance between science and art, logic and imagination. "Whole-brain" thinking.

CURIOSITA - An insatiably curious approach to life and an unrelenting quest for continuous learning.

DIMISTRAZIONE - A commitment to test knowledge through experience, persistence, and a willingness to learn from mistakes.

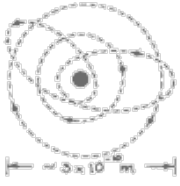


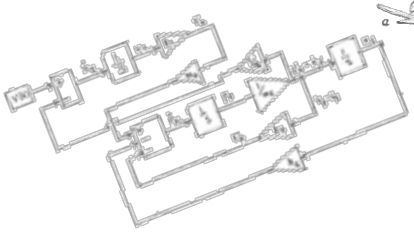
SENSAZIONE - The continual refinement of the senses, especially sight, as the means to enliven experience.

SFUMATO (literally "going up in smoke") - A willingness to embrace ambiguity, paradox, and uncertainty.

CONNESSIONE - A recognition of and appreciation for the interconnectedness of all things and phenomena.

CORPORALITA - The cultivation of grace, ambidexterity, fitness, and poise.





THE LYME SCHOOL'S
CORE SCIENCE STANDARDS

Standards:

Lyme's Core Science Standards derived from SAPA and SCIS science process standards.

Observing:
Using your five sense to gather facts and take notes

Measuring:
Using standard measurements to quantify the amount of change over time, size, mass, speed, etc.

Comparing:
Identifying how things are similar, different, and connected through observation and experimentation

Classifying:
Putting things into groups based on common characteristics

Interpreting:
Investigating relationships and patterns, making sense of your observations, and drawing conclusions

Inferring:
Suggesting a possible explanation based on collected observations

Predicting:
Stating an outcome of a future event based upon a pattern of evidence

Questioning:
Developing questions based upon observations that lead to investigations.

Experimenting:
Planning and designing an experiment in a controlled environment that responds to questions, outlines procedures, identifies variables, and produces reliable data.

Communicating:
Using words, graphics, and drawings to inform others about our ideas and observations

This Document...

Philosophy

Science is as much a way of thinking and experiencing the world as it is an academic discipline. It is everywhere, from helping make dinner to noticing changes in your backyard, the sky above and in the behaviors of everything around us. Science is doing, discovering, getting dirty, and engaging your curiosity. It is learning to be both practical and creative in solving problems as well as learning to enjoy the ambiguity of questions as much as the satisfaction of solutions. Most importantly, science quite often results in having fun.

Goal of this document

Understanding our goals in science (the science process standards) not only lets you know what your children are doing at school, it also allows you to support and practice them at home doing things you enjoy or need to do anyway.

While the content is important, it is presented lightheartedly. For two reasons, reading science standards can be painfully dry, and because science is fun and we should enjoy ourselves while we are doing it. This style does not suggest that science is not important work, just that we can smile while we are doing it, and in terms of this document it might result in more people getting all the way through it!

Reading this document will:

- **Articulate the goals of Elementary Science program**
- **Understand the meaning of the Science Process Standards (the goals).**
- **Provide examples of the Standards so that you can make connections to them at home.**
- **Maybe make you smile** (or at least better understand the odd sense of humor of the author).

THE LYME SCHOOL'S CORE SCIENCE STANDARDS

Standards:

Lyme's Science Standards derived from SAPA and SCIS science process standards.

Connections... HERE & HOME

CORE SCIENCE STANDARD:

OBSERVING: Using your five senses to gather facts and take notes

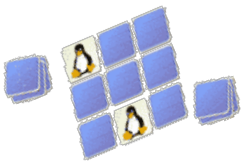
IN PRACTICE...

Using words to describe what it looks like, sounds like, smells like, feels like and tastes like (be careful with this one). Can this object be broken into smaller parts? (be careful with this one too) Can those parts be named or described? (and if broken replaced) Can you draw the parts and label them? (and can you tell me precisely where you left them)

THE RESULT...

Observations should lead to questions, inferences and predictions. "What is that object my little brother is swinging around his head? It looks hard. Sounds as though it may be heavy. I think it is my father's new golf club. I wonder what he intends to do with it? Maybe I should get out of his way. I wonder if I should go get mom? (answer: yes... once again, science maintains family bliss and restores peace and balance to the universe)

BY EXAMPLE...



- During cooking, use senses to observe changes. Smell and taste ingredients.
- Watch birds, squirrels, and ants. Notice what things are the same, what things are different.
- Start collections of flowers, leaves, and seashells. Make drawings. Label parts.
- Collecting leaves: "Do all leaves have veins?" "Do all leaves change color?"
- Experimenting with colors: "What happens to the paint when you add more water?"
- Water play: "Does the toy boat float better when we add more bubble bath to the water?"
- Laundry Day: "Oh my word! What is that smell?" (Why not? Make it a game)
- Identifying bird songs: Which sounds do you hear in the morning? At night? What does that tell us about the behavior of the bird?
- Games like Memory, and Connect Four

CORE SCIENCE STANDARD:

MEASURING:

Using standard measurements to quantify the amount of change over time, size, mass, speed, etc.

IN PRACTICE...

Using increasingly accurate tools to quantify characteristics of events and objects, in order to use in future comparisons and calculations.

THE RESULT...

Science is, in part, a pursuit of accurate answers. Measurement is one of the key skills to discovering accurate answers. The more skilled at making precise measurements, the more effective the individual is as a scientist.

BY EXAMPLE...

- In the kitchen: Measure during cooking, Follow recipes.
- Time: When driving places, estimate distances and check with the odometer. (Are we there yet?!)
- "How long does it take you to get ready for school in the morning?"
- "How long did it take us to drive to school? How far was it?"
- Counting: Count at the grocery store. "We need 3 apricots, help me count, 1, 2, 3...".
- "How many chips are in your bag of potato chips?" ("Chips? I don't have any chips." ... Now you are catching on)
- Practice fractions. "We have one pizza. How many people want to eat pizza? How many pieces do we need? Help me cut and count." (It was a ploy, now there is one less slice)
- Weigh things. "How much do you weigh with your backpack on? With your backpack off? How much do you think your backpack weighs?"
(..and where did you leave it?)
- Use money. "This costs $1.00. How many quarters is that?" "I gave the cashier $1.00. How much should I get back? (I only ask because the cashier was drooling.)

Science Standards:

Core Science Standard:

Comparing:

Identifying how things are similar, different, and connected through observation and experimentation

In practice...

Most often the initial stage of comparison is through observation: seeing how one object or event relates to others and testing and observing ways they are the same and how they differ under similar circumstances.

The result...

The ability to make comparisons about how things are similar and different is a critical skill in being able to organize data (the **Classifying** standard). It also extends our ability to make connections between those things that are familiar and those we do not understand yet, and make connections which may cross disciplines or extend outside the situation we are examining.

By Example...

- "This rock is lighter than this rock"
- "Mr. Valence's hair was a lot less grey when I was in kindergarten."
- "This leaf has veins and this one does not."
- Play board games like "Guess who?" or for younger students Domino's and card games like "Uno" or "War"
- Play "Which one of these is not like the other" from "Sesame Street". (or Mister Rogers or Electric company, I can't remember — either way I am dating myself. There is a song that goes with it too. You can probably Google it.)

Core Science Standard:

Classifying:

Putting things into groups based on common characteristics

In practice...

Classifying is a system of organizing which assists us in seeing patterns and making predictions and generalizations across a class of data. This allows scientists to extrapolate findings and generalize them to other circumstances.

The result...

Comparing and **Classifying** are skills that work hand in hand. They help students simplify their data, to see patterns and relationships, and how groups of differing events or objects are related. Classifying objects is one of the primary skills of human development and is a critical skill of science which requires keen observation and, in sophisticated circumstances, careful and methodical experimentation.

By Example...

- Play "what doesn't belong here" and take turns.

Explain what qualities you look for in classifying. Use quantities too. "Each of these leaves has three lines".

- Sort laundry together.
- Sort silverware together.
- Organize and put away groceries
- Dump out a junk drawer and organize it.
- Organize toys and label containers.
- When grocery shopping ask what aisle would you find eggs in? Apples? Cheese? Etc. Encourage them to investigate the answer independently. i.e. "That is a really good question. Can you think of other things that are similar?"
- Dogs and cats are good for cuddling. Bears, skunks and squirrels, not so much.According to Neuroscientists, the brain is most receptive to learning while at play...So have Fun!

Science Standards:

Core Science Standard:

Interpreting:

Investigating relationships and patterns, making sense of your observations, and drawing conclusions

In practice...

Once you have recorded your observations, gathered your data, compared instances of data and classified them into groups you can begin to investigate patterns and relationships within the data sets. This is the stage when you begin to make sense of the information you have gathered and begin to draw conclusions from what patterns arise through the data you collected.

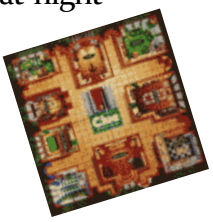
The result...

Interpretation is a crucial skill in order to understand what you observe in your data. It is where reasoning and analysis skills play their largest role in the development of an hypothesis and eventual conclusion.

By Example...

- Keeping a weather journal: Identify the sunniest month, rainiest, cloudiest etc.
- Census: Survey your family's favorite ice cream to determine which flavor is most popular, Count which flavor customers buy in an hour to determine a broader favorite flavor. Visit multiple Ice cream shops to determine the favorite place to get ice cream. (Visit a gym to determine how many miles it takes to burn the calories of the previous experiment.)
- Observe things around you and make "I notice " statements: I notice moths are most active at night around the porch light. I notice that many of the examples in this section involved ice cream (**Inference**: Mr. Valence was hungry when he was writing this)
- Play games like Clue, Othello, Chess, Mastermind





Core Science Standard:

Inferring:

Suggesting a possible explanation based on collected observations.

In practice...

Inferring is the stage of the process when you need to bridge the known with the unknown and propose possible explanations which would be the basis of your experiments.

"Based upon my observation of the size of Brunhilde's eraser (**Observation / Measurement**) versus the size of Rufus' eraser (**Comparison**), I would suggest Rufus makes more mistakes than Brunhilde (**Inferring**). So I will not ask Rufus to be my lab partner. Our lab grade will determine whether I was correct. (**Experimenting**)"

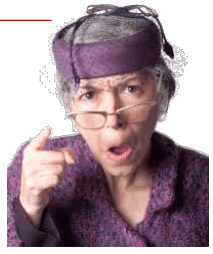
(Turned out Brunhilde ate paste regularly and preferred the company of imaginary friends, and Rufus merely liked the taste of his eraser and got an A on his lab. Sometimes inferences are wrong, like profiling, but I will leave that for civics class).

The result...

Science is about making sense of the unknown. As observations are recorded and interpreted the areas of the unknown begin to reveal themselves. This is the point when we have to take a step into uncertainty and propose what could possibly exist, could be a solution or result. You are assuming certain things based upon how you interpreted your observations and are proposing an explanation. Now you have to prove it through experimentation.

Just so you know...

It does not matter if you are a scientist or any other occupation, you use these skills daily to resolve all kinds of questions. Whether it is to leave in the morning with an umbrella or who you should seat Aunt Agnes next to at Thanksgiving dinner, you use these skills to solve the questions. *(Just please don't sit me next to her)*



Science Standards:

Core Science Standard:

Predicting:

Stating an outcome of a future event based upon a pattern of evidence

In practice...

"I presume this is a rock because it is hard and has crystals and appears like other rocks I have held...

(Observing➜ Comparing➜ Classifying➜ Interpreting)

I presume that is an insect because it has six legs and I have seen other insects which have six legs, it also crawls and seems to be enjoying eating that leaf much like other insects I am familiar with...

(Observing➜ Comparing➜ Classifying➜ Interpreting)

And I predict when I hit the "insect" with the "rock"... *Hey! Gimme that back, there is science going on here!*"

(Predicting➜ Experimenting) (sparing the life of an innocent insect)

The result...

Whether it is foreshadowing in literature, predicting cause and effect in Social Studies, or estimation in Mathematics, predicting is a behavior which is valued, learning how to accurately predict an outcome is a factor of accurate **interpretation** of **observations**. Practicing predicting in the study of science prepares you for nearly every circumstance you may enter in life. Whether it is predicting the outcome of an experiment in a lab or predicting the response of Aunt Bunny when she discovers you used her favorite tea service to mix finger paint.

By Example...

- Any activities that utilize or emphasize cause and effect, probability or patterning will allow students to use observation skills to develop their minds to evaluate the patterns which form and develop a prediction.
- Games such as Mastermind provide repeated opportunities to test predictions and refine the process which students develop their predictions.

Core Science Standard:

Communicating:

Using words, graphics, and drawings to inform others about our ideas and observations

In practice...

"After carefully reading this brochure, I conclude: 1) These skills are applicable to all kinds of situations 2) We can practice any of them at home 3) We are practicing them without even knowing it and 4) Those currently reading this are the best and most caring best parents ever (but shhhh don't tell anyone else.)

The result...

Ultimately, World peace. But we will take a well documented and reasoned explanation of the information and process.

By Example...

It is likely you try every day.

Just so you know...

One sheet of paper produces 1.163 milliwatt hours, or 0.00396832 British thermal units (BTUs) of energy. So don't bother burning this document, it does not even light a lightbulb. It does make good night time reading, however.

Science Standards:

Core Science Standard:

Experimenting:

Planning and designing an experiment in a controlled environment that responds to questions; outlines procedures; identifies variables, and produces reliable data.

In practice...

Experimentation is likely the final stage of Interpretation, Inference and Prediction. Experimentation is where these three sources of ideas or hypothesis are tested in a controlled environment.

The result...

Likely more questions and a conclusion to whether the ideas derived from Inferring, Interpreting and Predicting were accurate.

By Example...

• Give them sand and water, oil and water or blocks just about anything and let them play. Children are naturally inclined to experiment. Resist the desire to direct them or give directions and they will likely experiment.

According to Neuroscientists, the brain is most receptive to learning while at play...

So have Fun!