Grades K-12 Science Tutorials

Northfield Public Schools 8/31/2011

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Northfield Public Schools

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Building Blocks for K-12 Science Teachers

Northfield Public Schools

MISSION: Why we exist

It is the mission of the K-12 Science Department to foster life-long learning of science and engineering principles and equip our students to succeed in a highly-competitive global environment.

VISION: What we hope to become

We envision a K-12 Science Department in which teachers:

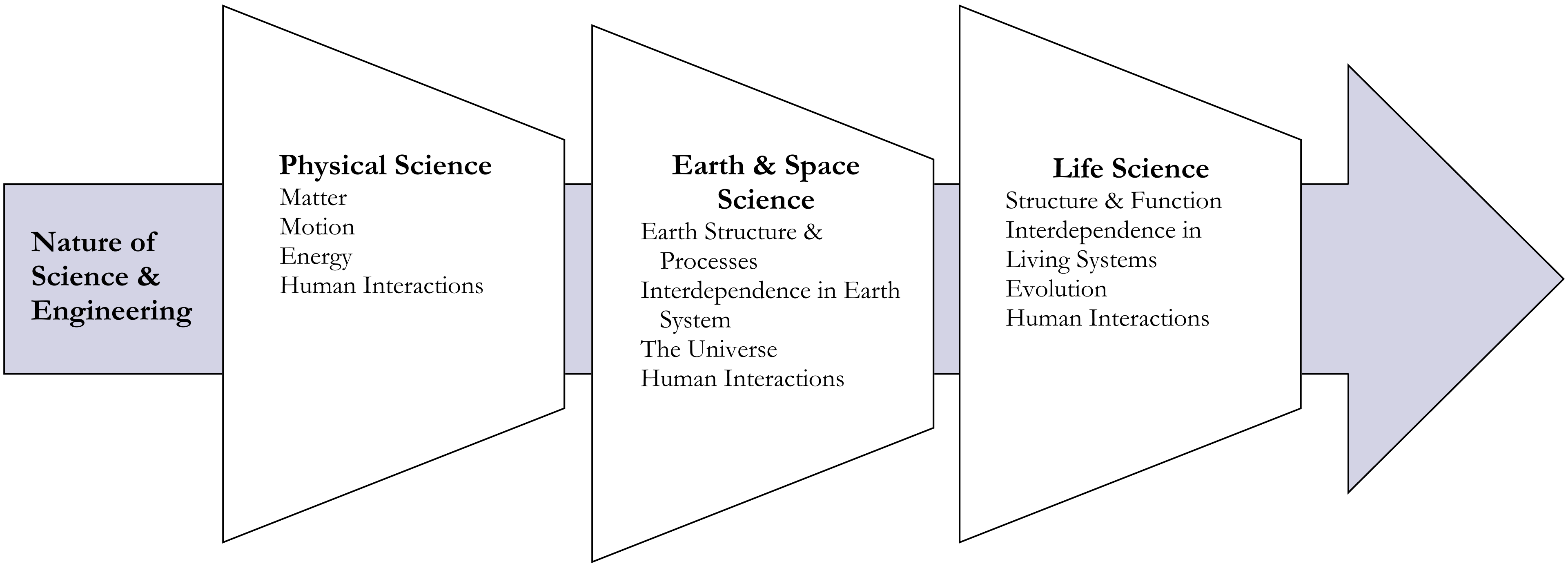
- Are well-versed in the standards and benchmarks assigned to their course/grade level.
- Work collaboratively and support each other.
- Deliver a guaranteed and viable curriculum in each course/grade level that provides all students with access to the same knowledge and skills regardless of the teacher to whom they are assigned.
- Stimulate creative problem solving and logical thinking.
- Inspire passion for scientific thinking.
- Monitor the learning of each student on a timely basis.

COLLECTIVE COMMITMENTS: How we will behave to achieve our vision

To achieve our vision, we will:

- Commit to teaching the standards and benchmarks assigned to our courses/grade levels.
- Work in PLC teams and grade level teams to learn and plan together.
- Identify and implement essential learnings, pacing schedules, formative and summative assessments, and standards of proficiency.
- Identify and implement best practice strategies.
- Deliver engaging, hands-on, inquiry-based instruction.
- Utilize real-life applications to teach science and engineering concepts.
- Accept various and differing viewpoints.
- Model safe and ethical practice.
- Use formative assessments to promptly identify student needs and make instructional changes accordingly.

MINNESOTA SCIENCE STANDARDS
Implemented 2011-2012



Adapted From Minnesota Department of Education

SCIENCE MCA-III TEST QUESTION DESIGN FOR GRADES 3-5

Test Design

The following table provides the approximate number of points by strand on the operational test for each grade. Multiple-choice (MC) items are each worth 1 point, while other item types are worth 1-3 points. Approximately 40-60 percent of the test will be comprised of multiple-choice items, and other item types will make up the remainder of the test.

Grade 5 Science MCA-III (Operational Form)

Strand	Approximate Number of Points	Approximate Percent of Points
Nature of Science and Engineering (NSE)	11-13	28
Physical Science (PS)	9-11	24
Earth and Space Science (ESS)	9-11	24
Life Science (LS)	9-11	24
Total	41	100

Grades 3-5 Points by Substrand

1. **Nature of Science and Engineering (11-13)**
    1. The Practice of Science (4-7)
    2. The Practice of Engineering (2-4)
    3. Interactions Among Science, Technology, Engineering, Mathematics and Society (3-6)
2. **Physical Science (9-11)**
    1. Matter (3-5)
    2. Motion (1-3)
    3. Energy (4-6)
3. **Earth and Space Science (9-11)**
    1. Earth Structure and Processes (2-4)
    2. Interdependence within the Earth System (2-4)
    3. The Universe (1-3)
    4. Human Interactions with Earth Systems (2-4)
4. **Life Science (9-11)**
    1. Structure and Functions in Living Systems (2-4)
    2. Interdependence Among Living Systems (2-4)
    3. Evolution in Living Systems (1-3)
    4. Human Interactions with Living Systems (2-4)

SCIENCE MCA-III TEST QUESTION DESIGN FOR GRADES 6-8

Test Design

The following table provides the approximate number of points by strand on the operational test for each grade. Multiple-choice (MC) items are each worth 1 point, while other item types are worth 1-3 points. Approximately 40-60 percent of the test will be comprised of multiple-choice items, and other item types will make up the remainder of the test.

Grade 8 Science MCA-III (Operational Form)

Strand	Approximate Number of Points	Approximate Percent of Points
Nature of Science and Engineering (NSE)	13-15	28
Physical Science (PS)	11-13	24
Earth and Space Science (ESS)	11-13	24
Life Science (LS)	11-13	24
Total	51	100

Grades 6-8 Points by Substrand

1. **Nature of Science and Engineering (13-15)**
    1. The Practice of Science (4-6)
    2. The Practice of Engineering (3-5)
    3. Interactions Among Science, Technology, Engineering, Mathematics and Society (5-7)
2. **Physical Science (11-13)**
    1. Matter (5-7)
    2. Motion (3-5)
    3. Energy (3-5)
3. **Earth and Space Science (11-13)**
    1. Earth Structure and Processes (5-7)
    2. Interdependence within the Earth System (3-5)
    3. The Universe (2-4)
    4. Human Interactions with Earth Systems (1-3)
4. **Life Science (11-13)**
    1. Structure and Functions in Living Systems (4-6)
    2. Interdependence Among Living Systems (3-5)
    3. Evolution in Living Systems (3-5)
    4. Human Interactions with Living Systems (1-3)

SCIENCE MCA-III TEST QUESTION DESIGN FOR GRADES 9-12

Test Design

The following table provides the approximate number of points by strand on the operational test for each grade. Multiple-choice (MC) items are each worth 1 point, while other item types are worth 1-3 points. Approximately 40-60 percent of the test will be comprised of multiple-choice items, and other item types will make up the remainder of the test.

Grades 9-12 Science MCA-III (Operational Form)

Strand	Approximate Number of Points	Approximate Percent of Points
Nature of Science and Engineering (NSE)	24-28	38
Life Science (LS)	40-44	62
Total	68	100

Grades 9-12 Points by Substrand

1. **Nature of Science and Engineering (24-28)**
    1. The Practice of Science (8-10)
    2. The Practice of Engineering (8-10)
    3. Interactions Among Science, Technology, Engineering, Mathematics and Society (8-10)
4. **Life Science (40-44)**
    1. Structure and Functions in Living Systems (9-11)
    2. Interdependence Among Living Systems (8-10)
    3. Evolution in Living Systems (11-13)
    4. Human Interactions with Living Systems (8-10)

WHAT IS THE DIFFERENCE BETWEEN SCIENCE AND ENGINEERING?

Scientists *investigate what is; they discover new knowledge by peering into the unknown …*

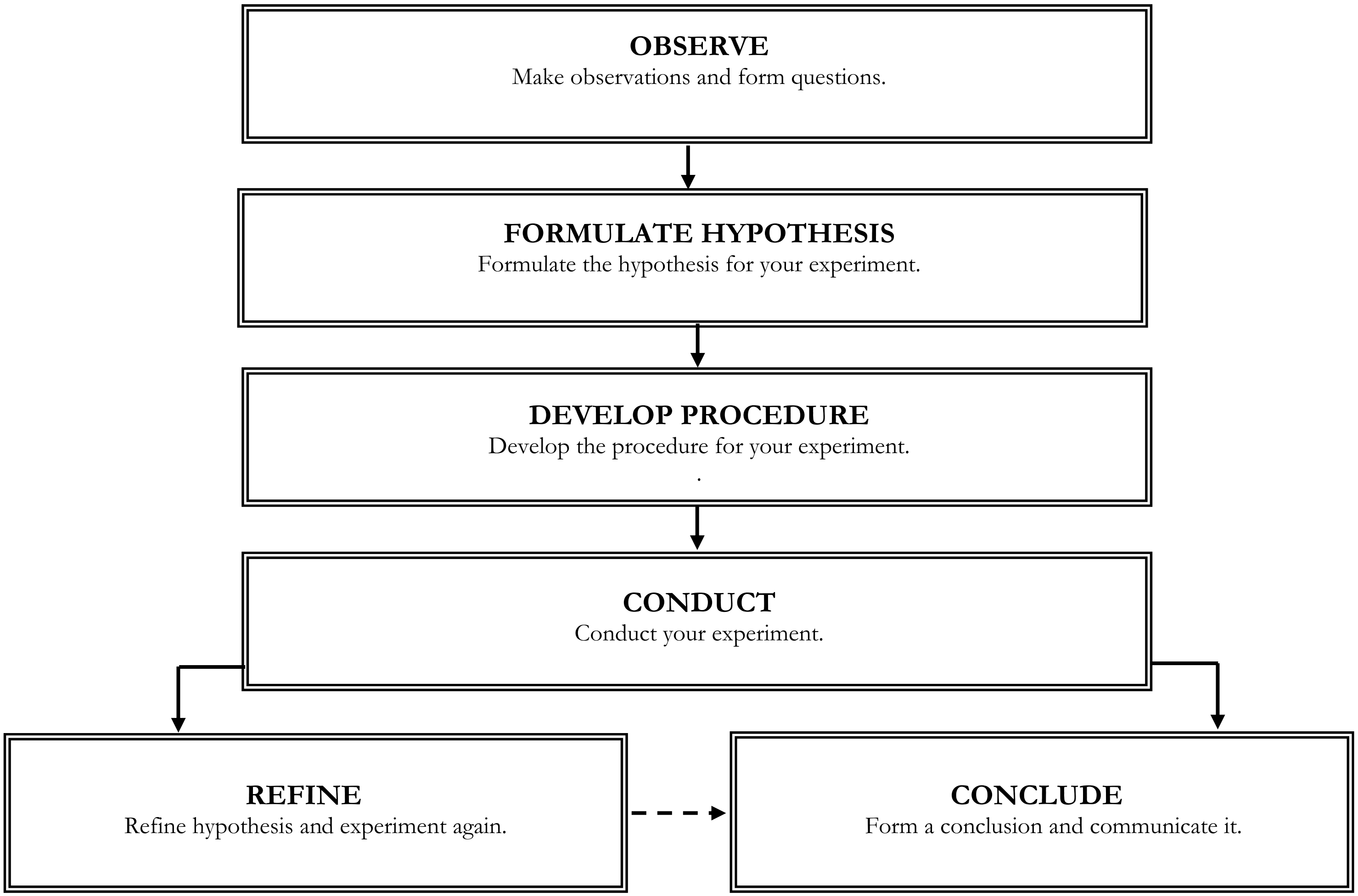
Engineers *create what has not been; they make things that have never existed before …*

Joe Bordogna, National Science Foundation

	SCIENTIFIC INQUIRY	ENGINEERING DESIGN
PROCESS	• Make observations and form questions. • Formulate the hypothesis for your experiment. • Develop the procedure for your experiment. • Conduct your experiment. • Refine hypothesis and experiment again. • Form a conclusion and communicate it.	• Identify and define the challenge to be solved. • Explore what others have done and what materials are available. • Develop a variety of solutions/designs, and then choose one. • Create your solution/design. • Test your solution/design. • Evaluate your solution/design, modify it, and test it again. • Use or market your final solution/design.
RESULTS	• Facts • Theories	• Products • Processes
GOALS	• Gain information and knowledge. • Understand and explain the natural world.	• Provide a solution to a challenge or problem. • Get someone to use or buy your solution.

The Scientific Inquiry Process

YOU ARE A SCIENTIST.



The Engineering Process

YOU ARE AN ENGINEER.

IDENTIFY THE CHALLENGE
Identify and define the challenge to be solved, including limits and constraints.

EXPLORE
Explore what others have done and what materials are available.

DESIGN
Use your knowledge and creativity to develop a variety of solutions/designs.
Choose one idea and draw or make a model of it.

CREATE
Create your solution/design.

TEST - TRY IT OUT
Test your solution/design.

MODIFY - MAKE IT BETTER
Evaluate how the solution/design worked and think of how you can improve it. Modify the design and test it again.

USE OR MARKET DESIGN
Use or market your final solution/design.

THE DEEP DIVE
Guidelines for Group Innovation

Have one conversation at a time.

Stay focused on the topic.

Encourage wild ideas.

Defer judgment.

Build on the ideas of others.

From IDEO, an innovation and design firm

BACKWARD DESIGN PROCESS

Identify the desired results.

- What should students know, understand, and be able to do?
- What are the essential learnings that all students must master?

Determine acceptable evidence.

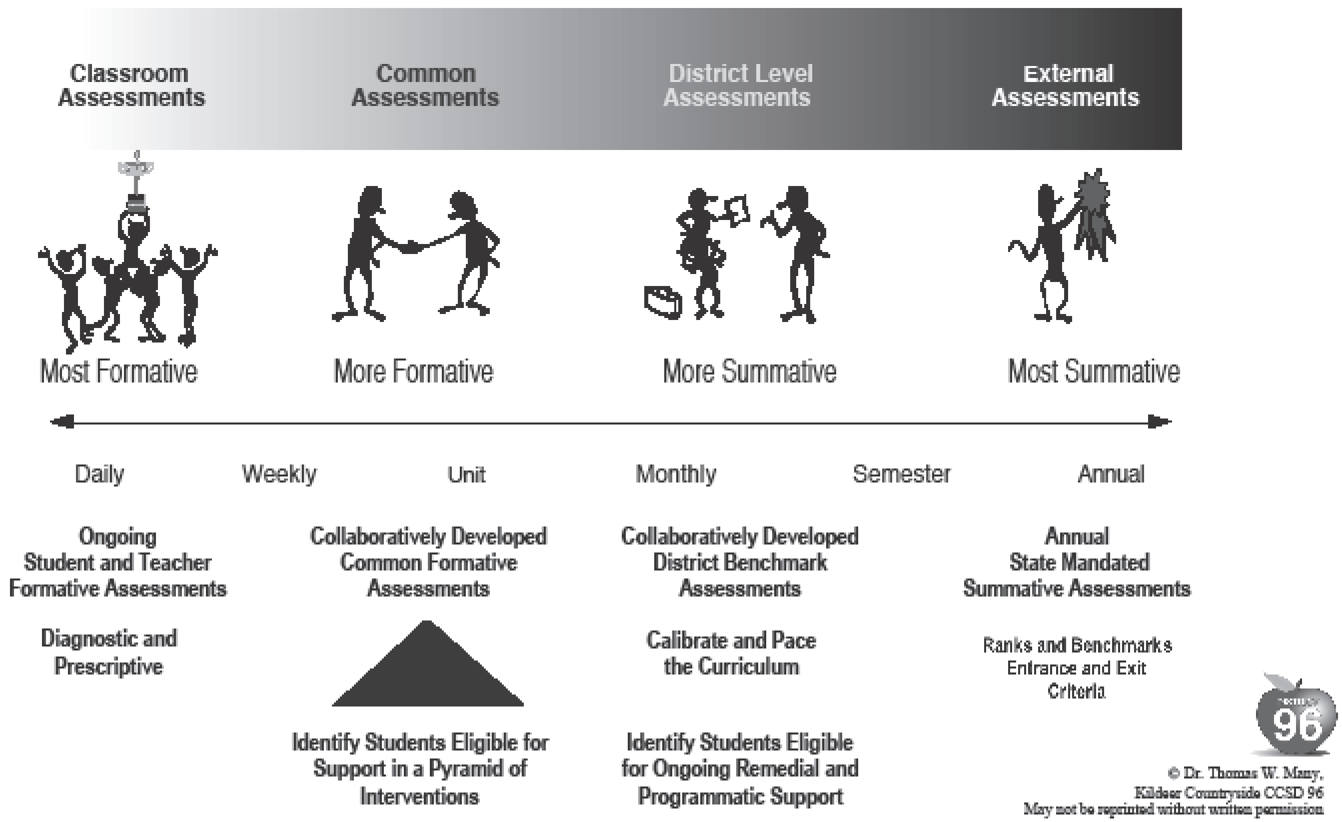
- How will we know if students have achieved the desired results and met the standards?
- What will we accept as evidence of student understanding and proficiency?
- How will students *show* us what they *know*?
- What variety of formative and summative assessments will we use to measure student learning?

Plan your instruction.

- What knowledge and skills will students need to achieve desired results?
- What activities will equip students with the needed knowledge and skills?
- What will need to be taught and coached, and how should it best be taught?
- What materials and resources are best suited to accomplish these goals?

Adapted from *Understanding by Design* by Grant Wiggins and Jay McTighe

A Balanced and Coherent System of Assessment



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	**Classroom Assessments**	**Common Assessments**	**District Level Assessments**	**External Assessments**
Locus of Control	Classroom	School	District	State and National
Summative/Formative	Most Formative	More Formative	More Summative	Most Summative
Frequency	Daily (frequent, ongoing)	Quarterly (at minimum)	Periodic (pre and post)	Annual (or longer)
Description of Data	Individualizes Student Data	Standards Based Data	Benchmark Data	Autopsy Data
Highlights	Mastery of strategies and skills	Levels of Proficiency	Groups of At-risk students	Programmatic Strengths and Weaknesses
Products	Descriptive Feedback	Diagnostic Feedback	Entrance and Exit Criteria	Rank order
Outcome	Reteaching and regrouping	Systematic Interventions	Program Support	Accountability

OPTIMAL LEARNING MODEL ACROSS THE CURRICULUM

Below is a teaching and learning model that can serve as a reminder of how to plan lessons and units
that will move students from dependent learners to independent learners.

DEPENDENT LEARNER → **INDEPENDENT LEARNER**

To Learners	***With Learners***			***By Learners***
Demonstration	**Shared Demonstration**	**Hand Over of Responsibility**	**Guided Practice**	**Independent Practice**
TEACHER	***TEACHER***		***STUDENT***	***STUDENT***
• Initiates • Models • Explains • Thinks aloud • Shows how to “do it”	• Demonstrates • Leads • Negotiates • Suggests • Supports • Explains • Responds • Acknowledges		• Applies learning • Takes charge • Practices • Problem solves • Approximates • Self-corrects	• Initiates • Self-monitors • Self-directs • Applies learning • Problem solves • Confirms • Self-evaluates
STUDENT	***STUDENT***		***TEACHER***	***TEACHER***
• Listens • Observes • May participate on a limited basis	• Listens • Interacts • Collaborates • Responds • Approximates • Participates as best he can		• Scaffolds • Validates • Teaches as necessary • Evaluates • Observes • Encourages • Clarifies	• Affirms • Assists as needed • Responds • Acknowledges • Evaluates • Sets goals

Adapted from “Reading Essentials” by Regie Routman (Heinemann: Portsmouth, NH); @2003