Noblesville Schools
Science Program Review

Report to the Board of School Trustees

21 June 2016

Contents

Science Program Review Committee Members

Hana Baker, parent
Ryan Bruick, science teacher, Noblesville High School
Melissa Chandler, instructional coach, White River Elementary School
Emily Crapnell, seventh grade science teacher, Noblesville West Middle School
Alison Cole, eighth grade science teacher, Noblesville East Middle School
Shelley Coover, instructional coach, Noblesville East Middle School
Jessica DuBois, parent
Erin Freestone, second grade teacher, White River Elementary School
Mona Gupta, parent
Molly Haas, fifth grade teacher, Promise Road Elementary School
Forrest Hurst, science teacher, Noblesville High School
Heidi Karst, principal, Stony Creek Elementary School
Melissa Kikta, science teacher, Noblesville High School
McKenzie Leckrone, third grade teacher, Noble Crossing Elementary School
Addie Matteson, media specialist, White River Elementary School
Cathy McCain-Kring, parent
Julie Meyer, seventh grade science teacher, Noblesville West Middle School
Tanya Mueller, seventh grade science teacher, Noblesville East Middle School
Rachel Neese, resource teacher, Noble Crossing Elementary School
Sierra Norman, kindergarten teacher, North Elementary School
Penny Patterson, media specialist, Hinkle Creek Elementary School
Annetta Petty, executive director of learning, Educational Services Center
Gretchen Prohm, fourth grade teacher, Stony Creek Elementary School
Adam Seyfried, third grade teacher, Hazel Dell Elementary School
Stephanie Spear, first grade teacher, Hinkle Creek Elementary School
Kevin Stuckwisch, assistant principal, Noblesville High School
Stacey Swan, principal, Noblesville West Middle School

Science Program Review Activities

September – October 2015	Form committee
November 2015	Discuss why science learning and teaching are important Define purposes and planned outcomes of the Science Program Review Review Noblesville Schools student achievement data in science Read current research in science education
January 2016	Report key information from research on science learning and teaching
February	Identify focus areas for classroom visits 24 committee members visit 85 classrooms throughout all ten Noblesville Schools to observe science learning and teaching Report key information from classroom visits, focusing on science content and skills, instructional strategies, and instructional resources (time, environment, resources)
March	Write survey questions for students, parents, and teachers Conduct surveys
April	Analyze survey responses and report key results Compile evidence gained from research (student achievement, research, observations, surveys) Compose recommendations
May	Draft, edit, finalize committee report Prepare presentation to Board of School Trustees

Organization of Study Groups, Subgroups

Committee members met in various subgroups according to their interests and expertise. Research groups formed according to the books they selected; classroom visits paired members from different grade levels; survey groups reflected members' preferred target audience; and report writing groups addressed their interests in the areas of science content and skills, instructional strategies, or instructional resources.

Bibliography of Reviewed Research

Gilbert, S. W. (2011). *Models-based science teaching*. Arlington, VA: NSTA.

Konicek-Moran, R., & Keeley, P. (2015). *Teaching for conceptual understanding in science*. Arlington, VA: NSTA.

Marshall, J. C. (2013) *Succeeding with inquiry in science and math classrooms*. Arlington, VA: ASCD.

Pahomov, L. (2014). *Authentic learning in the digital age: Engaging students through inquiry*. Arlington, VA: ASCD.

Pratt, H. (2013). *The NSTA reader's guide to the Next Generation Science Standards*. Arlington, VA: NSTA.

Rhoton, J. (2006). *Teaching science in the 21st century*. Arlington, VA: NSTA.

Vasquez, J.A. (2007). *Tools and traits for highly effective science teaching, K – 8*. Portsmouth, NH: Heinemann.

Evidence from Program Area Subgroups

Content and Skills

Surveys
Students
• Students learn science mostly (>50%) in a passive manner. Active learning, including making, interacting, and teaching others about science, was reported as making up less than 50% of instruction.
• 66% of students want to watch videos, while 61.1% want to interact.
• Learning science needs to be more interactive.
• Students need more time to explore science and communicate their ideas.
• Science learning needs to be as authentic as possible.
Teachers
• Primary: Teachers believe science is not a priority at the primary level, and most of all they need time to develop science curriculum.
• Secondary: Teachers want PD about standards-based grading and vertical PLC time (to look at alignment across grade levels).
Parents
• More hands-on and real-world learning needs to take place in science education.
• Problem solving and questioning were the highest valued skills; risk taking was valued the least.

Book Study
• Five components to look for in a science program include inquiry, research, collaboration, presentation, and reflection.
• Important structures for science education include inquiry, NGSS, Understanding by Design curriculum planning, student-centered learning, and appropriate assessments.
• Next Generation Science Standards (NGSS) define student outcomes; they are not a curriculum or a checklist; they are more rigorous than Indiana Academic Standards; they continue themes throughout K - 12, provide context and sequencing, and recommend assessment boundaries in each content area.
• Inquiry is a process, not a product; students should be less focused on answers and more on processes and causes; teacher questions should be about processes; application to other situations is important.
• Important student skills and knowledge include patterns, cause and effect, modeling, mechanism and explanation of how something works, scale, proportion, quantity, metaphors and analogies, systems, cycles, structure and function, stability and change.
• Important components of science learning include a spiral curriculum, building on understanding of concepts, and incorporating creative thought: imagining, brainstorming, and creating are part of science thinking.
• Science instruction should focus on overarching ideas and building thinking rather than on details.

Classroom Observations

• Observations sometimes showed students reading about science rather than "doing science."
• The depth of content was inconsistent within the same grade levels.
• Science activities in the middle schools seem characterized by "covering standards."
• Students were often more focused on process than on content.
• Students lack strong science vocabulary.
• Essential questions were posted in rooms for math and reading, but science and social studies are grouped together, and their importance seems diminished.
• Vertical articulation/alignment is needed to avoid repetition and gaps.

Instructional Strategies

Surveys

Students

• Small groups or individual, self-paced learning is preferred over whole-group discussions, lectures, and teacher-centered lessons.
• The best science experiences are labs/experiments, hands-on activities, projects, and group work. The worst science experiences include lectures, taking notes, reading, and completing worksheets.
• Science should be fun.

Teachers

• Teachers report that students listen to the teacher talk about science more frequently than is ideal.
• 100% of teachers believe that ideal science instruction should be experiment-based in a moderate to considerable amount.
• Of elementary teachers, 53.3% feel the need for professional development in science.
• 85% of elementary teachers are comfortable teaching science.
• Six secondary teachers do not feel comfortable teaching science. (These teachers may have general elementary licenses and are teaching exclusively sixth-grade science.)

Parents

• Problem solving and questioning are the highest-valued skills; risk taking is the lowest.
• More time needs to be devoted to science.
• More hands-on and real-world learning needs to take place in science education.
• 65.5% of parents feel that NS provides an adequate environment for science learning.

Book Study

• Five components that we should look for in a science program include inquiry, research, collaboration, presentation, and reflection.

Inquiry: essential questions to hook and hold student; voice and choice are important in each element
Research: personal, relevant, motivating; voice and choice!
Collaboration: all parties have a stake in designing and implementing the project; successful collaboration is documented, asynchronous, and classroom based.
Presentation: various modes (written, visual); present beyond school walls (online, contests and competitions, real-world professionals as authentic audiences); presentations and peer/adult feedback should be provided before students revise and edit, *then* teachers may grade
Reflection: identify mistakes and their causes; emphasize feedback over grades

- Create scenarios in which students work as true scientists.
- Cause student to use their senses, the "window to the brain."
- Science is not just the scientific method anymore; it's a process of engaging students through investigation.
- Students need to own their learning.
- Assessment should be *for* learning (teaching students how to think and continue thinking beyond the lesson) vs. assessment *of* learning (memorization for a particular assessment).
- Important elements of effective instruction include a common language, classroom doors open to visitors, outside partnerships, Teacher-Student Advisory, and effective first days (delay administrative work to allow opportunities for team-building activities).

Classroom Observations

- More teacher talk than student talk was observed.
- Choice and voice could improve engagement, as well as the quality of products, at all levels.
- Administrators were very encouraging of an inquiry approach, but teachers need professional development.
- Differentiation was lacking.

Instructional Resources (Time, Space, Materials)

Surveys

Students

- Students feel teachers encourage them to explore science: 60.5% of students answered they agree or strongly agree with this statement.

Teachers

- 50.7% of K - 5 teachers reported that access to materials was somewhat of an issue when teaching science, and an additional 26.7% considered access to materials as a major issue.
- 65.3% of K - 5 teachers see not having time to teach science is a major obstacle; the other 34.7% see it as a moderate obstacle.
- 40% of K - 5 teachers see the lack of time to collaborate and plan for science as a major obstacle.
- At the secondary level, 24 of 30 teachers noted they need time to plan for science. 17 teachers noted they need time to plan collaboratively, and some indicated that they would like to model lessons for one another. Many teachers stated that they work with great mentors and teachers, but feel the need for more time to use the team resources they have.

Parents

- Hands-on and real-world learning needs to take place in science education.

Book Studies

- Inquiry promotes hands-on learning/experiences, and although no *specific* materials are required, materials are needed in order to use the approach.

Classroom Observations

• Many classroom observations, especially at the elementary level, revealed insufficient time for science learning.
• In some classrooms, student questions were deflected because “not enough time” was available to answer questions.
• Depending on the school or classroom, inconsistent space is available for science learning and teaching.
• Some teachers reported a lack of supplies for science, noting that they bought supplies themselves or relied heavily on donations from parents.

Recommendations from Program Area Subgroups

Content and Skills

Align science process standards (or practices) and common language K-12.

Review vertical alignment of cross-cutting concepts K-12.

Consider developing science standards and alignment unique to Noblesville Schools.

Focus on integrating content within the scientific process across grade levels with an inquiry-based approach.

Adopt and integrate Next Generation Science and Engineering Practices K-12.

Analyze Indiana Academic Standards for Science, compare them with Next General Science Standards, and incorporate the best features of both in revisions of curricula and selection of instructional materials.

Instructional Strategies

Focus on the process of science inquiry with content embedded in science processes.

Teach science in a hands-on, project-based environment.

Reflect authentic science in science instruction: collaboration and reliance on team-oriented problem solving.

Plan units of study to promote student transfer of learning, including all four types of learning goals: knowledge, skills, meaning, and transfer.

Include practical application of scientific processes, learned skills, and content in science assessments.

Provide professional development that specifically targets inquiry and project-based instruction in science.

Instructional Resources

Reallocate the minutes per subject in the elementary day to increase time for teaching science.

Take advantage of the skills used in teaching science that overlap with literacy skills such as predicting, higher level thinking, etc.

Give teachers the flexibility to departmentalize at the elementary level, so they may go more in depth with science and other subject areas.

Provide time for teachers to collaboratively plan.

Develop funding for supplies to support science instruction, especially in K - 5.

Appendix: Key Points from Survey Responses

Students

K-5

- Students use books, iPads, videos and workbooks for learning.
- 60.5% of students agree or strongly agree that teachers do not encourage them to explore science.
- Students mostly learn science in a passive manner (over 50%). Making, interacting, and teaching others about science is low (less than 50%).
- 73.7% of students agree or strongly agree that they enjoy science.
- Students use different modalities to learn.
- Students want to watch science videos (66.3%) and interact (61.1%) while learning science.
- Students learn a variety of subtopics in science.
- The identified aspects of science topics should be addressed in appropriate grade levels.
- Learning science needs to be more interactive.
- Students need more time to explore science and communicate their ideas.
- Science learning needs to be as authentic as possible.

6-12

Students agree on the following:

- They learn what they want (72%).
- Science is taught in a variety of ways (79%).
- Tests and quizzes are fair (80%).
- Technology is helpful (73%).
- Resources are available (90%).
- Content is useful (73%).
- Content is clear (74%).

In addition, students

- prefer to learn in small groups, individually, or self paced.
- do not prefer whole group discussions, lectures, or teacher-centered instruction.
- like labs and experiments, hands-on activities, projects, and group work.
- dislike lectures and note-taking, reading about science, or completing worksheets.
- want science to be fun.

Parents

- 92.3% believe that NS values science.
- 27% believe that the current science curriculum does not meet their expectations.
- Problem solving and questioning are the highest valued skills; risk taking is the lowest.

- More time needs to be devoted to science.
- More hands-on and real-world learning needs to take place in science education.
- 65.5% of parents feel that NS provides an adequate environment for science learning.
- Parents would like to have more communication about what is going on in science at the elementary level.

Teachers

Elementary

- Teachers report that students are learning from listening to the teacher talk about science more frequently than is ideal.
- Students are reading from textbooks less frequently than ideal.
- Students are working individually on assignments less frequently than ideal.
- Ideally, teachers would not want students to write a report or paper about science (possible misinterpretation of question?).
- 100% of teachers believe science instruction should be moderately or considerably experiment-based.
- 65.3% of teachers see not having time to teach science as a major obstacle; the other 34.7% see it as a moderate obstacle.
- The second biggest obstacle is a lack of time to collaborate and plan for science; 40% of teachers see this as a major obstacle.
- 50.7% report that physical space is not an issue at the primary level.
- 50.7% report that access to materials is somewhat of an issue when teaching science, and an additional 26.7% consider access to materials as a major issue.
- 53.3% need professional development in science instruction.
- 85% of teachers feel comfortable teaching science.
- Teachers believe science is not a priority at the primary level, and most of all they need time to develop science curriculum.

Secondary

- Teachers desire PD about standards-based grading and vertical PLC time to look at the alignment across grade levels.
- Teachers desire collaboration time, time for planning, and lab materials.
- Sixth grade would benefit from lab classrooms.
- Most teachers want to do labs and have students read about science, but in reality most lessons are lectures and individual science assignments.
- Teachers desire time to model activities for each other.
- Many teachers say they have great mentors and teachers they work with but need more time to use the team resources they have.
- Teachers want to be more involved in local, state and national organizations in order to know “what’s out there.”

- Interest exists in allocating time during the summer or school year for teachers to collaboratively plan.
- Interest also exists in allowing teachers from one grade level from different schools to develop extended lesson plans together.
- Six secondary teachers do not feel comfortable teaching science. (These teachers may have general elementary licenses and are teaching exclusively sixth-grade science.)