Supplementary Material for Manuscript:
"Improvement in Student Science Proficiency Through InSciEd Out"

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InSciEd Out **Overview**

InSciEd Out (*Integrated Science Education Outreach)* is a collaborative partnership committed to rebuilding K - 12 science education curricula for the 21st century. The organization began in the spring of 2009 and presently represents a tripartite partnership between the Mayo Clinic (life science expertise), Winona State University (teacher education expertise), and Rochester Public Schools (teaching excellence). Recognizing a need to engage with lagging K - 12 science proficiency scores (46%) *and* a shortage of beginning teachers prepared to teach science in elementary or middle level classrooms, *InSciEd Out* represents a new partnership paradigm through which curriculum change is empowered by intellectual and technical resources rooted in partnerships of strengths.

InSciEd Out provides opportunities for in-service and pre-service teachers to grow themselves as scientists and science teachers, inviting multidisciplinary ***teams*** of teachers from a common school into Mayo Clinic's Zebrafish Core Facility for a duration of three weeks. While at the lab, participants learn more about genetics, development and the nature of science. Later, such knowledge is utilized to create constructivist curriculum modules for students in grades K – 8. The partnership begins as an internship and continues on in the form of continued mentorship, collaboration, outreach and support.

InSciEd Out differs from other professional development programs in that teachers themselves create new curriculum targeted specifically for problem areas identified by standardized testing programs. To that end, the internship opportunity embeds teachers in the culture of authentic science and provides them with cutting edge tools to utilize in their classroom. Each new curriculum module challenges students (and their teachers) to extend the knowledge of the teaching unit both at and away from the laboratory. These broad scientific literacy efforts aim to engage students, parents and staff in *being* and *becoming* authentic members of the scientific community.

Summer Internships At-A-Glance

Zebrafish internships are three weeks in length and take place in June (after the RPS school year wraps up), July (post-4th of July) or August (before RPS school year begins). *InSciEd* out is mindful of data that indicates educational initiatives are better supported by ***teams of teachers*** than individual teachers. As such, when selecting schools to join the program we give preference to sites that are prepared to bring entire grade level teams into the lab.

Overview of Internship

Week One = Nature of Science/Genetics/Development/The Role of Dialogue

Week Two = My Science (Teacher-led extension projects)

Week Three = Curriculum Module Development

Attendance = Monday – Friday (8:00 a.m. – 5:00 p.m.; 1 hour lunch break)

Academic Year-At-A-Glance

Curriculum modules are implemented during the academic year following a summer externship. Modules vary in length; some run for ten days, others can be as long as a month. Modules do not replace the Rochester Public Schools' science curriculum in its entirety. Instead, they might supplement or replace a particular thematic unit. For example, at the first grade level a module developed by teachers at Lincoln K – 8 Choice School titled "A Good Environment" has addressed what is identified as "Collecting and Examining Life" on the Grade 1 science curriculum map. Each module explicitly sets forth the Minnesota Science Standards addressed within. InSciEd Out also promotes the idea of horizontal integration. As such, modules clearly identify the mathematics, language arts, social studies, art, music, or physical education benchmarks addressed as well. (See example attached.) Finally, modules embed an element referred to as *difficult dialogue.* Difficult dialogue is included in modules to help uncover the diversity of feelings, beliefs, attitudes, and different meanings that are a part of the prior knowledge that students bring to any learning experience. This is especially true in any discussion that touches upon the nature of science and scientific experimentation with animals.

Scientists from Mayo Clinic, pre-service teachers from Winona State University, and the InSciEd Out community help to support implementation of modules in the classroom. Necessary materials are generally available through *InSciEd Out,* WSU's STEM Village, and/or the Science House (St. Paul, MN).

Ongoing Partnership

The internships represent the beginning of an active and sustained partnership between Mayo Clinic, Winona State University, and school sites within Rochester Public School district. Grade level teams collaborate *within* school sites to promote cohesive and coherent vertical alignment of curriculum and *across* school sites to continually refine and enhance pedagogical practice. Data analysis is a collaborative endeavor, with a complement of metrics gauging the impact of InSciEd Out on student-learning, pre-service teacher development, and in-service teacher development. Together, we work to continually improve our impact on fostering a scientifically literate community.

Integrated Science Education Outreach

Principal role in Internships: InSciEd Out

In all cases, "Principal" indicates school principal or an administrative designee.

****NOTE: This document and experience are new to 2012 and may, therefore, stress the timeline of getting our new partnership rolling. Please know that the leadership team of InSciEd Out will do everything we can to help smooth this process.

There are multiple stages of the principal role in partnering with InSciEd Out. They include: pre-partnership planning, principal workshops, presence at teacher team internships, coaching and principal team meetings, and steering committee support.

The approximate timelines and goals for each are listed below.

I. Pre-partnership planning (Fall of year prior to first teacher internships):

A. Principal begins visiting with teaching teams about professional development in the coming year, discusses InSciEd Out as an option.

B. Principal and a small team of teacher representatives visit Mayo Clinic and a representative partner school (approximately half day). In this visit, we introduce the scope and mission of InSciEd Out and allow the team to meet teachers and students who are working with InSciEd Out.

C. Principal opens communication with district leadership to determine priority of InSciEd Out among upcoming initiatives.

D. Principal invites InSciEd Out leadership to present to whole staff (approx 40 minutes).

E. Principal follows up and determines if there is a grade level team or whole school team ready to participate in the InSciEd Out 12-day internship.

F. Principal (and any designees) prepares an application for participation in the upcoming summer internships (March 5, 2012 deadline).

G. Principal (and any designees) prepares an application for funding (if requesting consideration for InSciEd Out funds) (March 5, 2012 deadline).
H. InSciEd Out leadership determines ranking of applications and replies to potential partner teams with criteria for final confirmation (Second Monday in March).
I. Principal confirms final internship team and responds to all criteria (March 27, 2012).
J. Principal to host staff meeting at school to support those choosing to participate (March-May). Parents invited and introduced.
K. Principal meets with internship team and reviews student outcomes in science from all previous science testing.
L. Teachers prep a blog or communication device for keeping parents up to date on their internship.

II. Principal Workshop (5 Days total):

A. Content includes sessions in: Genetics/Development, Dialogue basics, Pedagogy overview, Coaching, District "big picture", Dissemination planning, Grant writing
B. Activities: 2-day intensive science, 3 days throughout remainder of spring
C. Personal Science: each participant will follow through a scientific experiment that stems from his/her own question. This work will be supported by technologists in order to fit the scheduling hurdles of the principal.

III. During Teacher Internship: (all times to be announced along with full copy of teacher internship curriculum.

A. Principal joins the group for the overview of InSciEd Out to share the school's vision of partnership (40 minutes).
B. Principal joins for the initial planning of the Curriculum (to aid in targeting opportunities (1-2 hrs).
C. Principal joins for the Dialogue 5 session (expectations) (2 hours).
D. Principal can join anytime and should respond to blogs or communications by teachers.

IV. Coaching and Administrative meetings:

A. 3-day help for teachers (code release, protected time, etc.): each teaching team will need to arrange 3 full days during the fall semester to complete the work of their module.
B. Parent day sharing: each team is expected to have some information available to parents for fall parent-teacher conferences or similar event.
C. Coaching follow-up: InSciEd Out leadership team will check in with principal during the year to see how coaching is going.

D. Participant Administrative meetings: A bimonthly meeting will be scheduled to get all principals (or designees) together to share progress or hurdles in their team's implementation process. This may be done as a video conference from their sight.
E. Revision time (following vetting): all principals are expected to manage (or delegate when appropriate) the revision process of their teams and report any resource needs to the InSciEd Out team.
F. Curriculum Team meeting (District oversight): During the vetting year, principals should regularly update their district leadership on their progess.
G. Next team planning : Principals should develop a "scale-up" model for their own school with a plan for participation of any future teams.
H. Tier 2/3 planning: Principals should develop a plan for the continuous improvement of their team's curriculum product, to include plans for Tier 2 and 3 internships (in cultural relevance and subject alignment).
I. Paying it forward: Our sincere hope is that each principal and their team becomes a potential partner for new administrators starting this process.
J. Grantsmanship: Each principal and team should consider designating a partner to work on acquiring new funds to support ongoing needs of their team and curriculum.

V. Steering committee:

A. Every school that participates in InSciEd Out is expected to provide a leadership team to participate in our Steering Committee.
B. A Team = Principal, Teacher, Parent, Student
C. Meetings for the Steering committee are quarterly.
D. Our expectation is that the schools will form a steering subcommittee to prepare their team for the Quarterly meetings. This subcommittee should meet 2 weeks prior to each of the Steering Committee meetings and be led by the team (from B).
E. Once we achieve a larger number of teams, it will become less necessary for all teams to attend regular steering committee meetings, and we will develop a process of election of a single principal, teacher, parent, and student representative for multiple or all schools.

Integrated Science Education Outreach

February 14, 2012

Hello All,

On Monday, March 12, 2012, members of the InSciEd Out leadership team will be meeting to discuss plans for summer internships and the 2012-2013 academic year. Because you've expressed an interest in InSciEd Out science education reform, we're writing to request responses to the questions below. Each site's responses will help inform the decision-making process we engage in as we work to identify partners, goals, and support structures for the year ahead. We ask that you reply to this message no later than March 5 , 2012.

As you respond to the series of questions below, keep in mind that summer internships are 12 days (see point 4 below) in duration and, as an organization, we are mindful of data that indicates educational initiatives are better supported by teams of teachers than individual teachers. (In this document: team = whole school or grade-level team.)

1. **Depth of Teacher Commitment:** How many teachers do you have who would like to participate in a summer internship? (Please list by grade level and/or specialty area.) How did you measure teacher team commitment?

2. **Depth of Administrative Commitment:** How many administrators do you have who would like to participate in our administration workshop? Note: The expectation is that teams will include an administrator to participate with them in the first year of your school's partnership with InSciEd Out. Full expectations of the principal/administrator is detailed in our "Principal /Administrator role in internships" worksheet.

3. **Honoring the Investment of Time:** Dedicated teacher time is critical to the success of an InSciEd Out partnership. How does your site plan to honor teachers for their commitment during the summer? Note: In years past, schools have utilized compensatory aid, professional development funds, and/or grant funds to provide teachers with stipends. While InSciEd Out does not require that summer interns are compensated monetarily, we do wish to be transparent about how schools have elected to handle this.

4. **Initial Time Commitment:** Time commitment for your teams will include a 12-day internship held with our team during the summer. Additionally, teams are expected to commit an additional three days of effort on the resulting curriculum during fall semester. This can be a combination of evening, weekend, or code 06/07 time appropriately approved through your administration. All new curriculum will be vetted in

the spring of the academic year following the internship. Following vetting, curriculum units will be peer-reviewed and returned to teams for revision prior to approval for support in subsequent years.

5. **Administrative Support**: As this opportunity includes efforts that will address your team's individual needs with regard to professional development and curriculum, it is understood by the InSciEd Out leadership team that you have worked with school and/or district leadership in a manner that will maintain all appropriate lines of communication. This may be best shown through a letter of support from school or district leadership. Additionally, applications spanning multiple schools within one district will be strengthened by participation of district administrators in the Principals/Administrators Workshop.

6. **Availability:** We will be looking to host Grade K-5 teams this year in June, and 6-8 teams in July. The dates are as follows:
   - June: June 11-15, June 25-29, July 2,3
   - July 9-24

The leadership team of InSciEd Out would like to ensure that any potential partner has the opportunity to gather all information that will help to drive success in your school. Please do not hesitate to contact us at the numbers or email above if there is anything we can do to clarify this process.

Sincerely,
The InSciEd Out Leadership Team

Excerpt from Teacher Internship Curriculum
Genetics Thread

Essential Question(s):
What is science?
How does science advance and/or limit our understanding of the world?
What makes me the way I am?
What does a fish tell me about me?
How do I identify good science?
What is the value of Generative Dialogue in science?
What is my role in improving the work of others? What is their role in improving mine?
How is science shared within my community?

Learning Goals: TLWU:

1. science as a process
    a. shaped by the scientific method
    b. driven and sustained by personal inquiry

2. science as a Discourse
    a. shaped through peer review (formative and summative)
    b. shared with unique styles of communication (poster, oral presentation, publication)
3. science drives and is driven by society
    a. including the health and comfort of individuals, families, and communities
4. core genetic concepts ABAT explain gene expression as a mechanism of development
5. core concepts of development ABAT describe the products of vertebrate development
6. Generative Dialogue as a distinct form of Discourse in scientific inquiry
7. the nature of Dialogue appropriate to their pupils' developmental level(s)

Benchmarks Addressed:
AAAS Benchmarks, American Association for the Advancement of Science, Copyright 1993, 2009:

1A/H3a: No matter how well one theory fits observations, a new theory might fit them just as well or better, or might fit a wider range of observations.
1A/H3bc: In science, the testing, revising, and occasional discarding of theories, new and old, never ends. This ongoing process leads to a better understanding of how things work in the world but not to absolute truth.
1B/H2: Hypotheses are widely used in science for choosing what data to pay attention to and what additional data to seek, and for guiding the interpretation of the data (both new and previously available).
1B/H3: Sometimes, scientists can control conditions in order to obtain evidence. When that is not possible, practical, or ethical, they try to observe as wide a range of natural occurrences as possible to discern patterns.

1B/H9: To be useful, a hypothesis should suggest what evidence would support it and what evidence would refute it. A hypothesis that cannot, in principle, be put to the test of evidence may be interesting, but it may not be scientifically useful.
1B/H11: To avoid biased observations, scientific studies sometimes use observers who don't know what the results are "supposed" to be.
1C/H5a: Current ethics in science hold that research involving human subjects may be conducted only with the informed consent of the subjects, even if this constraint limits some kinds of potentially important research or influences the results.
1C/H7: The strongly held traditions of science, including its commitment to peer review and publication, serve to keep the vast majority of scientists well within the bounds of ethical professional behavior. Deliberate deceit is rare and likely to be exposed sooner or later by the scientific enterprise itself. When violations of these scientific ethical traditions are discovered, they are strongly condemned by the scientific community, and the violators then have difficulty regaining the respect of other scientists.
1C/H12: The dissemination of scientific information is crucial to its progress. Some scientists present their findings and theories in papers that are delivered at meetings or published in scientific journals. Those papers enable scientists to inform others about their work, to expose their ideas to criticism by other scientists, and, of course, to stay abreast of scientific developments around the world.
2B/H2: Mathematics and science as enterprises share many values and features: belief in order, ideals of honesty and openness, the importance of criticism by colleagues, and the essential role played by imagination.
2C/H3: To be able to use and interpret mathematics well, it is necessary to be concerned with more than the mathematical validity of abstract operations and to take into account how well they correspond to the properties of the things represented.
5A/H2: The degree of relatedness between organisms or species can be estimated from the similarity of their DNA sequences, which often closely match their classification based on anatomical similarities.
5A/H3: Similar patterns of development and internal anatomy suggest relatedness among organisms.
5B/H1: Some new gene combinations make little difference, some can produce organisms with new and perhaps enhanced capabilities, and some can be deleterious.
5B/H3: The information passed from parents to offspring is coded in DNA molecules, long chains linking just four kinds of smaller molecules, whose precise sequence encodes genetic information.
5B/H4: Genes are segments of DNA molecules. Inserting, deleting, or substituting segments of DNA molecules can alter genes. An altered gene may be passed on to every cell that develops from it. The resulting features may help, harm, or have little or no effect on the offspring's success in its environment.
5B/H5: Gene mutations can be caused by such things as radiation and chemicals. When they occur in sex cells, they can be passed on to offspring; if they occur in other cells, they can be passed on to descendant cells only. The experiences an organism has during its lifetime can affect its offspring only if the genes in its own sex cells are changed by the experience.
5B/H6b: Different parts of the genetic instructions are used in different types of cells, influenced by the cell's environment and past history.

5C/H4a: The genetic information encoded in DNA molecules provides instructions for assembling protein molecules.
5C/H4b: The genetic information encoded in DNA molecules is virtually the same for all life forms.
5F/H4a: Heritable characteristics can be observed at molecular and whole-organism levels—in structure, chemistry, or behavior.
5F/H4b: Heritable characteristics influence how likely an organism is to survive and reproduce.
6A/H1: The similarity of humans in their cell chemistry and DNA sequences reinforces the idea that all humans are part of a single species.
6E/H2: Faulty genes can cause body parts or systems to work poorly. Some genetic diseases appear only when an individual has inherited a certain faulty gene from both parents.
6E/H3a: New medical techniques, efficient health care delivery systems, improved diet and sanitation, and a fuller understanding of the nature of health and disease give today's human beings a better chance of staying healthy than their ancestors had.
8F/H3: Knowledge of genetics is opening whole new fields of health care. In diagnosis, mapping of genetic instructions in cells makes it possible to detect defective genes that may lead to poor health. In treatment, substances from genetically engineered organisms may reduce the cost and side effects of replacing missing body chemicals.
11A/H4: Even in some very simple systems, it may not always be possible to predict accurately the result of changing some part or connection.
11C/H12: Even though a system may appear to be unchanging when viewed macroscopically, there is continual activity of the molecules in the system.
12A/H1: Exhibit traits such as curiosity, honesty, openness, and skepticism when making investigations, and value those traits in others.
12A/H4: Scientists value evidence that can be verified, hypotheses that can be tested, and theories that can be used to make predictions.
12A/H5: Curiosity motivates scientists to ask questions about the world around them and seek answers to those questions. Being open to new ideas motivates scientists to consider ideas that they had not previously considered. Skepticism motivates scientists to question and test their own ideas and those that others propose.
12D/H6: Participate in group discussions on scientific topics by restating or summarizing accurately what others have said, asking for clarification or elaboration, and expressing alternative positions.
12D/H7: Use tables, charts, and graphs in making arguments and claims in oral, written, and visual presentations.
12E/H3: Consider whether some event of interest might have occurred just by chance.
12E/H6a: Notice and criticize arguments in which data, reasoning, or claims are represented as the only ones worth considering, with no mention of other possibilities
12E/H6b: Suggest alternative trade-offs in decisions and designs and criticize those in which major trade-offs are not acknowledged.

Lesson One: ***A fish and I… Animals in Research***

Essential question(s):
How does science advance our understanding of the world?
What does a fish tell me about me?

Teaching strategies:
1. Tour
2. Mini-lecture
3. Mini –dialogue
4. Think-Pair-Share and group discussion

Content Objectives: The learner will be able to (TLWBAT):
1. Reflect upon your experiences within Mayo Clinic Zebrafish Core Facility (ZCF).
2. Understand the Pros and Cons of using animals in research.

Resources:
1. Forms: ZCF/fluorescent microscope observation sheet; PPT for mini-lecture; TPS prompt card; small group discussion prompt
2. Supplies: colored pencils; transgenic larvae (assorted as available, this will need to be set up 2-4 days ahead of time); multi-well plate; transfer pipet; embryo water; wall chart; post-its; markers
3. Technology: fluorescent microscope; laptop; LCD projector; screen
4. Human: ZCF management or designee; ZCF technologist

Academic language:
model organism, indicator species, abstract, transgenic, larva, gene expression

Engage, Explore, Explain

1. Follow a tour of the Mayo Clinic Zebrafish Core Facility. (Engage)
    a. Learners will use the observation sheet provided to record observations of fish in the ZCF and larvae displayed on a fluorescent microscope.
    b. Learners will trade observation sheets with a partner. Each should enter one compliment of his/her partner's observation drawings on the partner's observation sheet (Peer Review).
    c. The tour and microscope observations will be done in groups of 3-4 and rotate between the microscope and ZCF every 20 minutes.
2. History of Healthcare (Explain)
    a. The instructor will share a short lecture about medical science past and present
        1. PPT slides are available
3. The instructor will lead learners in a discussion (mini-Dialogue) of animals used in laboratory research. (Explore/Explain)
    a. Follow Dialogue prompt. As learners are new to Dialogue, this is meant only as an exercise in "hearing" others.
4. Think-Pair-Share (Explore/Explain):
    a. The discussion will start with a brief Think-Pair Share (prompt provided) on the costs and benefits of animal use in scientific research. Post-its will be added to share the costs and benefits of animal use to a chart on the wall.
5. All learners will be given time to review the final list of pros and cons. Instructor will then use the prompt to begin a brief discussion (Explore/Explain).

Excerpt from Teacher Internship Curriculum
Pedagogy of Inquiry Thread

Lesson Two: ***Constructivism and the 5E Model***

Content Objectives:

1. After reading Duckworth's, *The Having of Wonderful Ideas* learners will generate posters that convey what a constructivist classroom looks like and sounds like compared to a non-constructivist classroom.
2. After viewing a PPT on the 5E model of science instruction, learners will identify when they were situated within each of the 5E lenses (Engage, Explore, Explain, Evaluate, and Extend) as part of their program at Mayo Clinic.

Language Objectives:

1. Learners will orally compare and contrast constructivist classrooms and non-constructivist classrooms.
2. Learners will apply the 5E model to their experience at Mayo.

Academic Language

Constructivism
5E Model of Science Education
Engage, Explore, Explain, Evaluate, Extend

Resources:

The Having of Wonderful Ideas
Directed Reading Thinking Activity to accompany *The Having of Wonderful Ideas*
5E PPT
Chart Paper
Markers

Explore/Explain/Evaluate

1. Provide learners with time to read *The Having of Wonderful Ideas*. Ask them to complete the DRTA as they read.
2. Facilitate a discussion using the DRTA as prompts.
3. Introduce the term constructivism.
   a. Create anchor charts on constructivism.
   b. Post two charts in the room. Label one "Constructivist Classroom" and the other "Non-Construtivist Classroom". Ask learners to desribe what they would see or hear in each room. Record ideas on the charts.
   c. Briefly explain the idea behind anchor charts and their use in the classroom. Note how this ties to constructivist theory.
4. Introduce the 5E model. Use powerpoint presentation to mediate overview of each lens.

InSciEd Out Module Scavenger Hunt:
Developing a Situated Understanding of a Module

Components of a Module:

Standards

1. Where are the standards this module covers, listed? What academic area(s) do these standards come from?

Objectives

2. Identify the two types of objectives and explain how they are different from one another.

5E Lens of Module

3. What is the function of the 5 E view of the module?

Day-by Day View

4. What happens on Day 8 in this module? On what page(s) can you find the lesson plan that corresponds to Day 8?

Assessment/Evaluation

5. In this module students were evaluated in multiple lesson using different methods of assessment. Identify three lessons and the method of assessment found in each lesson. Were these formative or summative assessments?

Dialogue Purposefully Embedded

6. What is the topic of dialogue in this module? Where is the dialogue embedded?

Pupil Peer Review Embedded

7. Where in the module is pupil peer review embedded? What was the purpose of the peer review in this lesson?

Instruction

8. What is the title of the Module?

9. What is the title of Lesson 2.1?

10. What is the objective of Lesson 2.1?

11. What is the academic vocabulary embedded within Lesson 4.1?

12. Develop a list of questions YOU HAVE about the curriculum and/or curriculum guide. Be prepared to share these questions with the group?

Excerpt from an InSciEd Out Grade 1 Module

5-E View of "Introduction to Environment" Grade 1 Module

Engage:

1.1 **Introduction to Environment:** Draw the environment for this animal.
4.1 **Song:** "A Good Environment" and shared reading/ revisit posters and vocabulary.
6.1 **Changed environments:** chairs removed and adapt.

Explore:

2.1 **Lincoln Butterfly Garden** environment observation and discussion.
5.1 **Zebrafish** environment observations.
7.1 **Create different environments**.

Explain:

3.1 **Classify with poster environments** from observations.
5.2 **Discussion of zebrafish observations**
6.2 **Changed environment** discussion from chairs.
8.1 **Difficult dialogue:** How do environments get changed in our community? Are these changes good for animals?

Extend:

9.1 **Groups: I wonder discussion/questions** with visiting scientists. (planning)
9.2 **Groups: I wonder project day** with scientists and big pals from discussion/question day.
10.1 **Sharing extensions**.

Evaluate:

11.1 **Draw an environment and an adaptation** for the animal from pre-assessment.

Academic Standards Addressed Within the Module:
MN Science Benchmarks:

1.4.1.1.1 Describe and sort animals into groups in many ways, according to their physical characteristics and behaviors.
1.4.2.1.1 Recognize that animals need space, water, food, shelter, and air.
1.4.2.1.2 Describe ways in which an animal's habitat provides for its basic needs.
1.1.1.1.1 When asked "How do you know?" students support their answer with observations.
1.1.1.1.2 Recognize that describing things as accurately as possible is important in science because it enables people to compare their observations with those of others.

MN Language Arts Benchmarks:

1. II.A.2 Use informal writing to record information or observations.
1. III.A.1 Participate in and follow agreed-upon rules for conversation and formal discussions.
1. III.A.2 Follow two- or three-step oral directions.

1. III.A.3 Attend to and understand the meaning of messages.
1. III.A.4 Communicate needs, feelings and ideas to peers and adults in complete sentences.
1. III.A.6 Use voice level appropriate for language situation.
1. III.A.7 Ask and respond to questions.

Other skills of focus:

- Compare and Contrast
- Use of Venn Diagrams

Day-by-Day View of "Introduction to Environment" Module

Day 1:
Drawing an Environment
Day 2:
Observing Environments
Day 3:
Comparing and contrasting of environments using Venn Diagrams
Day 4:
Recognizing animals' basic needs in a "good environment"
Day 5:
Part 1: Zebrafish environment observation
Part 2: Discussion of zebrafish observations
Day 6:
Part 3: Zebrafish natural habitat geography work
Day 7:
Changing environments
Day 8:
Creating different environments
Day 9:
Peer dialogue and "I Wonder" assignment
Day 10:
Part 1: Day with the Scientists
Part 2: Developing understanding extension project assignment
Day 11:
Sharing extension projects
Day 12:
Drawing an environment and an adaptation

Daily Lesson Plan Excerpt from 1st Grade Module

1.1: Drawing an Environment

MN Science Standards:

1.4.1.1.1 Describe and sort animals into groups in many ways, according to their physical characteristics and behaviors.

Content Objectives:

1. TSWBAT draw an environment for a given animal.

Language Objectives:

1. TSWBAT to *describe* their drawing in small group.
2. TSWBAT to *label* their drawing identifying key features of the animal in its environment.
3. TSWBAT to *record* facts about their animal using cards from the "All About Animals Photo Library."

Materials Needed:

Science notebook for each student
Animal picture (1 per student – each student having a different picture)
Crayon, colored pencils and/or marker

Academic Vocabulary:

Environment: The world around you that affects how you live and grow ("Life in the Forest" from Scott Foresman Unit 2 at 1st grade level).
Science notebook: (See Appendix)

1.1 Engage (pre-assessment)

Opening:

1. Today we're going to do some thinking about where people and animals live. To begin, I'm going to give you each a piece of paper. When you get the paper, I want you to draw where *you* live. Use pictures and words to *describe* where you live.
2. Facilitate a discussion about students' pictures. What were some things that you noticed were the same about the places we live? What were some things you noticed that were different?
3. Next, we're going to do some thinking about animals. Animals, like people, make their home in an environment. Each of you is going to get a card with a picture of an animal on it. When you get your card, I want you to think about where you think that animal lives. Draw a picture to show what you think the animals environment looks like. Then, write down anything you know or think you know about your animal
4. Model the procedure for students using chart paper as a page of a science notebook:
   a. Choose an animal picture from a hat.
   b. Draw a picture of the animal in your science notebook.
   c. Draw the animal's environment.
   d. Write down what you know (or think you know) about the animal.
5. Allow students to select animals and follow the procedure described in step 4.

6. Facilitate a think-pair-share discussion about the students' drawings. Model the process of one student describing his/her animal and drawing to another person. Use the think-pair-share strategy to ensure that all voices are active in the discussion.
    a. Tell the name of my animal.
    b. Tell about where it lives.
    c. Tell what I know or think I know about the animal.
7. Re-engage student interest: In our next lesson we will be visiting two different environments. What do you think they might be?
   Hang a piece of chart paper in the classroom for students to record what they think the two environments might be. This allows them to connect their personal lives/experience to the context of the module.

Example: Evaluation Plan for InSciEd Out (and samples of tools)

Evaluation plan
Evaluation of K-8 teachers Content knowledge and understanding is assessed with concept maps, portfolios, daily reflective writings, and pre- and post talking drawings. Additionally teachers participate in review of their peers. Process • Internship: Level of participation, involvement, and professional development is evaluated by facilitators by analysis of reflective writings, portfolios, and pre- and post talking drawings. • Coaching: Level of participation, involvement, professional development, and positive impact on teaching is evaluated during the coaching process by coaches. Outcome: Improved teacher science literacy, knowledge of science education, and educational professionalism. Demonstrated positive impact on student behavior, attitude, view, participation in science activities, satisfaction, and standardized test results. **Evaluation of facilitators and program** Content of internship is evaluated by K-8 teachers in end-of-internship survey, satisfaction survey, and via daily reflective writings. Process • Internship: Process of internship is evaluated by K-8 teachers in end-of-internship survey and satisfaction survey • Coaching: Process of coaching is evaluated by K-8 teachers with a coaching survey and satisfaction survey. Outcome of internship is evaluated by K-8 teachers in end-of-internship survey, satisfaction survey, and via daily reflective writings. Focus groups will be used to gather feedback from teachers and parents on the impact of InSciEd Out on community. **Evaluation of students** Content knowledge and understanding is assessed by standardized testing as well as pre- and post in talking drawings and reflective writings. Process Engagement and participation is assessed by teachers via daily reflection journals and pre- and post attitude change towards science, own ability to understand science, and ability to carry out science activities. Outcome Student cohorts will show growth in science proficiency compared to their own baseline as measured by; Minnesota Comprehensive Assessment (MCA), SAT 10^{th} ed., and Measures of Academic Progress (MAP); increased participation in science fairs and other science activities; and increased registration in high school Honors biology courses.

Evaluation Metrics
Evaluation of K-8 teachers Content Teachers will need S in all evaluation components (S/N): Talking drawings, concept maps, portfolios, and reflective writings. Process Participation, involvement, professional development, ongoing revision of curriculum and product are evaluated step by step as the process evolves. Teachers will need S in all evaluation components (S/N). Outcome Improvement in science literacy, knowledge of science education, and educational professionalism as evaluated by facilitators via talking drawings, concept maps, portfolios, and reflective writings. **Evaluation of facilitators and program** Content, Process, and Outcome Facilitators and program evaluations are both qualitative and quantitative and analysis will be performed on all data, first separately and then combined for a comprehensive assessment. Metrics assessed are quality, quantity, appropriateness, professionalism, and organization of activities and program. Facilitators will receive an overall grade provided by teachers. Acceptable grade is B and above. Program is graded by teachers. Acceptable grade is B and above. Outcome In addition to above metrics, facilitators and the program will be evaluated on the basis of impact on student outcome such as grades on standardized tests, participation in science activities, and registration numbers in high school Honors biology classes in. **Evaluation of K-8 Students** Content Students are evaluated both qualitatively and quantitatively. Qualitative assessment is done on talking drawings and reflective writing and quantitative evaluation is done via MCA, MAP and SAT 10^{th} ed.; increased participation in science fairs and other science activities; and increased registration in high school Honors courses. Process Students participation and engagement is evaluated qualitatively via teachers' assessment of talking drawings and reflective writing. Outcome The outcome is measured as improved test scores on standardized tests (MCA and MAP), but is reflective of a less numeric outcome: student improvement in science literacy.

Evaluation Tools
Evaluation of K-8 teachers Content Process and Outcome Rubrics will be used to evaluate teachers' comprehension, understanding, and application of content, process, and outcome for all product components. The rubrics define clarity of thought, process, and participation. Additionally they address reflective writing, portfolio, and talking drawings as well as impact on students' academic behavior. Teachers are evaluated during internship as well as the coaching period with separate rubrics. Outcome of each process is reported separately. **Evaluation of facilitators and program** Content, Process, and Outcome is evaluated by teachers via Practice of Science Teaching Survey, end-of-internship survey administered at the end of each tier, coaching survey, and satisfaction survey where there are both qualitative and quantitative questions. Both facilitators and program are expected to receive an overall score of 4.0 or higher on a 5 point scale as well as on all quantitative components. Focus groups will be conducted with parents and teachers (in separate groups) to assess impact on community. **Evaluation of K-8 Students** Content, Process, and Outcome is evaluated: 1) Qualitatively via talking drawings and reflective writing; 2) Quantitatively via Student attitude survey which is administered 3 times during the year; MCA, MAP and SAT 10th ed. with subsequent comparative analysis; and. Value added assessment tool which assess the difference between expected outcome (based on the historical performance of district students with similar prior achievement/ability scores and demographics) and actual outcome

Example of Intern Evaluation:
Excerpt from Teacher Internship Portfolio Rubric

	1 – Minimally Meets Requirements	2 – Meets Requirements	3-Exceeds Requirements
Portfolio Introduction	Description of purpose and goals of internship lacks specificity	Description of purpose and goals of internship provides clear understanding and explains selection process.	Fulfills previous requirements with additional rich detail that shows clear linkage between entries, purpose and goals
Learning Theme Entries			
• **Nature of Science**	Introduction describes area(s) of new learning; general statement of how documents *show* evidence of new learning. Delineates area(s) of greatest learning.	Introduction includes area(s) of greatest growth in learning and includes a description of how documents reflect this new learning.	Fulfills preceding requirement and includes how you will use new learning about nature of science to help children acquire scientific knowledge and scientific process.
• **Process of Science**	Briefly describes growth in understanding about the nature of scientific processes; includes ways you've learned to help students investigate their own world and think, observe, and communicate what they have learned	Describes ***enhanced*** understanding of the process of science; reflection on new ways you have learned during the externship to help students investigate their own world in ways that help them think, observe and communicate what they have learned	Fulfills preceding requirement and includes a detailed, authentic analysis of own ***new*** learning (e.g. strength and weaknesses, any confusions or remaining questions); evidence demonstrates your ability to design lessons that engage students in authentic and engaging science learning
• **Generative Dialogue**	Entry demonstrates your understanding of value, role, & application of generative dialogue in science learning	Entry demonstrates thorough understanding of value, role, and application of generative dialogue as a unique form of scientific	Fulfills preceding requirements and includes a detailed analysis of your level of understanding of using generative dialogue in

		discourse; reflects on how dialogue can be incorporated into a module. Includes clear linkage between your documentation and new learning about dialogue	science learning, your level of confidence in facilitating a dialogue and what else might be needed to do it well
• **Pedagogy Inquiry**	Entry describes and demonstrates new/enhanced understanding of how students learn science and ways to teach and assess science authentically	Entry demonstrates a clear understanding of ways to engage students in authentic science experiences that includes multiple disciplines. Compelling description of linkage between understanding and documentation	Fulfills preceding requirements and includes a detailed analysis of your strengths and weaknesses in this area; self-analysis of your ability to utilize science pedagogy.
Final Reflective Summary	Summary of your most powerful learning during internship, any remaining questions, confusions, areas needing further investigation; honest evaluation of you engagement throughout the 3-weeks	Detailed summary of your most powerful learnings; describes the quality of documents you chose to demonstrate your learning; includes summary of next steps before implementing module.	Fulfills preceding requirements and includes a detailed analysis of any learning and application gaps that need to be addressed; honest self-assessment of the level of your involvement in all learning experiences and assignments.

Example: Evaluation tool for intern content knowledge: Portfolio Project

PORTFOLIO CHECKLIST

INTRODUCTION:
_____What drew you to this internship?
_____What knowledge/skills did you bring with you to the internship?
_____What expectations did you bring to the experience?
_____How did the experience help you meet or exceed your expectations?

DOCUMENTATION:
For each of the learning threads (NOS, Genetics, Development, Dialogue, Pedagogy of Inquiry) select the most compelling evidence you have of NEW/enhanced learning to submit as artifacts.
_____Nature of Science artifact(s) selected:
_____Genetics artifact(s) selected:
_____Development artifacts(s) selected:
_____Dialogue artifact(s) selected:
_____Pedagogy of Inquiry artifact(s) selected:
_____Explanation of how each artifact links up to the learning threads
_____why you feel it is the most compelling evidence of your new/enhanced learning as a result of these three weeks.

FINAL REFLECTION:
The final reflection is intended to promote analysis and deep reflection on your entire 3-week experience as a way to consolidate your learning. Questions that might help you think through this section are included below. Try to weave them into a well-composed summary statement for your portfolio
_____What most surprised you and why?
_____What new understandings (stories) might account for previous incomplete or misunderstandings?
_____What inspired you?
_____Where are your greatest areas of growth during the externship?
_____What areas need continued attention or further study?
_____What continuing questions, confusions, and curiosities do you have?
_____Where did you take or avoid taking learning risks during the three weeks?
_____What are you willing to risk during the module implementation phase?
_____In what areas do you feel most and least confident in moving forward?
_____What are your next steps before implementing your module?

Example: Intern (or student) Evaluation Tool, The pre/post talking Drawing

Content Pre-/Post- Assessment:

Talking Drawings: The talking drawing honors developmental abilities of early learners by allowing them to demonstrate their conceptual understanding of a topic by drawing a picture, adding whatever text they're able to provide, and then "tell the story" of the drawing to a teacher, paraprofessional, or parent volunteer who transcribes the explanation.

To facilitate the talking drawings metric, students will be asked to draw a picture of their understanding of a particular topic or concept at the beginning of a module and then asked to draw a picture of their understanding at the end of the module. Analysis of the pre- and post-module drawings will enable teachers and parents to measure growth and shifts in student understanding.

Take 5-10 minutes and draw a picture and/or use words that capture your understanding of the question:
“What does a fish tell me about me?”

As you complete your picture, prepare a story to share it with a partner.
Take 5 minutes and share your picture with a partner. They should take notes on your descriptions, capturing the essence of your story. Then listen to your partner’s story and take notes for them.

Example: Facilitator team evaluation tool (peer to peer)

Proposal for Teaching Team Professional Growth & Development

The summer internship teaching team is committed to professional growth and development and has crafted a mentoring process that includes:

- Sharing of individual goals with criteria for growth
- Engagement in a mentoring process that invites observations of their teaching/mentoring activities
- Receiving feedback related to their goals in order to improve their involvement in the program and enhance the overall program

Time Frame:

3. The teaching team will meet for ½ day prior to the summer internship to:
   - Formulate individual goals for that summer
   - Determine teaching pairs for observation/learning
   - Develop a form that captures the purpose of an observational focus (receiving feedback on teaching and/or learning about an area outside of the individual's expertise)
   - Determine the number of observations

2. A time for a weekly teaching team meeting will be incorporated into the internship schedule to discuss how things are going with interns and to assess how the team mentoring process is progressing—what's working, what doesn't seem to be working, what do we need to revisit or change in the short run?

3. A final ½ day retreat to
   - share results of mentoring
   - review and analyze program evaluations from interns
   - determine any improvements needed in the internship curriculum or structure
   - determine any improvements needed in the team mentoring process.

Example: Evaluation tool for Teachers, Facilitators, and Program

COURSE EVALUATION

COURSE TITLE InSciEd Out Internship
Teaching Team (Circle those present): Chris, Andy, Corey, Jean, Jim, Tyler, Maggie
Year ____________ Group___________

Directions: Please circle the number on the right that corresponds to your opinion in each of the following areas:

The Teaching team:	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1. Is actively helpful when learners have difficulty	1	2	3	4	5
2. Appears sensitive to the learners' feelings and problems	1	2	3	4	5
3. Encourages learners to ask questions, disagree, express ideas	1	2	3	4	5
4. Is fair and impartial in dealing with learners	1	2	3	4	5
5. Gives fresh insights rather than simply dwelling on the obvious	1	2	3	4	5
6. Is interested in the subject	1	2	3	4	5
7. Uses enough examples or illustrations to clarify the material	1	2	3	4	5
8. Presents material in a well-organized fashion	1	2	3	4	5
9. Stimulates thinking	1	2	3	4	5
10. Presents material in an interesting way	1	2	3	4	5
11. Is responsive to our feedback and questions	1	2	2	4	5

Overall, how would you rate the teaching team for this course?

EXCELLENT VERY GOOD GOOD FAIR POOR VERY BAD

Comments (if any

CHARACTERISTICS OF THE COURSE:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
5. The objectives of the course were clear	1	2	3	4	5

2. The activity I enjoyed most was: (why?)

3. The assigned readings were of appropriate difficulty	1	2	3	4	5
4. The assignments were fair	1	2	3	4	5

IF NOT, WHY NOT?

5. I felt safe to share my voice during this internship	1	2	3	4	5

IF NOT, WHY NOT?

5. I am glad I took this course	1	2	3	4	5

Overall, how would you rate this course?

EXCELLENT VERY GOOD GOOD FAIR POOR VERY BAD

The thread(s) that I found most challenging was/were (Genetics, Development, Nature of Science, Dialogue, Pedagogy of Inquiry) because

The thread(s) that I found most rewarding was/were (Genetics, Development, Nature of Science, Dialogue, Pedagogy of Inquiry) because

Changes I would make to improve the program:

Describe the atmosphere for learning in terms of the presence/absence of safety here during the internship:

Comments:

CHARACTERISTICS OF INTERNS:

	Not very		Somewhat		Highly
On a scale of 1 to 5 circle a number to indicate where you were in terms of knowledge & skills in science education when you walked in the door on the 1st day of our internship	1	2	3	4	5
On same scale circle the number that indicates your skills and knowledge in science education today.	1	2	3	4	5
Circle the number that indicates your comfort with science on the 1st day.	1	2	3	4	5
Circle the number that indicates your comfort with science today.	1	2	3	4	5

Example: Student Attitude survey and Extension Rubric

Water Treatment Attitude Survey

Please read each statement carefully and circle your answer. Please circle ONLY ONE answer each statement.

I think science is interesting.	Disagree	Unsure	Agree
Science is necessary to help our world.	Disagree	Unsure	Agree
I know a lot about what scientists do.	Disagree	Unsure	Agree
Anyone can be a scientist.	Disagree	Unsure	Agree
I enjoy science class.	Disagree	Unsure	Agree
I want to be a scientist.	Disagree	Unsure	Agree
I know how people get clean water.	Disagree	Unsure	Agree

Extension Rubric

	1	2	3
Connection to class unit	Extension was not related to classroom module's theme	Related to classroom module's theme	Related to classroom module's theme showing new applications
Presentation	Did not present	Presented extensions to peer group	Presented extension utilizing technology and showed creativity in presentation
Peer Review Process	Did not discuss project with peer review group	Engaged in discussion regarding extension	Engaged in discussion regarding extension and possible further research
Scientific method	Used parts of scientific method	Followed all steps of scientific method	Followed all steps clearly and accurately of scientific method

Default Question Block

How many years of teaching experience do you have?

- 0 (This will be the start of my first year.)
- 1
- 2 to 4
- 5 to 8
- 9 to 20
- More than 20.

What is the highest educational degree you have earned?

- Undergraduate (BA, BS, BT)
- Graduate (MS, MA, MT)
- Specialist (Ed.S.)
- Doctorate (Ed.D., Ph.D.)

Do you teach in an elementary or middle school?

- Elementary
- Middle School

What grade level do you currently teach?

- K
- 1
- 2
- 3
- 4
- 5

What grade level do you currently teach?

- 6
- 7
- 8

How many students were in your classroom last year?

How many students do you anticipate will be in your classroom in the coming year?

What was your average class size last year?

What do you anticipate your average class size will be throughout the year ahead?

In the past year, how much time on average did you spend teaching science each week?

- 0 - 30 minutes
- 30 - 60 minutes
- 60 - 90 minutes
- 90- 120 minutes
- Greater than 120 minutes

Within your school setting, indicate the extent to which:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
School administration demonstrates a high priority for science education.	☐	☐	☐	☐	☐
You have a sense of what your students experience as part of their science education before they arrive in your classroom.	☐	☐	☐	☐	☐
You have a sense of what your students will experience as part of their science education as they advance through their school years.	☐	☐	☐	☐	☐

Within your teaching practice, indicate the extent to which:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
You understand science concepts well enough to be effective teaching elementary science.	☐	☐	☐	☐	☐
You understand science pedagogy well enough to be effective teaching elementary science.	☐	☐	☐	☐	☐
You enjoy teaching science.	☐	☐	☐	☐	☐

Do you have opportunities to collaborate with other teachers at (or near) your grade level to share ideas about teaching science?

- Yes
- No

Describe the nature and duration of such opportunities.

Do you have the resources necessary to provide students with effective scientific learning experiences?

- ◯ Yes
- ◯ No

Please identify where such resources come from.

Have you received professional development training specifically for science education?

- ◯ Yes
- ◯ No

Describe the nature and duration of the professional development you have experienced that specifically focused upon science education.

Within your classroom practice, indicate the extent to which:

	Never	Rarely	Sometimes	Most of the Time	Always
Students use evidence to support their explanations for scientifically oriented questions.	☐	☐	☐	☐	☐
Students demonstrate that they evaluate their explanations by considering alternative explanations that address the same concept/topic of inquiry.	☐	☐	☐	☐	☐
Students effectively communicate and justify their explanations to one another and to you.	☐	☐	☐	☐	☐
Students effectively communicate and justify their explanations to an external audience (other teachers, students at other schools, community members, etc.).	☐	☐	☐	☐	☐
Mathematics plays a significant role in the science work that students engage in.	☐	☐	☐	☐	☐

Observation plays a role in the scientific investigations conducted by students.	☐	☐	☐	☐	☐
A student has the opportunity to pursue scientific projects unique to his/his individual interests.	☐	☐	☐	☐	☐
Students generate their own data charts or graphic organizers to organize their investigations.	☐	☐	☐	☐	☐
Students are supported by scientists in the community.	☐	☐	☐	☐	☐
Students are engaged during science class.	☐	☐	☐	☐	☐
Students are enthusiastic about science.	☐	☐	☐	☐	☐
Students have ownership of the scientific inquiry they engage in.	☐	☐	☐	☐	☐
Science learning is integrated to connect with other academic subject areas in a deliberate and cohesive manner.	☐	☐	☐	☐	☐
You are able to locate the resources you need to facilitate scientific learning in your classroom.	☐	☐	☐	☐	☐
You are able to facilitate the MN State Science standards (at your grade level) in the classroom during the scope of an academic year.	☐	☐	☐	☐	☐

Agree or Disagree, then explain your choice.

Science is not really important in the primary grades; it's more important that students learn how to read and master basic math skills.

○ Agree

○ Disagree

Explain.

Agree or Disagree, then explain your choice.

There is enough time in my weekly classroom schedule to make science education an active part of students' learning experiences.

○ Agree

○ Disagree

Explain.

Agree or Disagree, then explain your choice.

If students are to be successful in high school and college, they need a strong science education in the elementary grades.

- Agree
- Disagree

Explain.

Agree or Disagree. Then, explain your choice.

There is a difference between understanding science content and understanding the nature of science.

- Agree
- Disagree

Explain.

Agree or Disagree. Then, explain your choice.

My experiences in undergraduate education prepared me to be an effective science teacher.

- Agree
- Disagree

Explain.

Agree or Disagree. Then, explain your choice.

My experiences in graduate education prepared me to be an effective science teacher.

◯ Agree

◯ Disagree

Explain.

Vignette #1:

After completing an experiment with zebrafish, your students watch the teacher dispose of the fish according to policy protocol. Students are upset and beg to take the fish home and care for them in their own aquarium. Describe the ways in which a difficult dialogue might be helpful in this situation.

Vignette #2:

You are teaching 5th grade science and the topic is water quality. Several students approach you and are interested in the ability to eat fish from Rochester area waterways. Describe how you address this interest in the confines of your class experience.

Vignette #3:

You are teaching 2nd grade and you realize that many of your students are not reading at grade level. Describe how this affects the delivery of science curriculum in the classroom.

Vignette #4:

Describe the nature and purpose of extensions within an elementary or middle level science curriculum. Provide a specific example to contextualize your response.

Vignette #5:

Upon working with a scientist on classroom curriculum, you discover that s/he believes in a literal interpretation of the Bible. Do you believe this is aligned with his/her role as a scientist? Why or why not?