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ABSTRACT

This paper presents a rubric developed as a continuum for assessing elementary students' science process knowledge. The continuum was designed to capture the growth of an individual student's knowledge of processes that are essential to learning science. The assessment tool is meant to document changes in science processes that are incremental and not easily captured by multiple choice or short answer instruments. Use of the continuum should not require changes in the science curriculum, but feedback from the student assessments can be used to modify instructional strategies. The science process skills identified as necessary for K-6 students include observing, asking questions, naming and classifying objects, attending to details, familiarity with equipment, using resources, rational thinking, and integrating science with other disciplines. The rubric indicates which of the science process skills can be evaluated by a single student-teacher interaction and which should be evaluated after multiple interactions. Additionally, teachers are directed to look for assessment evidence from a variety of sources including observation of a student's behavior, verbal statements, written text, or illustrations. (WRM)

DEVELOPING A RUBRIC FOR ASSESSING SCIENCE PROCESS KNOWLEDGE IN GRADES K-6

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A CONTINUUM FOR ASSESSING SCIENCE PROCESS KNOWLEDGE IN GRADES K-6

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Assessing Science Process Knowledge

Assessment of elementary school students' knowledge about science is essential for at least two reasons. First, if teachers are to increase both the amount of science content taught and opportunities for learning about processes associated with learning science, they need more accurate information regarding what a student does and does not know. Second, more accurate feedback regarding the content and process knowledge of students at all grade levels could inform many of the parties interested in science education reform such as teachers, policy makers, and administrators. While the National Science Education Standards (NRC, 1998) call for teaching more science content at all grade levels, they also recognize that students need to learn the processes associated with scientific thought as well. Accurate assessments in both areas would allow teachers to know more about how students are learning science, schools districts to know about the effectiveness of their enacted curricula, and policy makes to know about the effectiveness of their decisions to reform science teaching and learning.

In spite of the facts that curricular materials and assessment tools exist for science content and concepts at all grade levels, there is very little information on how to assess the science process skills students are expected to learn through science instruction. The continuum for assessing science process knowledge we developed offers a fresh approach to capturing this knowledge over time. We believe this continuum has the potential to provide additional information and more accurate feedback to students, teachers, school administrators, and policy makes in ways that traditional content assessments alone do not.

It is important to note that the assessment continuum we developed is not designed to evaluate everything a student could know about science. Knowledge of specific science content, for example, is not something this continuum is designed to assess. Instruments that document learning of specific science content knowledge are generally prepared to reflect the course of study adopted by a local school district (e.g., the Southwestern City Schools Science Course of Study, n.d.). In additional, many states have or are developing competency based examinations in science that evaluate unifying concepts such as systems, constancy and change, and form and function (see Science: Ohio's Model Competency Based Program, 1994). In Ohio, instruments that assess this type of information are required of all students in grades four, six, and nine. Frequently, the feedback provided on these types of instruments is "high-stakes" in that it is used as a primary source of data for evaluating students, teachers, administrators, and the decisions of policy makers. We, on the other hand, intentionally wrote our continuum for assessing science process knowledge to capture a different aspect of learning - the growth of an individual student's knowledge about processes we believe are essential when learning science.

The assessment rubric that arose from our efforts to document changes in learning to learn science is presented in Appendix B. However, before describing the development of our continuum, it is necessary that we provide the reader with some of our assumptions about the ability of elementary school teachers to assess science process knowledge. Knowing that most elementary school teachers are keen observers of incremental change in process skills associated with reading and writing, we assumed they should also be able to observe and record information regarding science process skills once they understood the assessment items on our continuum. A second assumption of our efforts to produce this continuum was that repeated use of the continuum by a teacher would capture the development of a student's science process knowledge over time. Our intent here was to have an assessment rubric that could document changes in knowledge of science processes that were incremental and not easily captured by multiple choice or short answer instrument. Finally, we assumed that any instrument we developed would require few changes to the existing science instruction for an elementary school teacher. The point here is that we did not want teachers to think that their curriculum must change to address the items on our continuum. Rather, we wanted teachers who used the continuum to use the feedback they received from using the continuum to adjust their instruction as needed. Before presenting the science continuum we would like to describe some of the significant factors that contributed to producing the continuum for assessing science process knowledge.

Highland Park Elementary

Construction of the assessment continuum took place at Highland Park Elementary (Southwestern City Schools, Grove City, OH) through the efforts of four Highland Park teachers, one teacher from a neighboring school, and a university science educator. Highland Park is one of seventeen elementary schools in the Southwestern City School District with approximately 500 students, kindergarten through grade five. Most students live in the surrounding neighborhoods, although some attend by special request of their parent(s). The children come from a wide range of socio-economic backgrounds. Most of the teacher at Highland Park have been teaching at this school for more than five years, and most hold the master's degree in education. A child-centered school, the staff at Highland Park shares a developmental philosophy of learning that is not linked strictly to a student's age. The Highland Park view of learning includes the notions that children are motivated and capable learners from their first enrollment at the school. Students experience elementary school as only one point on a learning continuum that begins with their preschool experiences. Students in all grade levels are free to follow their own interests through a curriculum that includes thematic units of instruction. During instruction, teachers work with individual students and collaborative groups of students to ensure that all areas of the curriculum have been covered.

Through their shared teaching experiences at Highland Park, these teachers have found that many children progress through stages of development that reflect increasingly complex ways of representing what they are learning. These teachers have settled on describing the progressive development of students as emerging, beginning, developing, advancing or consolidating with respect to how they represent their thinking on a topic (see the Literacy and Writing sections of Student Progress Reports in Appendix A). The teacher's task is to assess a student's stage of intellectual development and then expand upon that student's knowledge and abilities so that he or she develops competency in specific intellectual abilities as well as practical skills. In doing so, these teachers explicitly recognize that children learn at different rates and in different ways. They plan their instruction, both individual and whole class, in response to feedback they receive from applying assessment rubrics like the ones for reading and writing. Although the methods of instruction at Highland Park differ significantly from other schools in the Southwestern School District, students in the school are expected to follow the same course of study as other students in the district.

Applying their philosophy of learning to themselves, the Highland Park staff regularly seek out professional development activities that suit their needs as teachers. In 1991, Highland Park was selected by College of Education at Ohio State University as a professional development school (PDS). The model of PDS at Ohio State is designed to "connect colleges of education with schools; to establish working partnerships among university faculty, practicing teachers, and administrators that are designed around systematic improvement in practice; and to serve as settings for teaching professionals to test different instructional arrangements, for novice teachers and researchers to work under the guidance of gifted practitioners, for the exchange of professional knowledge between university faculty and practitioners, and for the development of new structures designed around the demand of a new profession." (Kirschner, 1995)

Highland Park's involvement in PDS allowed staff members to initiate and design experiences that contributed to their learning while earning graduate credit from The Ohio State University. In 1991, the Highland Park staff sought out Dr. Becky Kirschner, an Ohio State University professor, to assist with the coordination of their professional development interests. Among these interests was an action research project involving two teachers in redesigning the school's student progress report (Howlett & Kerstetter, 1995). The intent of this research was to make the assessment of reading and writing consistent with the Highland Park philosophy of learning. In brief, these teachers wanted to change "the way they assessed children, both for ongoing instruction and for 'reporting to parent' purposes" (Dickinson, Kirschner & Rogers, 1995, p. 43). In light of these interests, they wanted to develop an assessment instrument that would communicate developmental aspects of learning in reading and writing in addition to answering the most commonly asked question by parents - "Is my child reading at grade level?" An assessment of this kind would also offer teachers feedback on their instruction, feedback that could be used when planning future instruction. In the end, these teachers developed a system of documenting student progress that included portfolios of student work to document growth as learners, a revised assessment instrument that could contribute to their ongoing instruction, and a revised reporting mechanism for parents (Dickinson, Kirschner & Rogers, 1995). Appendix A contains samples of the Primary and Intermediate Student Progress Report's that were fully developed for assessing reading and writing.

Development of the science assessment continuum

Over the years, Highland Park teachers made many modifications to their assessment continua for reading and writing. However, other content areas such as social studies, science, and health remained lumped together on the student progress report under the heading of "Integrated Curriculum." In an effort to continue developing the student progress report, teachers at Highland Park (the co-authors of this paper) again contacted a science educator (the first author) to construct a continuum for assessing science that was similar in format to those already in use for assessing reading and writing. Our joint involvement began in 1996 by sharing each individual's ideas about what it might mean to be scientifically literate in grades K-6. Next we discussed processes of science we believed were applicable when learning a wide variety of science content. Among the processes we identified as necessary for K-6 students were observing, asking questions, naming and classifying natural objects, attending to details, familiarity with equipment, using resources, rational thinking, and integrating science with other disciplines. From this list we developed a rationale for why we thought each component was important to scientifically literate people (see Table 1).

We then illustrated each component of science with assessment items we felt a student might say or activities they might engage in that would indicate they were competent with a particular item at each developmental level (see Table 2).

Table 1
Processes of Science

Observing

Rationale: Scientific questions usually begin with observations of the natural world. Scientists observe objects, properties of those objects, and phenomena that objects undergo.

Asking questions

Rationale: Scientists ask questions about objects in the natural world and the phenomena they undergo.

Naming and classifying natural objects

Rationale: Fundamental to all scientific investigations is communicating about the objects, parts of objects, and phenomena that occur in the natural world. Scientists give names to objects and phenomena so they can be precise when talking about the object or phenomena they are interested in studying.

Attending to details

Rationale: Scientists keep careful records of their observations. All scientists collect, organize, and analyze data in many forms to help answer their questions.

Familiarity with equipment

Rationale: Scientists use equipment to help them make more precise observations. They must be comfortable with the technology used in their investigation.

Using resources

Rationale: Scientists use existing resources to help them think about their current questions. Some of the resources they consult include people (colleagues or experts in the field), reference books or tables, printed reports of past research, and the internet.

Rational thinking

Rationale: Scientific thinking involves reasoning about data and drawing conclusions. This reasoning may be either inductive (starting with a hypothesis and gathering data that support/confirm an idea) or deductive (gathering data that can be used to test the validity of a hypothesis).

Integrating science

Rationale: Science includes using (and sometimes learning) mathematics, writing, thinking, reading, and working with others. More often than not, science involves teams of researchers with each member of the team contributing different strengths to the combined efforts of all. Scientists report the results of their investigations in several ways --orally at conferences involving their peers and through written media such as journals and the internet.

Table 2
Developmental Levels of Science Process Knowledge

•Emerging — Beginning — Developing — Advancing — Consolidating•

♦ Emerging
- describes the gross physical characteristics of objects
- explores the physical capacity of containers or objects
- knows the names for (un)common physical object
- asks questions of a factual nature
- defers explanation to others or authorities

♦ Beginning
- asks questions about the characteristics of objects and phenomena
- explains how an object interacts with its' surroundings
- uses science equipment to collect information (rather than as a toy)
- understands that phenomena can have names
- gives egocentric reasons as an explanation

♦ Developing
- understands how to collect and organize data
- uses science equipment safely, appropriately, and effectively
- identifies variables that affect an experiment
- gives procedures for what was done
- explores the research of others
- gives increasingly more precise descriptions of common physical objects
- is thinking about objects and physical event from a perspective other than their own
- links explanations for an event with observations of the event

♦ Advancing
- describes common physical objects in precise detail
- predicts how an object would behave if you changed the conditions
- uses science information books or resources in the library
- extracts useful facts or constants from reference materials
- recognizes the importance of the data or information collected
- selects appropriate science equipment to use during an investigation
- links events into a chain/sequence of events that explain some phenomena
- describes the outcome of an investigation

♦ Consolidating
- uses scientific vocabulary appropriately and accurately
- is comfortable/confident using science equipment
- gives causal explanations for why something happened as it did
- beginning to reason about events that could happen hypothetically
- completes a series of investigations on one topic
- writes about questions they would like to study next
- communicates their findings and questions of interest to others

Testing and revising the continuum

In spite of our efforts to bring the continuum to this stage of development, the first attempt to use our continuum was met with several significant problems. First, the teachers found that some assessment items could not be assessed from a single interaction with a student. To address this problem we identified those assessment items that could be evaluated by a single interaction with (+) and those that need multiple interactions with (√). Second, we found that most of the data we attended when using the assessment were verbal or written statements made by students. This problem was addressed by adding four columns to the right of each assessment item. Information placed in these columns could come from a variety of sources including observation of a student's behavior, verbal statements, written text or illustrations. The intent of these column was to force teachers to look for additional ways that students might represent their understanding of science process knowledge.

When using the continuum for the first time several teachers noticed that the students they rated higher on this continuum were not necessarily the same students who were placed higher on the continua for reading and writing. This seemed odd at first because there was an implicit assumption that better readers and writers should be better in all subjects. However, as the teachers began to talk about the individual students who they placed higher on the science continuum, it became clear that the evidence for competency in science was not exclusively limited to competency with reading and writing. We believe that assessing across the four categories of teacher observation, verbal comments, written text, and pictures etc. offers a more complete and accurate assessment of a student's knowledge of science processes.

To further address the problems we recognized when first using the continuum we continued to add examples of evidence that we called benchmarks to the four evidentiary columns. These benchmarks were placed in a grid that linked each assessment item to the data that could serve as evidence that he or she had achieved competency for an item (see Appendix B). This process required a considerable amount of time (and is still underway) but resulted in a much clearer understanding of the developmental aspect of learning we were attempting to capture with the continuum.

After completing the grid, we tested the continuum a second time and found it to be much easier to use and more informative. In particular, because the evidence we now accepted for competency in science can be demonstrated through multiple modes of representation, we believe our continuum is a more accurate means of assessing what a student does or does not know. Put another way, some aspects of learning how to learn science (e.g., uses science equipment safely, appropriately, and effectively) must be demonstrated, they can not be determined by paper and pencil assessments. A second benefit of using the revised continuum was that the teachers were starting to become much more aware of how the science activities students engaged in did or did not allow them to assess items on the continuum. While feedback from using this continuum allows teachers to provide students with more accurate information regarding their current development as a learner of science, it also allowed them to examine their assessment practices related to science instruction. This was an unexpected outcome but one that does fit well with the National Science Standard recommendation that there be a "match between the technical quality of the data collected and the consequences of the actions taken" (NRC, 1998, p.5).

Conclusions

Parents of students attending Highland Park have yet to receive Student Progress Reports that include the new form of science assessment. However, they have been very receptive to similar information about their child's development with respect to reading and writing. Highland Park teachers believe that many parents use feedback from the Student Progress Report to help their children work on specific literacy skills outside of the school setting. We anticipate that feedback from the science continuum will have similar impacts on the parents of these students. It is also our belief that, in combination with district and state level evaluations of specific science content and themes, information obtained from our continuum can provide a more complete picture of the process knowledge a student needs to master in order to learn science well. The continuum for assessing science process knowledge was recently presented to all of the teachers at Highland

Park Elementary with the expectation that they would use the continuum to assess students during the next term (Spring 1999). We plan to continue refining our continuum based on the feedback we receive from these teachers and to include the fully developed continuum on the Student Progress Report for the 1999-2000 academic year.

References

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Appendix A

Highland Park Student Progress Report
(note completed continua for Reading and Writing)

INTEGRATED CURRICULUM

SOCIAL STUDIES, SCIENCE, HEALTH	Nov	Jan	Mar	Jun

Units of Study:

Nov ____________________

Jan ____________________

Mar ____________________

Jun ____________________

EFFORT	Nov	Jan	Mar	Jun

MATHEMATICS

Math Concepts

	Nov	Jan	Mar	Jun
Patterns				
Numbers				
Addition				
Subtraction				
Multiplication				
Geometry				
Measurement				
Problem-Solving				
Graphs				
Estimation				
EFFORT				

The parent handbook includes descriptions of each concept. See accompanying letter for specific math skills and concepts emphasized this reporting period.

Teacher Comments/Recommendations

Your child will be in grade _____ next year.

Highland Park Elementary
South-Western City Schools
STUDENT PROGRESS REPORT
PRIMARY

Name ____________________

Teacher ____________________

Grade Level ____________________

Year ____________________

Developmental Philosophy

At Highland Park we believe that all children are unique and capable learners. Our goal is to build and expand upon the knowledge and abilities that children bring to school. We also recognize that children learn at different rates and in different ways.

This document identifies the learning progression that children make as they move through the grade levels. It demonstrates that there is a range of normal development.

This document should be used with the parent handbook to follow your child's learning.

ATTENDANCE

	Nov	Jan	Mar	Jun
Absent				
Tardy				

Progress affected by absence (*)

Parent Signature

1 ____________________

2 ____________________

3 ____________________

Developed by Highland Park Professional Development Site Staff in conjunction with The Ohio State University, College of Education, Department of Educational Theory and Practice, 1994. Revised June 1996.

KEY

for Levels of Achievement for INTEGRATED CURRICULUM, MATH, ART, MUSIC, & PHYSICAL EDUCATION

1 - Applies skills and concepts independently
2 - Is exploring skills/concepts
3 - Is successful when assisted
4 - Is experiencing difficulty
☐ - (Blank Space) Not applicable at this time

KEY

for EFFORT and SOCIAL DEVELOPMENT

O Outstanding
S Satisfactory
I Improving
N Needs Improvement

SOCIAL DEVELOPMENT

	Nov	Jan	Mar	Jun
Works independently				
Works well with others				
Listens attentively				
Accepts responsibility for actions				
Can cooperate and compromise				
Follows directions				
Follows rules				
Organizes time, work, and belongings				
Works carefully and neatly				
Completes work in a reasonable time				
Effectively communicates ideas orally				

ART

Understands key ideas/demonstrates skills				
Participates in activities				

MUSIC

Understands key ideas/demonstrates skills				
Participates in activities				

PHYSICAL EDUCATION

Demonstrates appropriate motor skills development				
Participates in activities/demonstrates sportsmanship				

L I T E R A C Y

READING Your child's learning progression as of:

Emerging — Beginning — Developing — Advancing — Consolidating

Emerging:
- enjoys books and being read to
- reads from pictures rather than print
- tells a familiar story while turning the pages
- knows that books have a front and back
- recognizes that print contains meaning
- responds positively to being read to

Beginning:
- is building confidence as a reader
- is increasing ability to use reading strategies
- demonstrates knowledge of the conventions of print
- responds to stories
- recognizes sight words

Developing:
- is achieving confidence as a reader
- is developing the ability to use a variety of reading strategies
- knows more print conventions
- responds to stories
- uses basic reference skills
- is increasing sight vocabulary rapidly

Advancing:
- is a confident reader
- uses a variety of strategies successfully
- responds to literature and text
- expresses opinions and can support them with evidence from a book
- uses books to get information
- has a wide reading vocabulary

Consolidating:
- is an accomplished reader
- can manipulate texts
- responds to literature texts in a variety of ways
- gathers information and ideas from texts
- has an expanded vocabulary

	Nov	Jan	Mar	Jun
EFFORT				

WRITING Your child's learning progression as of:

Emerging — Beginning — Developing — Advancing — Consolidating

Emerging:
- understands that language can be written
- knows some print conventions
- may try to read own writing

Beginning:
- is building confidence as a writer
- is becoming aware of steps in the writing process
- tries limited forms of writing
- forms letters correctly
- applies some spelling knowledge
- uses some punctuation

Developing:
- demonstrates growing confidence as a writer
- is beginning to use steps in the writing process
- begins to consider audience for each piece of writing
- is trying different forms of writing
- writes legibly in print or cursive
- is increasing spelling knowledge
- uses more punctuation

Advancing:
- is a fluent, confident writer
- is consistently using most steps of the writing process
- writes appropriately for different audiences and purposes
- controls more forms of writing
- spelling is generally accurate
- punctuation is generally accurate

Consolidating:
- is an accomplished writer
- is effectively using all steps of the writing process
- writes for a wide range of purposes
- knows that the purpose and audience for writing will dictate the form
- spelling and punctuation are highly accurate

	Nov	Jan	Mar	Jun
EFFORT				

Appendix B
Rubric Sheets for Assessing Science Process Knowledge

Emerging (Grades K-1-2)
+ assessed by one observation, relatively easy to assess
√ assessed by more than one observation, adequately assessed over time

+	√	Assessment item	Observe	Verbal	Text	Picture, etc.
+		describes gross physical characteristics of an object	sorts and classifies objects based on physical characteristics	states obvious physical characteristic - *the bear is brown*	writes descriptive comments about an object - *the brown bear has big teeth*	draws a picture that resembles an object - colors a bear brown
+		explores the physical capacity of containers	pours water/rice/sand from one container to another	makes comparisons between differing volumes - combines two or more volumes into one container	writes about the number of objects (i.e., counting bears) that fit in a container	
	√	knows the names for (un)common physical objects		gives names to objects - *this is a kangaroo, a crystal, the root of a plant*		labels or names objects in a drawing
	√	asks questions of a factual nature		questions can be answered with an undisputed fact _ *How many ...? What are the parts of ...? Where does it come from?*		
	√	defers explanation to others/authorities		Defers explanation to others - *my parent said...*	cites the ideas of others - *in the book it said ...*	

Beginning (Grades 1-2-3)

+ assessed by one observation, relatively easy to assess

√ assessed by more than one observation, adequately assessed over time

		Assessment item	Observe	Verbal	Text	Pictures, etc.
+		asks questions about the characteristics of objects and phenomena		asks questions about the properties of an object - *Why is this rock shiny? What makes thunder? Which objects sink/float?*	writes questions as hypotheses - *We wanted to know why this rock is shiny. We wanted to know why things sink and float.*	
+	√	explains how an object interacts with its surroundings		mentions the interaction of two or more objects - *the plant needed sunlight to grow*	constructs a concept or idea map	draws before and after pictures
+	√	uses science equipment to collect information (rather than as a toy)	gradually spends more time working with (than playing with) equipment			
	√	understands that phenomena can have names				
	√	gives egocentric reasons as an explanation				

Developing (Grades 2-3-4)

+ assessed by one observation, relatively easy to assess

√ assessed by more than one observation, adequately assessed over time

		Assessment item	Observe	Verbal	Text	Pictures, etc.
+	√	understands how to collect and organize data			includes a summary of data as part of a lab report - includes a chart, graph or drawing	provides a title and labels the axis of a bar graph, pie chart or drawing
+	√	uses science equipment safely, appropriately, and effectively	uses equipment to extend senses - uses a magnifying glass, balance or eye dropper to make precise observations or measurements		writes about how equipment helped them extend their senses - *we measured exactly five drops of water...*	
+		identifies variables that affect an experiment		states which variable(s) they might investigate - *we could investigate the effects of water or light or soil*	writes about the variable(s) and control group they plan to investigate - *we studied how much water plants need to grow well by...*	
+		gives procedures for what was done		states procedures in sequential order - *first we... then we...*	writes formal procedures for an investigation - *Step 1: prepare soil for seeds. Step 2: plant seeds just under the soil.*	

+	√	explores the research of others	consults existing resources - reads books, explores the internet resources	identifies the questions that were important to an investigator - *these investigators wanted to know...*	cites information gleaned from more than one source in a lab report - *Smith said...and Jones said...*	
	√	gives increasingly more precise descriptions of common physical objects		knows the names for common parts - *the parts of a plant are the root, stem, leaf, and flower*	describes the functions of parts of an object - *the root absorbs water, the leaf makes food for the plant*	labels a drawing of an object - labels the parts of a plant accurately
	√	is thinking about objects and physical event from a perspective other than their own		explains how other might see an event - *if you were on the sun, the earth would revolve around you*		illustrates objects that are beyond their immediate perception - draws objects seen through a microscope or the planets in our solar system
	√	links explanations for an event with observations of the event		relates an observation to an explanation - *the puddle dried up when the sun came out and made the water evaporate*	explains how they think something happened - *the red dye went through the Celery and into the leaves*	

Advancing (Grades 3-4-5)

+ assessed by one observation, relatively easy to assess

√ assessed by more than one observation, adequately assessed over time

		Assessment item	Observe	Verbal	Text	Pictures, etc.
+		describes common physical objects in precise detail		uses precise terminology - *this is the femur*	describes objects in detail - *the crystals are clear, triangular, and shiny*	labels precise details in a drawing - labels the filament, anther, stigma, style, and ovary
	√	predicts how an object would behave if you changed the conditions	tests a prediction - puts hot water and cold in a freezer to see which turns solid first	states a prediction - *if I put hot and cold water...*	writes about the results that came from testing a prediction - *we put hot and cold water in the freezer and...*	
+		uses science information books or resources in the library	locates resources such as atlases, encyclopedias, and field guides	refers to an information resource they used - *we found this is in...*	uses information from resources in written reports - includes a bibliography in a report	incorporates illustrations from science information resources in written reports
	√	extracts useful facts or constants from reference materials			includes new facts in a concept or idea map	
	√	recognizes the importance of the data or information collected		reports orally on the data collected - the sample of water we looked at had...	summarizes data to make a point - the data we collected tells us that...	

+		selects appropriate science equipment to use during an investigation	chooses equipment to measures precise volume, mass, etc.			
	√	links information into a chain/sequence of events that explain some phenomena		states events in a sequence that explains how a event happens - water, warmed by the sun, evaporates into the atmosphere, condenses around a dust particle, precipitates as rain, snow or dew, and runs back to the ocean	writes a sequence that explains how a event happens	
	√	describes the outcome of an investigation		talks about an investigation in several ways - to describe procedures, persuade peers, summarize data, etc.	writes about the what, when, where, and how of an experiment	

Consolidating (grades 5-6+)
+ assessed by one observation, relatively easy to assess
√ assessed by more than one observation, adequately assessed over time

		Assessment item	Observe	Verbal	Text	Pictures, etc.
+		uses scientific vocabulary appropriately and accurately				
+	√	is comfortable/confident using science equipment				
	√	gives causal explanations for why something happened as it did				
+		beginning to reason about events that could happen hypothetically				
	√	completes a series of investigations on one topic				
	√	writes about questions they would like to study next				
	√	communicates their findings and questions of interest to others				

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