Achieve

Report

Connecting Science Standards with Assessment: A Snapshot of Three Countries' Approaches – England, Hong Kong and Canada (Ontario)

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Introduction

The education community has known for some time that a powerful lever in improving student achievement is putting into place an instructional system where the central components—academic standards, quality assessments, teacher education and professional development and instructional materials are aligned. Implementation has trailed vision in the U.S., but there is now renewed energy toward realizing the vision with the adoption, by a growing majority of states, of the Common Core State Standards in English language arts and mathematics. In fact, work has already begun on plans for states to collaborate on common assessments in those subjects.

While the attention of policy leaders and the education community at-large has been focused on English language arts and mathematics, calls for reform of science education have been building in intensity since the release of *Rising Above the Gathering Storm* in 2005[1] and bolstered by other related influential reports. Most recently, the Carnegie foundation gave fresh impetus to STEM reform when it published *The Opportunity Equation* in 2009[2] with the stated goal of having all students graduate from high school as STEM-capable and agreed to fund the National Research Council to develop a new conceptual framework for science education after which Achieve will lead the development of aligned next generation science standards. The National Research Council (NRC), Council of Chief State School Officers (CCSSO), National Governor's Association (NGA), American Association for the Advancement of Science (AAAS), the National Science Teachers Association (NSTA), and the Council of State Science Supervisors (CSSS), will be active in the development of the new standards.

Few quarrel with the need to re-think science education. Science education in the United States has a long history of standards characterized by shallow coverage, disconnected lists of topics, and too little attention to how understandings can be supported and scaffolded from grade to grade. In preparation for the development of the NRC conceptual framework and next generation science standards, Achieve undertook a study of ten countries' standards in a search for exemplary features and to identify the emphasis, on average, that countries give to major curriculum topics. In the process of examining these international standards and supporting documents, Achieve noted that a few countries took pains to underscore the connection of their standards to their assessments. Specifically, in this brief, Achieve looks at the links between standards and assessments in three countries—England, Hong Kong and Canada (Ontario).

Achieve, through support from the Noyce Foundation, examined ten sets of international standards with the intent of informing the development of both the conceptual framework and new U.S. science standards. Achieve selected countries based on their strong performance on international assessments and/or their economic, political, or cultural importance to the United States.

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[1] Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future.

[2] Carnegie Corporation of New York and Institute for Advanced Study, The Opportunity Equation: Transforming Mathematics and Science Education for Citizenship and the Global Economy
<http://www.opportunityequation.org/report/executive-summary/>

Implications for States

As the movement toward enacting higher standards and more rigorous assessments becomes more entrenched in the U.S., the demand for support from state education agencies (SEAs) by their local districts will only continue to grow. Certainly this proved to be the case when the No Child Left Behind Act required states to implement science standards and assessments in 2007. It has been standard practice for SEAs to produce and post content descriptions on their websites regarding statewide assessments. And it is also common for SEA staff to develop instructional frameworks and curricular materials to use for teacher professional development and to enrich lesson planning. In support of helping SEAs meet these on-going challenges, this brief offers a glimpse of other countries' guidelines. The 10 countries Achieve examined in its international benchmarking study take a variety of approaches to standards and assessments, but three countries' efforts (England, Hong Kong and Canada[3]) to connect their standards, assessments and instruction stand out. By underscoring the importance of connectivity, the respective policy leaders made an excellent decision, for this type of practice engenders trust and opens up communication channels. When curriculum and assessment experts, who have complementary skills, collaborate, it becomes feasible not only to develop assessments that are aligned to standards, but also stretch from formative classroom assessments to summative state assessments. Without such collaboration, there are often disconnects between the intended rigor and quality of the standards and enacted assessments.

The practices that the three countries put in place are worthy of consideration by states. To be effective, teachers must have a clear understanding about the content of the statewide assessment and how it relates to everyday instruction. Involving teachers in the process of linking assessments to standards serves to deepen their understanding of the alignment process, including the types of items required for rigorous assessment—especially those required to evaluate higher-order thinking, inquiry and design skills. Experience has also shown that engaging teachers in the process of constructing and scoring classroom and school-based assessments is a powerful form of professional development that results in improving student achievement. Thus it is worth the effort for SEAs to be as transparent as possible regarding the assessment to standards connection and develop models that districts can adopt and/or adapt. Thoughtfully developed, aligned models substantiate the connection and counteract impressions that the statewide assessment is based on a hidden set of standards.

In sum, SEAs go through extensive protocols to align assessment with standards that are necessary to ensure a valid assessment instrument and to increase students' opportunity to learn the assessed material. With some extra effort, states can enhance this practice by insisting upon collaboration between staff in charge of standards and curriculum and staff in charge of assessment. A unified effort ensures alignment and a clear message to all stakeholders as to content, rigor, and intent of both classroom and state assessments.

[3] Canada is represented by standards from the Province of Ontario. Canada delegates responsibility for the development of standards to the provinces or territories so that like U.S. states, each province has its own set of standards. Ontario's standards are clearly written and therefore are a good choice for comparison – throughout the rest of this document references to Canada are referring to the Province of Ontario's standards).

Similarities and Differences Among Countries Assessment Practices

While a thorough description of each country's assessment system is beyond the scope of this brief, what follows is some helpful context for the examples we feature.

In two of the countries, England and Hong Kong, decisions about education goals, content of the curriculum, and formal assessments are made by a national governing authority. England and Hong Kong both have national curricula and a system of national, high-stakes secondary assessments to help ensure rigor and transparency. England publishes its secondary examinations online, while Hong Kong does not—although candidates are able to purchase subject examination reports and question papers. Despite having strong central education agencies, both countries allow and encourage localities and schools to assume some responsibility for making curricular decisions.

Canada is similar to the United States in that the education decision-making authority is reserved for each of Canada's 13 jurisdictions (10 provinces and three territories),[4] including the development of standards and curricula. Thus, Canada's national standards are used as the basis for provinces developing their own standards—a situation reminiscent of states modeling their science standards on the NRC's National Science Education Standards. Canada has a national assessment in language arts, math and science, the Pan-Canadian Assessment (PCAP) that is similar to PISA (in which Canada also participates) in that it targets one content area each testing round and is not a high-stake assessment. Unlike PISA, which assesses 15 year-olds, PCAP is administered to a sample of 13 and 16 year olds. Some provinces, such as Alberta and Ontario, administer their own exams based on their own standards and require these for graduation. In recent years, the provinces and territories have come together under an umbrella organization, the Council of Ministers of Education (CMEC), to foster cooperation on issues of common concern. Currently, there is no move toward national education standards.

One concern that is common to the three countries is an expressed interest in providing for more in-depth study and assessment of key abilities. For example, England's recent report on *Science and Mathematics Secondary Education for the 21st Century* includes as one of its recommendations: *The style of examinations should be re-balanced towards assessment of students' in-depth problem solving and deeper understanding of subject concepts; and there should be greater emphasis on the accurate use of the English language in answers to examination questions.*[5] Hong Kong re-vamped science education in its primary schools in 2004 with the intent of promoting creativity through hands-on, minds-on learning experiences and problem-solving processes and by emphasizing inquiry and learning to learn skills. They further encouraged the shift by putting laboratories or activity rooms for science in primary schools. Reforms were extended to Lower Secondary schools and significant changes occurred at Upper Secondary with the introduction of school-based assessment to reduce the pressure of one high-stakes exam.[6] Hong Kong's curriculum unit topics for Upper Secondary courses are described as *Compulsory* (for example, Cells and Molecules of Life) or *Elective* (for example, Biotechnology) to support extended investigations. Canada, by virtue of the emphasis on

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[4] International Review of Curriculum and Assessment Frameworks Internet Achieve. 2007. *Education Around the World: Canada* <http://www.inca.org.uk/1205.html>

[5] *Science and Mathematics Secondary Education for the 21st Century: Report of the Science and Learning Expert Group.* February 2010. p. 13

[6] Alice Siu Ling Wong and Benny Hin Wai Yung. The University of Hong Kong. *Science Education and Science Teacher Education in Hong Kong*. Power Point Presentation.

investigation and design that permeates its Science and technology standards, makes its goal in this regard, absolutely clear.

All three countries share an interest in making the role of formative assessment more central in their systems. Ontario, in developing detailed rubrics supported by student work, best captures the potential power of thoughtfully developed classroom and/or school-based assessment to raise student achievement. A capsule summary of each country's effort to realize and communicate the connection between its standards and assessments follows below.

England

England sets forth its statuary requirements that schools must meet in relation to the national curriculum by defining key stages and aligned programmes of study that describe what must be taught within a key stage.[7] However, the National Curriculum is not meant to be fully prescriptive, but rather *provides flexibility for schools to adapt the curriculum to their needs.*[8] At the secondary level England has national examinations that are the main route to higher education and may be required for some jobs. General Certificate of Secondary Education tests are taken by pupils of school leaving age. In science, at the end of Grade 9, most students take *Science A*. This award, along with a second assessment, *Additional Science,* allows progression to post-16 science courses. These more rigorous science examinations, i.e., General Certificate of Education subject-based tests (A Levels, short for Advanced levels) are mostly taken by students aged 16-19. In science these include Biology, Chemistry and Physics.

England specifies a set of attainment targets that link the key stages and programmes of study, helping to ensure students are on track to pass the national assessments. These targets describe, for students of different abilities and levels of maturity, the specific ways in which pupils can be said to demonstrate the acquisition of knowledge, skills and understandings that correspond to each key stage. Teachers are instructed that: *In deciding on a pupil's level of attainment at the end of a key stage, teachers should judge which description best fits the pupil's performance. When doing so, each description should be considered alongside descriptions for adjacent level.* [9]

The attainment targets are therefore intended to be specific criteria against which students' progress is to be assessed. An example of these can be seen in the following excerpt from an attainment target pertaining to *materials and their properties* and their relationship to Earth:

Attainment Target 3: materials and their properties
Level 1
Pupils know about a range of properties [for example, texture, appearance] and communicate observations of materials in terms of these properties.
Level 2
Pupils identify a range of common materials and know about some of their properties. They describe similarities and differences between materials. They sort materials into groups and describe the basis for their groupings in everyday terms [for example, shininess, hardness, smoothness]. They describe ways in which some materials are changed by heating or cooling or

[7] Science: The National Curriculum for England p.6 <http://www.nc.uk.net>
[8] National Curriculum Frequently asked questions (FAQs) <http://www.nc.uk.net>
[9] Science The National Curriculum for England, p. 74. © Crown copyright 1999 <http://www.nc.uk.net>

by processes such as bending or stretching.

Level 3

Pupils use their knowledge and understanding of materials when they describe a variety of ways of sorting them into groups according to their properties. They explain simply why some materials are particularly suitable for specific purposes [for example, glass for windows, copper for electrical cables]. They recognise that some changes [for example, the freezing of water] can be reversed and some [for example, the baking of clay] cannot, and they classify changes in this way.

Level 4

Pupils demonstrate knowledge and understanding of materials and their properties drawn from the key stage 2 or key stage 3 programme of study. They describe differences between the properties of different materials and explain how these differences are used to classify substances [for example, as solids, liquids, gases at key stage 2, as acids, alkalis at key stage 3]. They describe some methods [for example, filtration, distillation] that are used to separate simple mixtures. They use scientific terms [for example, evaporation, condensation] to describe changes. They use knowledge about some reversible and irreversible changes to make simple predictions about whether other changes are reversible or not.

Level 5

Pupils demonstrate an increasing knowledge and understanding of materials and their properties drawn from the key stage 2 or key stage 3 programme of study. They describe some metallic properties [for example, good electrical conductivity] and use these properties to distinguish metals from other solids. They identify a range of contexts in which changes [for example, evaporation, condensation] take place. They use knowledge about how a specific mixture [for example, salt and water, sand and water] can be separated to suggest ways in which other similar mixtures might be separated.

Level 6

Pupils use knowledge and understanding of the nature and behaviour of materials drawn from the key stage 3 programme of study to describe chemical and physical changes, and how new materials can be made. They recognise that matter is made up of particles, and describe differences between the arrangement and movement of particles in solids, liquids and gases. They identify and describe similarities between some chemical reactions [for example, the reactions of acids with metals, the reactions of a variety of substances with oxygen]. They use word equations to summarise simple reactions. They relate changes of state to energy transfers in a range of contexts [for example, the formation of igneous rocks].

Level 7

Pupils use knowledge and understanding drawn from the key stage 3 programme of study to make links between the nature and behaviour of materials and the particles of which they are composed. They use the particle model of matter in explanations of phenomena [for example, changes of state]. They explain differences between elements, compounds and mixtures in terms of their constituent particles. They recognise that elements and compounds can be represented by symbols and formulae. They apply their knowledge of physical and chemical processes to explain the behaviour of materials in a variety of contexts [for example, the way in which natural limestone is changed through the action of rainwater, ways in which rocks are weathered]. They use patterns of reactivity [for example, those associated with a reactivity series of metals] to make predictions about other chemical reactions.

Level 8

Pupils demonstrate an extensive knowledge and understanding drawn from the key stage 3 programme of study, which they use to describe and explain the behaviour of, and changes to, materials. They use the particle model in a wide range of contexts. They describe what happens in a range of chemical reactions and classify some [for example, oxidation, neutralisation]. They represent common compounds by chemical formulae and use these formulae to form balanced symbol equations for reactions [for example, those of acids with metals, carbonates or oxides]. They apply their knowledge of patterns in chemical reactions to suggest how substances [for example, salts] could be made.

Exceptional performance

Pupils demonstrate both breadth and depth of knowledge and understanding drawn from the key stage 3 programme of study when they describe and explain the nature and behaviour of materials. They use particle theory in a wider range of contexts, recognising that differences in the properties of materials relate to the nature of the particles within them. They recognise, and give explanations for, examples of chemical behaviour that do not fit expected patterns. They routinely use balanced symbol equations for reactions. They interpret quantitative data about chemical reactions, suggesting explanations for patterns identified.

As can be observed in the example, the targets are formulated in terms of the types of evidence that can be referenced in determining the level that each pupil has attained, making assessment in effect an intrinsic part of the standard.

Hong Kong

Hong Kong offers a somewhat contrasting perspective on connecting standards to assessment. The standards for Primary through Lower Secondary are embedded in a Curriculum Guide that includes a full chapter on assessment. The standards for Upper Secondary, entitled *Curriculum and Assessment Guides,* are specific to each science discipline, and the discussion of assessments permeates the entire document. A few comments regarding Hong Kong's philosophy and structure of its overall assessment system sets a context for the specific example described below.

The Guides all emphasize the importance of formative assessment and its critical role in helping students understand *how to plan and take control of their learning* and note that *summative assessment should not be used as the only means of assessment*.[10] Hong Kong guidelines stress that schools should use a variety of assessment including oral questioning, practical work and scientific investigations, written tests and projects. In Upper Secondary, summative public assessment, which includes public examinations and moderated school-based assessments[11], come to the fore. The Hong Kong Diploma of Secondary Education provides a common end-of-school credential that gives access to university study, work, and further education and training. Hong Kong's curricular documents discuss a wide range of types of evidence that should be collected to verify student's attainment of specific learning targets. For example, with respect to Microbiology in secondary school: [12]

[10] Science Education Key Learning Area Curriculum Guide (Primary 1-Secondary 3) 2002, pp. 55-56.
[11] HKEAA has adopted an SBA Moderation Mechanism to adjust SBA marks submitted by schools to iron out possible differences across schools in marking standards.
[12] Biology Curriculum and Assessment Guide (Secondary 4-6). 2007. pg. 54.

Students should learn	Students should be able to
a. Microbiology	
Viruses	
• Multiplication of viruses	• Describe how a virus reproduces by infecting a living cell.
Diversity of microorganisms	
• Representative organisms of Bacteria, Protista and Fungi	• Distinguish different groups of microorganisms based on group features. • Discuss the effects of environmental factors on the growth of microorganisms.
Growth of microorganisms (e.g. yeast)	
• Growth requirement – Temperature, pH, carbon and nitrogen sources, oxygen and water availability • Stages of growth • Measurement of growth – Cell counts, biomass and optical methods	• Measure and identify the different stages of growth of microorganisms in culture. • Outline the principle of aseptic techniques. • Use aseptic techniques and follow safety procedures in handling, culturing and disposing of microorganisms.

This example is typical of the entire standards document – all learning targets are presented along with a specification of the types of things students should be able to do that *demonstrate* their attainment of these goals.

Canada (Ontario)

In Ontario, an important priority in their standards is "to promote greater consistency in the assessment of student work across the province."[13] But the approach is different – rather than only describing criteria for determining the level of attainment of pupils or detailing specifications of the measurement standards, Ontario has designed a set of assessment tasks and scoring rubrics, and collected and published samples of actual student work. These are regarded as illustrations of the types of skills and knowledge that students should give evidence of as verification of their attainment of various levels of proficiencies associated with Ontario's goals.

The tasks are described in detail, including the types of measures that they are intended to provide, and then the rubrics are also detailed. Proficiency levels are tied to each one of these rubrics, and finally, two examples of genuine student work, associated with each one of the proficiency levels, are provided as illustrations. Each example is discussed and linked to both the rubric and the original description of the proficiency levels. Below is an example:

MAKING A TOY

<u>The Task</u>

Students were asked to build a toy for a young child incorporating mechanisms and simple machines. Specifically they were to:

- clarify the problem;
- brainstorm some possible solutions;
- draw design sketches for three of the solutions;

[13] The Ontario Curriculum - Exemplars, Grades 1 and 2; Science and Technology. P. 58

- choose one sketch as their plan;
- design and build a model;
- test the model and make any necessary changes;
- reflect on their learning.

Expectations

This task gave students the opportunity to demonstrate their achievement of all or part of each of the following selected overall and specific expectations from the strand Structures and mechanisms; Grade 2 – Movement

Students will:

1. Describe the position and movement of objects, and demonstrate an understanding of how simple mechanisms enable an object to move;
2. Design and make simple mechanisms, and investigate their characteristics;
3. Recognize that different mechanisms an systems move in different ways, and that the different types of movement determine the design and method of production of these mechanisms and systems;
4. Ask questions about and identify needs or problems related to structures an mechanisms, and explore possible answers and solutions;
5. Plan investigations to answer some of these questions or solve some of these problems, and describe the steps involved;
6. Communicate the procedures and results of investigations and explorations for specific purposes, using drawings, demonstrations, and oral and written description.

Prior Knowledge and Skills

To complete this task, students are expected to have some knowledge or skills related to the following:

- attaching axles and wheels
- making hinges and other simple linkages
- recognizing different simple machines
- using a design-process model
- connecting parts to create movement in different ways and directions

Task Rubric – Grade 2: Making a Toy

Expectations	Level 1	Level 2	Level 3	Level 4
Understanding of Basic Concepts	**The student:**			
	Demonstrates limited understanding of how mechanisms enable movement and changes in direction	Demonstrates some understanding of how mechanisms enable movement and changes in direction	Demonstrates general understanding of how mechanisms enable movement and changes in direction	Demonstrates thorough understanding of how mechanisms enable movement and changes in direction
Design Skills	**The student:**			
Identifying the problem/need	Describes with limited clarity the challenge of	Describes with some clarity the challenge of	Clearly describes the challenge of designing and	Precisely describes the challenge of designing and

Expectations	Level 1	Level 2	Level 3	Level 4
	designing and building a model of a toy incorporating simple machines	designing and building a model of a toy incorporating simple machines	building a model of a toy incorporating simple machines	building a model of a toy incorporating simple machines
	Lists a few of the steps needed to execute the plan	Lists some of the steps needed to execute the plan	Lists most of the steps needed to execute the plan	Lists in a detailed manner all or almost all of the steps needed to execute the plan
Making the plan	Creates a minimally labeled plan	Creates a partially labeled plan	Creates a fully labeled plan	Creates a detailed, fully labeled plan
Executing and evaluating the plan	Makes a few modifications to the plan as needed	Makes some modifications to the plan as needed	Makes appropriate modifications to the plan as needed, giving reasons for the modifications	Makes appropriate, detailed modifications to the plan as needed, giving reasons for the modifications
	Creates a model that resembles the plan to a limited extent	Creates a model that resembles the plan to some extent	Creates a model that resembles the plan including most recorded modifications	Creates a model that resembles the plan to a limited extent including most or almost all recorded modifications
	Makes limited improvements to the model	Makes some improvements to the model	Makes considerable improvements to the model	Makes insightful improvements to the model
Communication of Required Knowledge	**The student:**			
	Makes limited use of appropriate science and technology vocabulary to describe simple machines and their mechanisms	Makes some use of appropriate science and technology vocabulary to describe simple machines and their mechanisms	Makes general use of appropriate science and technology vocabulary to describe simple machines and their mechanisms	Makes extensive use of appropriate science and technology vocabulary to describe simple machines and their mechanisms
	Explains with limited clarity how the mechanism or simple machine is used to create movement, including changes in speed and direction	Explains with some clarity how the mechanism or simple machine is used to create movement, including changes in speed and direction	Explains clearly how the mechanism or simple machine is used to create movement, including changes in speed and direction	Explains precisely how the mechanism or simple machine is used to create movement, including changes in speed and direction
	Provides a simple	Provides a	Provides a clear	Provides a complex

Expectations	Level 1	Level 2	Level 3	Level 4
	explanation of how the toy could be used to improve fine-motor skills	somewhat clear explanation of how the toy could be used to improve fine-motor skills	explanation of how the toy could be used to improve fine-motor skills	and detailed explanation of how the toy could be used to improve fine-motor skills
Relating of Science and Technology to each other and to the world outside the school	**The student:**			
	Describes in limited detail similarities between the model and mechanisms and simple machines in real-life objects	Describes in some detail similarities between the model and mechanisms and simple machines in real-life objects	Describes in detail similarities between the model and mechanisms and simple machines in real-life objects	Describes in rich detail similarities between the model and mechanisms and simple machines in real-life objects

Following is a sample of a Grade 2 student's work assessed as Level 3, along with Teacher's Notes that explain the evaluation.[14]

[14] Adapted from The Ontario Curriculum – Exemplars Grades 1 and 2: Science and Technology 2002. Grade 2- Structures and Mechanisms – Making a Toy: Level 3, Sample 2 pgs 87-91. http://www.edu.gov.on.ca/eng/curriculum/elementary/scientec12ex/scien2_3.pdf

A

What I Need To Do

1. My job is to:

Make a toy for a small child to develop fine moter skills. The toy must have two simple machines.

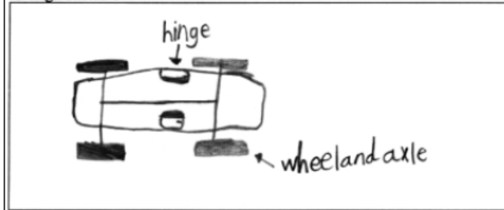
I need to:

plan my toy and then I have to biuld my toy then I have to explane how it works in front of the camras

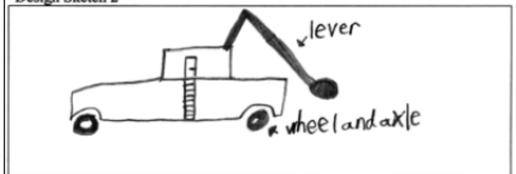
B

My Design Sketches

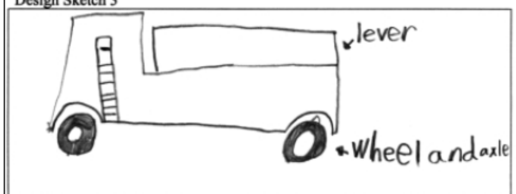
Design Sketch 1



Design Sketch 2



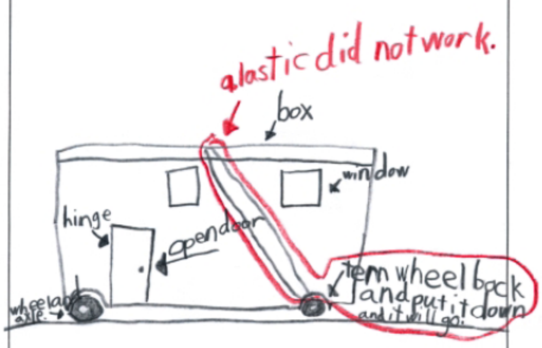
Design Sketch 3



C

My Working Plan

Label Your Work:



the reason I chose this design is because I hade a good plan.

D

My List of Materials

I need a box, wheels, alastic, stiks, glue, scissors, tape.

E

My Step-By-Step Procedures
(Remember to number your steps)

1. Gather materials. 2. Take box 3. Pok four holes inbox. 4. Pote two sticks throught holes. 5. make hole in the bottom. 6. atach elastic from top of the box to stick. 7. make windows and door.

F

My Reflections

1. What simple machines did you use, and how did you connect any moving parts?

I used a hinge and a wheel and axle. I glued two wheels to one axle and put it through two holes. I cut out a door to make a hinge.

2. What changes did you make to improve your toy?

I wonted to make a wined up car but I couldn't because the ilastic cept on breaking.

3. How did you use simple machines to make something move faster and/or change direction?

I yoused a wheel and axle to make it go fast and push it back and forth so it can chang direction.

G

4. How can your toy be used to help a young child to improve his or her fine motor skills?

They have to push the the door open and shut.

5. Identify and describe an object in the outside world that uses one of the same simple machines you used in your model to create movement.

A car has hing and wheel and axle.

H

6. What are other ways we use simple machines to make our lives more enjoyable?

We use wheels and axles for biciKles and levers for see saws and pullys to pull stuf up.

Teacher's Notes

Understanding of Basic Concepts

- The student demonstrates general understanding of how mechanisms enable movement and changes in direction (e.g., [P] My Reflections [3]: "I yoused a wheel and axle to make it go fast and push it back and forth so it can change direction."; [V] "I used an axle to connect two wheels.").

Design Skills

- The student clearly describes the challenge of designing and building a model of a toy incorporating simple machines (e.g., [P] What I Need To Do [1]: "Make a toy for a small child to develop fine moter skills. The toy must have two simple machines."; [2]: "plan … biuld [build] … explane howit works …").
- The student lists most of the steps needed to execute the plan (e.g., My Step-By-Step Procedures: lists seven steps).
- The student creates a fully labelled plan (e.g., [P] clearly indicates on the labelled plan the mechanisms used: "hinge, wheel and axle").
- The student makes appropriate modifications to the plan as needed, giving reasons for the modifications (e.g., [P] indicates modification in My Working Plan drawing and makes reference to the change in My Reflections [2]: "I wanted to make a wined up [wind-up] car but I couldn't because the ilastic cept on breaking.").
- The student creates a model that resembles the plan, including most recorded modifications (e.g., [V] builds a model that clearly matches the working plan; [P] My Working Plan: records on plan that "ilastic [elastic] did not work.").
- The student makes considerable improvements to the model (e.g., [P/V] realizes, through testing, that the wind-up mechanism kept breaking, so substitutes a simpler mechanism).

Communication of Required Knowledge

- The student makes general use of appropriate science and technology vocabulary to describe simple machines and their mechanisms (e.g., [P] My Reflections [6]: "… wheels and axles for bicikles [bicycles] and levers for seesaws and pullys to pull stuf up."; [V] "I used an axle to connect two wheels.").
- The student explains clearly how the mechanism or simple machine is used to create movement, including changes in speed and direction (e.g., [V] "… used a wheel and axle to move and to change directions you push it forward and backwards."; [P] My Reflections [3]: "I yoused [used] a wheel and axle to make it go fast …").
- The student provides a clear explanation of how the toy could be used to improve fine-motor skills (e.g., [P] My Reflections [4]: "They have to push the door open and shut.").

Relating of Science and Technology to Each Other and to the World Outside the School

- The student describes in detail similarities between the model and mechanisms and simple machines in real-life objects (e.g., [V] "… a car uses a wheel and axle and hinge."; [P] My Reflections [6]: "We use … levers for seesaws and pullys to pull stuf up.").

Comments/Next Steps

- The student demonstrates a good understanding of the design process, including testing and modifying.
- The student could provide more detail in written and oral responses.
- The student should try to supply relevant reasons to support the choice of product design.
- The student should correct spelling errors by referring to resources such as word lists, wall charts, and a personal dictionary.

91 Grade 2 – Structures and Mechanisms

Conclusion

Achieve focused on England, Hong Kong and Canada (Ontario) to show how three countries link their standards to their assessments. What is essential to note is that all three countries conceive of standards as being inextricably linked to a discussion of the body of evidence that must be assessed in order verify how well standards have been attained. This linkage is one feature of a strong standards document. The role of standards and their connection to assessments in all three countries examined will be important to keep in mind as Achieve and its partners move forward in the development of next generation science standards.

