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Effective Lesson Planning

A Resource Manual for Developing Effective Lesson Plans

HOBOKEN SCHOOL DISTRICT

Contents

Lesson Planning Template
Implementation Schedule

Usage of the District Lesson-Planning Template during the 2011 – 2012 School Year:

	Non-Tenured Teachers	**Tenured Teachers**
Marking Period #1	All Lessons	Use is Optional
Feedback Form to Teachers	Used for all Plans	Optional
Marking Periods #2 & 3	All Lessons	Elem. – Minimum of all ELAL Lessons Secondary – Min. of 1 Course/Section
Feedback Form to Teachers	Used for all Plans	Used for Min. # of Lesson Plans
Marking Period #4	All Lessons	Elem. – Min. of all ELAL & all Math Lessons Secondary – Min. of 2 Course/Sections
Feedback Form to Teachers	Used for all Plans	Used for Min. # of Lesson Plans
School Year 2012 – 2013	All Lessons	All Lessons
Feedback Form to Teachers	Used for all Plans	Used for all Plans

Introduction

Effective lesson planning is at the core of effective teaching. This resource manual is intended to provide a concrete, systematic method for designing and evaluating Unit Plans and Lesson Plans. This manual contains a rubric to evaluate lesson plans, and a glossary which offers definitions for terms used in that rubric. Unit Plan and Lesson Plan templates are also included. These templates are available to staff members on the District web site. Additionally this resource manual includes sample lesson plans which are provided as exemplars.

According to Madeline Hunter (1982) the effective teacher is one who teaches to an objective, at the correct level of difficulty, and then monitors and adjusts instruction to maximize student learning. Madeline Hunter's seven-step approach (1982) to lesson planning is reflected in this resource manual. The seven steps fall under four categories as follows:

Getting Students Ready to Learn
1. Review
2. Anticipatory Set - focus attention, gain interest - the "hook", connect new to known
3. Stating the objective

Instruction
4. Input and modeling

Checking for Understanding
5. Check for understanding
6. Guided practice - provide feedback without grading

Independent Practice
7. Independent practice - usually for a graded assignment

A highly valuable resource for teachers is Grant Wiggins' website:
http://www.authenticeducation.org/ae_bigideas/

LESSON PLAN EVALUATION RUBRIC

OBJECTIVE	**Not Evident / Unsatisfactory**	**Basic**	**Proficient**	**Distinguished**
Statement of Objective(s) (Learning, Behavior, & Condition)	Objective(s) not stated	Objective(s) stated but no reference to what the students will know and be able to do	Objective(s) stated with reference to what the students will know and be able to do	Objective(s) clearly stated with reference to what the students will know and will be able to do and how they will demonstrate what they know and are able to do, and under what circumstances the learning will take place
CCCS Alignment	No alignment or inaccurate alignment with CCCS	Alignment with CCCS partially accurate and/or incomplete	Alignment with CCCS accurate	Alignment with CCCS accurate and reflects more than one content area
Cognitive Level of Lesson (Refer to Bloom's Taxonomy)	Cognitive Level of Lesson not stated or cannot be determined	Cognitive Level of Lesson not appropriate and/or not linked to Objective(s)	Cognitive Level of Lesson appropriate and linked to stated Objective(s)	Cognitive Level of Lesson appropriate, linked to Objective(s) and refers to what students will know, understand, and be able to do

INSTRUCTIONAL STRATEGIES	**Not Evident / Unsatisfactory**	**Basic**	**Proficient**	**Distinguished**
Opening (Purpose Setting, Anticipatory Set, Assessment of Background Knowledge with anticipated responses, Review)	No evidence of Opening elements	Evidence of at least one Opening element	Evidence of at least two opening elements	Clearly stated evidence of integration of at least three Opening elements
Presentation (Input, Modeling, Checking for Understanding)	No evidence of Input, Modeling or Checking for Understanding	Evidence of Input or Modeling or Checking for Understanding	Evidence of at least two presentation elements	Clearly stated evidence of integration of presentation elements throughout the lesson
Guided Practice	No evidence of Guided Practice	Practice provided but no guidance by teacher	Guided Practice provided	Guided Practice provided with clearly stated alternative strategies for practice planned
		(Continued)		

INSTRUCTIONAL STRATEGIES	Not Evident / Unsatisfactory	Basic	Proficient	Distinguished
Closure (with anticipated responses)	No evidence of closure	Closure only provides summary of major points	Closure provides summary of major points and ties those points into a coherent whole	Closure provides clearly stated summary of major points, ties those points into a coherent whole and provides preview of future lesson

ASSESSMENT	Not Evident / Unsatisfactory	Basic	Proficient	Distinguished
Formative	No evidence of formative assessment	Evidence of formative assessment but does not appropriately align with objective	Evidence of formative assessment and appropriately aligns with objective	Clearly stated evidence of formative assessment, appropriately aligns with objective and alternate assessment planned
Individual Measurability	No evidence of formative assessment; therefore, not individually measurable	Formative assessment appropriately aligns with objective but is not individually measurable	Formative assessment appropriately aligns with objective and is individually measurable	Clearly stated evidence of formative assessment appropriately aligns with objective, is individually measurable; multiple measures employed to assess individual student understanding
Summative	No evidence of summative assessment	Summative assessment included, but does not align with objective	Summative assessment included, and aligns with objective	Summative assessment included, aligns with objective, used to link to subsequent lessons

DIFFERENTIATION	Not Evident / Unsatisfactory	Basic	Proficient	Distinguished
Varied Content (Readiness/Skills, Interests, Learning Styles)	No evidence of differentiation of content	Evidence of one appropriate approach to differentiation of content but not linked to teacher knowledge of the students	Evidence of one appropriate approach to differentiation of content linked to teacher knowledge of the students	Clearly stated evidence of two or more appropriate approaches to differentiation of content linked to teacher knowledge of the students
Varied Process (Input, Classroom Organization and Instructional Grouping)	No evidence of differentiation of process	Evidence of at least one process element of differentiation, but not linked to teacher knowledge of the students	Evidence of at least two process elements of differentiation, and linked to teacher knowledge of the students	Clearly stated evidence of all three process elements of differentiation, and linked to teacher knowledge of the students
		(Continued)		

DIFFERENTIATION	Not Evident / Unsatisfactory	Basic	Proficient	Distinguished
Varying Product (Task and/or assessment)	No evidence of differentiation of product	Evidence of one or both product elements of differentiation, but not linked to teacher knowledge of the students	Evidence of one or both product elements of differentiation, and linked to teacher knowledge of the students	Clearly stated evidence of both product elements of differentiation, and linked to teacher knowledge of the students

TECHNOLOGY	Not Evident / Unsatisfactory	Basic	Proficient	Distinguished
Integration of Technology into the lesson	No evidence of technology integration	Evidence of technology considered as a tool at either the Entry* or Adoption* level	Evidence of technology considered as a tool at either the Constructive* or Authentic* level	Clearly stated evidence of technology considered as a tool at either the Authentic* or Goal-Directed* level
Variety of Technology Used in the Lesson	Little or no technology used during the lesson	One instance of technology usage	More than one type of technology or application is integrated into the lesson, at least one of which is used by the student.	Multiple types of technology or applications are integrated into the lesson, and students use two or more of these.

*Levels of Technology Integration are taken from the Technology Integration Matrix (Florida Center for Instructional Technology, USF). See Page 26 of this booklet, or: http://fcit.usf.edu/matrix/index.php

Lesson Plan Evaluation Sheet
(For Use with Lesson Plan Rubric)

Teacher's Name:

Lesson Plans for the Week of:

Course/Subject Area:

Rating Scale: U = Unsatisfactory / B = Basic / P = Proficient / D = Distinguished

Statement of Objective	CCCS Alignment	Cognitive Level of Lesson	Opening	Presentation	Guided Practice	Closure

Formative Assessment	Individual Measurability	Summative Assessment	Varying Content	Varying Process	Varying Product	Technology Integration	Variety of Technology

Overall Rating:

Narrative Comments:

______________________________ Administrator

______________________ Date

LESSON PLANNING GLOSSARY OF TERMS

Anticipated Responses

The predicted student responses to questions asked by the teacher to check for understanding. achieve closure and assess background knowledge.

Anticipatory Set

Anticipatory set or Set Induction: sometimes called a "hook" to grab the student's attention: actions and statements by the teacher to relate the experiences of the students to the objectives of the lesson. To put students into a receptive frame of mind.

- to focus student attention on the lesson.
- to create an organizing framework for the ideas, principles, or information that is to follow (c.f., the teaching strategy called "advance organizers").
- to extend the understanding and the application of abstract ideas through the use of example or analogy...used any time a different activity or new concept is to be introduced.
- to activate and assess prior knowledge.

Assessment of Background Knowledge

Determination of what students know about a topic before it is taught. (See also Anticipatory Set)

Checking for Understanding

Determination of whether students have "got it" before proceeding. . If there is any doubt that the class has not understood, the concept/skill should be re-taught before practice begins. Anticipated Responses by students must be included in the lesson plan to assess their understanding. Closure in a lesson provides the last opportunity to check for understanding.

Classroom Organization

The physical layout of the classroom

Clearly Stated

This description (used in Advanced Proficient) refers to clarity, cohesiveness, and precision of language. This phrase indicates that there are very few, if any, spelling, grammar, or usage errors.

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LESSON PLANNING GLOSSARY OF TERMS
(Continued)

Closure

Those actions or statements by a teacher that are designed to check for understanding and to bring a lesson presentation to an appropriate conclusion. Used to help students bring things together in their own minds, to make sense out of what has just been taught. (the objectives) "Any questions? No. OK, let's move on" is not closure. Anticipated Responses by students must be included in the lesson plan to assess their understanding.

Closure is used:

- to cue students to the fact that they have arrived at an important point in the lesson or the end of a lesson,
- to help organize student learning,
- to help form a coherent picture, to consolidate, eliminate confusion and frustration, etc.,
- to reinforce the major points (the objectives) to be learned...to help establish the network of thought relationships that provide a number of possibilities for cues for retrieval. Closure is the act of reviewing and clarifying the key points of a lesson, tying them together into a coherent whole, and ensuring their utility in application by securing them in the student's conceptual network for future related lessons.

Cognitive Level of Lesson (Bloom’s Taxonomy)

Identifies the six cognitive levels: Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation. Levels must be indicated in Instructional Strategies and Assessment sections of lesson plan.

Differentiation

Recognition of students’ varying background knowledge, readiness, language, preferences in learning, interests. Differentiated instruction is a process to approach teaching and learning for students of differing abilities in the same class. The intent of differentiating instruction is to maximize each student’s growth and individual success by meeting each student where he or she is, and assisting in the learning process.

Differentiating the Content

Because students vary in readiness, skill levels, interests and learning styles, it is important to vary or differentiate content in response to those student traits. Strategies for differentiating content include providing materials at various reading levels, pre-teaching and re-teaching, providing interest centers with tasks at varying levels, and presenting in visual, auditory and kinesthetic modes.

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LESSON PLANNING GLOSSARY OF TERMS
(Continued)

Differentiating the Process/Activities

Differentiating the processes means varying learning activities or strategies to provide appropriate methods for students to explore the concepts. It is important to give students alternative paths to manipulate the ideas embedded within the concept. For example students may use graphic organizers, maps, diagrams or charts to display their comprehension of concepts covered. Varying the complexity of the graphic organizer can very effectively facilitate differing levels of cognitive processing for students of differing ability.

Differentiating the Product

Differentiating the product means varying the complexity of the product that students create to demonstrate mastery of the concepts. Students working below grade level may have reduced performance expectations, while students above grade level may be asked to produce work that requires more complex or more advanced thinking. There are many sources of alternative product ideas available to teachers. However sometimes it is motivating for students to be offered choice of product.

Essential Questions
See Below

Enduring Understanding (Big Idea)
See Below

Formative Assessment

Ongoing assessment that provides information to guide teaching and learning for the purpose of monitoring and adjusting instruction to improve student achievement.

Guided Practice

An opportunity for each student to demonstrate grasp of new learning by working through an activity or exercise under the teacher's direct supervision. It is essential that students practice doing it right so the teacher will know that the students understand before proceeding. The teacher moves around the room to determine the level of mastery and to provide individual remediation as needed.

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LESSON PLANNING GLOSSARY OF TERMS
(Continued)

Independent Practice

Once pupils have mastered the content or skill, it is time to provide for reinforcement practice. It is provided on a repeating schedule so that the learning is not forgotten. It may be home work or group or individual work in class. It can be utilized as an element in a subsequent project. It should provide for de-contextualization: enough different contexts so that the skill/concept may be applied to any relevant situation...not only the context in which it was originally learned. The failure to do this is responsible for most student failure to be able to apply something learned.

Individual Measurability

The ability to assess each student's understanding of the lesson content.

Infusion of Technology

Technology used in the teaching, comprehension, application, analysis, and/or the synthesis of the content of the lesson. Technology can support a number of research-based strategies (Marzano et al., 2001). Students and teachers use technology as a tool to improve teaching and learning by adapting the curriculum through software, the internet and assistive technology.

Input

Teacher-provided information needed for students to gain the knowledge or skill.

Instructional Grouping

Various arrangements of students from whole class to small group to individualized instruction.

Modeling

Teacher demonstrates examples of what is expected as an end product of the student work. The critical aspects of the product are explained through labeling, categorizing, comparing, etc.

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LESSON PLANNING GLOSSARY OF TERMS
(Continued)

Objective

A statement which specifies the following three decisions: what content to teach (learning), what the students will do to learn and to demonstrate that learning has occurred (behavior), and under what circumstances the learning will take place (condition)

Example:

Students will be able to
Learning: compare and contrast Robert E. Lee and Ulysses S. Grant (Know and be able to do)
Behavior: by individually completing a Venn diagram (How they will demonstrate what they know and are able to do)
Condition: after reading chapter 4 in their textbook (under what circumstances the learning will take place)

Purpose Setting

Outlines the objective of that day's lesson. Here the teacher emphasizes how students will benefit from the lesson .

Review

Typically at the beginning of the lesson, review previous material that is relevant to this lesson.

Summative Assessment

Used to measure what has been learned. Summative assessments tend to be evaluative in nature, and their results are often encapsulated and reported as a score or grade.

Transfer
See Below

What Is an Essential Question?

By - Grant Wiggins
Nov 15, 2007

What *is* an essential question? An essential question is – well, *essential*: important, vital, at the heart of the matter – the *essence* of the issue. Think of questions in your life that fit this definition – but don't just yet think about it like a teacher; consider the question as a thoughtful adult. What kinds of questions come to mind? What is a question that any thoughtful and intellectually-alive person ponders and should keep pondering?

In *Understanding by Design* we remind readers that "essential" has a few different connotations:

One meaning of "essential" involves ***important questions that recur throughout one's life***. Such questions are broad in scope and timeless by nature. They are perpetually arguable – What is justice? Is art a matter of taste or principles? How far should we tamper with our own biology and chemistry? Is science compatible with religion? Is an author's view privileged in determining the meaning of a text? We may arrive at or be helped to grasp understandings for these questions, but we soon learn that answers to them are invariably provisional. In other words, we are liable to change our minds in response to reflection and experience concerning such questions as we go through life, and that such changes of mind are not only expected but beneficial. A good education is grounded in such life-long questions, even if we sometimes lose sight of them while focusing on content mastery. The big-idea questions signal that education is not just about learning "the answer" but about learning how to learn.

A second connotation for "essential" refers to ***key inquiries within a discipline***. Essential questions in this sense are those that point to the big ideas of a subject and to the frontiers of technical knowledge. They are historically important and very much "alive" in the field. "What is healthful eating?" engenders lively debate among nutritionists, physicians, diet promoters, and the general public. "Is any history capable of escaping the social and personal history of its writers?" has been widely and heatedly debated among scholars for the past fifty years, and compels novices and experts alike to ponder potential bias in any historical narrative.

There is a third important connotation for the term "essential" that refers to what is needed for learning core content. In this sense, a question can be considered essential ***when it helps students make sense*** of important but complicated ideas, knowledge, and know-how – findings that may be understood by experts, but not yet grasped or seen as valuable by the learner. In what ways does light act wave-like? How do the best writers hook and hold their readers? What models best describe a business cycle? By actively exploring such questions, the learner is helped to arrive at important understandings as well as greater coherence in their content knowledge and skill.

A question is essential when it:

1. causes genuine and relevant inquiry into the big ideas and core content;
2. provokes deep thought, lively discussion, sustained inquiry, and new understanding as well as more questions;
3. requires students to consider alternatives, weigh evidence, support their ideas, and justify their answers;
4. stimulates vital, on-going rethinking of big ideas, assumptions, and prior lessons;

5. sparks meaningful connections with prior learning and personal experiences;
6. naturally recurs, creating opportunities for transfer to other situations and subjects.

Here is a variety of subject-area examples of such questions:

How well can fiction reveal truth?

- Why did that particular species/culture/person thrive and that other one barely survive or die?
- How does what we measure influence how we measure? How does how we measure influence what we measure?
- Is there really a difference between a cultural generalization and a stereotype?
- How should this be modeled? What are the strengths and weaknesses of this model? (science, math, social sciences)

Note that an essential question is different from many of the questions teachers typically ask students in class. The most commonly asked question type is factual – a question that seeks "the" correct answer. For example, in a history class, teachers are constantly asking questions to elicit recall or attention to some important content knowledge: "When did the war break out? Who was President at the time? Why, according to the text, did Congress pass that bill?"

Such questions are clearly not "essential" in the sense discussed above. Rather, they are what we might call 'teacherly' questions – a question essential to a *teacher* who wants students to know an important answer.

Is such a leading question bad? No. There are all sorts of good pedagogical reasons for using a question format to underscore knowledge or to call attention to a forgotten or overlooked idea. But those questions are not "essential" in the sense of signaling genuine, important and *necessarily-ongoing* inquiries. Teachers have to be careful not to conflate two ideas: "essential to me in my role as a teacher" and "essential to anyone as a thinking person and inquiring student for making *meaning* of facts in this subject."

What is a Big Idea?

By - Grant Wiggins
Jun 10, 2010

Nobody can be a good reasoner unless by constant practice he has realized the importance of getting hold of the big ideas and of hanging onto them like grim death.
– A. N. Whitehead, 1929

What is a "big idea"?

An idea is "big" if it helps us make sense of lots of confusing experiences and seemingly isolated facts. It's like the picture that connects the dots or a simple rule of thumb in a complex field. For example: "the water cycle" is a big idea for connecting seemingly discrete and one-way events (the water seems to just disappear as it evaporates). "The heroic cycle" enables us to comprehend literature from many places, cultures, and times. "Measure twice, cut once" is a profound reminder about how to avoid heartache and inefficiency in building anything.

A big idea is thus a way of seeing better and working smarter, not just a vague notion or another piece of knowledge. It is more like a lens for looking than another object seen; more like a theme than the details of a narrative; more like an active strategy in your favorite sport or reading than a specific skill. It is a theory, not a detail.

If an idea is "big" it helps us make sense of things. So, an idea is not "big" merely because it categorizes a lot of content. "Change," "relationships," and "number system" certainly encompass an enormous amount of knowledge and understanding, but these concepts don't contain much insight or direction beyond their definition. They aren't particularly powerful or illuminating on their own as concepts. On the other hand, "For every action there is an equal reaction" is a powerful idea about change: we can use it to study, organize, make sense of phenomena, and predict changes in motion. So, too, is the idea that "blood is thicker than water" powerful for understanding many relationships in societies and throughout history – and, perhaps for understanding a few puzzling decisions made by our family members!

A genuine idea is thus not a "mere" idea. It is not abstract in the bad sense, it is concrete; it is a *useful* theory; it has real impact. For example, consider a detective trying to make sense of many puzzling clues whose meaning and relationship are unclear. Any theory as to "whodunit" will relate to motive. A good detective has some big ideas about motive to bring meaning to what might otherwise seem like odd, isolated, and unique little facts to the rest of us. The "big idea" (whether it is "Look for love triangles" or "Follow the money") is thus quite practical: it helps distinguish clues from unimportant facts, and shows the way toward more facts - and a persuasive narrative.

Similarly, in literacy or history teaching, the important "themes" are big ideas. Why? Because – if used properly – they provide learners with mental schemas or templates that help make sense of all the details of texts that threaten to overwhelm inexperienced readers. If I am alerted to "the heroic quest," or "the American Dream" I can read and think with more control and insight.

In science, the most illuminating hypotheses are the big ideas of science. So, the idea that we are all part of a "food chain" of living and nonliving things is big because it links seemingly different (and isolated) animals and plant matter into a bigger comprehensible "ecosystem" of energy exchange. We then see the role of predators, garbage, and our relationship to nature in a completely new and helpful way than before. Newton's laws of motion are three of the biggest ideas ever posed: suddenly, thousands of seemingly unrelated facts and phenomena – spoons dropping, the tides, the moon's orbit – had not only a meaningful explanation but could be seen as part of a huge coherent system with endless predictive and connective power.

In short: think of "big" as "powerful" not as a large abstract category.

a powerful idea vs. a mere abstraction

John Dewey – as we might expect – articulated the notion of a useful idea long ago. He often wrote to describe the difference between a "genuine" idea and an idea treated as a "fact":

Ideas are not then genuine ideas unless they are tools in a reflective examination which tends to solve a problem. Suppose it is a question of having the pupil grasp the idea of the sphericity of the earth. This is different from teaching him its sphericity as a fact. He may be shown (or reminded of) a ball or a globe, and be told that the earth is round like those things; he may then be made to repeat that statement day after day till the shape of the earth and the shape of the ball are welded together in his mind. But he has not thereby acquired any idea of the earth's sphericity; at most, he has had a certain image of a sphere and has finally managed to image the earth after the analogy of his ball image. To grasp sphericity as an idea, the pupil must first have realized certain perplexities or confusing features in observed facts and have had the idea of spherical shape suggested to him as a possible way of accounting for the phenomena in question. Only by use as a method of interpreting data so as to give them fuller meaning does sphericity become a genuine idea. There may be a vivid image and no idea; or there may be a fleeting, obscure image and yet an idea, if that image performs the function of instigating and directing the observation and relation of facts.

- John Dewey (1910) – *How We Think*. Emphasis added.

So, we musn't equate "big idea" with a concept taught as a fact or definition. Only when we help the learner see firsthand that an idea is an inference, and one with power to provide meaning and transfer, does it become a "big idea."

The difference between a vital idea with power and a lifeless scientific notion was beautifully clarified by Nobel Physicist Richard Feynmann in discussing science instruction:

There is a first grade science book which, in the first lesson of the first grade, begins in an unfortunate manner to teach science, because it starts off with the wrong idea of what science is. There is a picture of a dog--a windable toy dog--and a hand comes to the winder, and then the dog is able to move. Under the last picture, it says "What makes it move?" Later on, there is a picture of a real dog and the question, "What makes it move?" Then there is a picture of a motorbike and the question, "What makes it move?" and so on.

I thought at first they were getting ready to tell what science was going to be about--physics, biology, chemistry--but that wasn't it. The answer was in the teacher's edition of the book: the answer I was trying to learn is that "energy makes it move."

That's only the definition of energy; it should be reversed. We might say when something can move that it has energy in it, but not what makes it move is energy. This is a very subtle [but important] difference.

Perhaps I can make the difference a little clearer this way: If you ask a child what makes the toy dog move, you should think about what an ordinary human being would answer. The answer is that you wound up the spring; it tries to unwind and pushes the gear around.

What a good way to begin a science course! Take apart the toy; see how it works. See the cleverness of the gears; see the ratchets. Learn something about the toy, the way the toy is put together, the ingenuity of people devising the ratchets and other things. [Otherwise,] suppose a student would say, "I don't think energy makes it move." Where does the discussion go from there?

I finally figured out a way to test whether you have taught an idea or you have only taught a definition.

Test it this way: you say, "Without using the new word which you have just learned, try to rephrase what you have just learned in your own language." Without using the word "energy," tell me what you know now about the dog's motion." You cannot. So you learned nothing about science.

In short, if the word is just a technical term rather than a vital approach, it isn't a big idea.

Covering facts vs. uncovering understandings: avoiding the temptation to treat all scientific ideas as facts.

But teachers often unwittingly conflate terms with ideas. In their desire to make teaching more efficient, they often treat the theory or strategy as a fact related to a definition, as in Feynmann's example. They end up turning an insightful inference into a thought-ending word. We pay for this desire to cover things ever more quickly: by treating all ideas as facts to be learned instead of inferences to be validated and analyzed through use, we unwittingly end up inhibiting meaning and transfer. Students end up just trafficking in meaningless words; science gets treated as a foreign language rather than a body of knowledge and understanding.

Let's put this issue of efficiency vs. effectiveness in terms of the learner, the novice struggling to understand. After a few days in your room as a new student, I will likely feel overwhelmed with information; I don't yet see a pattern or a mental organizer by which I can begin to make sense of all that you are teaching me and that we are reading about. I need a helpful schema, a framework, a touchstone, a guidepost, a strategy for making sense of everything I am learning. In other words, I need a framework for my new content: I need a way to order, categorize and prioritize what I am learning.

Now, suppose we ask: if you could as teacher alert the student to a key recurring idea that can make sense of the learning as well as further it, what would it be? What aphorism, imperative, and/or rules of thumb would permit the student to make more and more sense of their work and how to be successful all year in your course? That's what we're calling a big idea.

Here are some possible answers, for different subjects and grade levels:

- In history class: verify the source and determine the credibility of the source. Keep asking: Who said it? Why? How credible a statement is it? How credible is the source of the statement?
- In reading: Converse with the author. Assume the text makes sense. You will likely only understand the text if you assume it is meaningful and ask questions of it – if you 'converse' with the author.
- In evolution: keep remembering that the idea that mutations are random and that selection is "natural"

means that there is no guiding purpose to life-form change. This is the part of the theory of evolution that is most controversial, not the idea of evolution per se.

- In writing: keep asking – Who is my audience? What is it I want them to see, think, feel, or do?

What modern theories of human learning and understanding tell us is that the learner has to be helped to "construct" understandings, not just be told them. No meaning and no transfer occur if "useful theory" is reduced to fact – even though teaching thereby becomes more efficient. The distinction between "knowledge" and "understanding" (or, if you like, "facts" and "genuine ideas") is not merely semantic. We slowly come to an understanding, as a result of using facts and ideas to make sense of things. (Facts are apprehended, ideas are comprehended, in Dewey's original formulation). "Teaching" an understanding is as counter-productive as "teaching" someone to be honest. Learners have to see the power of honesty and the unforeseen consequences of dishonesty before they can truly commit to honesty as a value.

The real harm of stressing that ideas are merely words, phrases, and statements with technical meaning (instead of the power they represent) is that such teaching tends to end thought rather than further it. Rather, a big idea is alive. We develop understanding by extending and challenging understanding. A big idea reaches out, it pushes against boundaries, it asks us to possibly rethink other things we thought we knew. It raises questions and problems - and thus, generates new ideas. We see new connections and we initiate inquiries to validate or critique the idea. A big idea activates thought and permits transfer – and, thus creativity. "Coverage" of an idea, by contrast, kills it: our job is not to think with ideas but just learn stuff. The best teaching does the opposite. It brings seemingly inert content to life. And in science it reminds us that today's Big Idea is potentially tomorrow's discredited notion. This is key to empowering the student: there will always be room for new ideas in any authentic teaching of science as fallible theorizing.

The article Jay McTighe and I recently wrote for *Educational Leadership* called 'Put Understanding First' makes the point in a different way: both teachers and students need to understand that there are three different educational goals always at play: Acquisition, meaning-making, and transfer or prior learning. Here is a brief excerpt from the article (which was in the May 2008 issue, on High School Reform):

To better explain what curriculum needs to be, we think it is helpful to distinguish what are in fact three different yet interrelated academic goals of high school -- students should be helped to: 1) acquire important information and skills, 2) make meaning of that content (i.e., come to understand important ideas), and 3) transfer their learning to new situations, effectively. In this paper, we will refer to these three key learning goals as A-M-T. Acquisition is a means; meaning making and transfer are the ends.

The categories should seem intuitively sound. A fact is a fact; a skill is a skill. We acquire each in turn. To ask, however: What do these facts imply? Or: When would I use this skill (or not)? is to ask what those facts and skills mean. A third question can also be asked: How should I apply my prior facts, skills, and ideas effectively in this particular situation? This question is about transfer. I must take what I have previously acquired and understood, and see how it can best be used in a particular and novel situation. Thus, when we speak of "learning for understanding," we really are referring to two different long-term aims: meaning making and transfer, utilizing previously acquired knowledge and skills – our short-term goal.

While such a classification scheme is not new or radical (see Dewey, 1933 ; Bloom, 1956 ; Marzano, et. al. 1992), the distinctions are real – and critical to intelligent planning, purposeful instruction, and valid assessment. Put simply: if you want understanding and transfer, you have to design backward from it.

Any understanding, essential question, or transfer task is made up of a big idea; it is built out of it, in other words. So, making a question using a big idea turns into an essential question. A food chain is a big idea. “On what energy do we depend and how can we ensure access to it?” is an essential question about that big idea. While it is true that sometimes when asked to name a big idea we frame it instinctively as a question or a statement, sometimes we just express it as a phrase or word.

We first started talking about “big ideas” to help those using the UbD template who did not find it easy to come up with essential questions (and understandings). People were often inappropriately trying to come up with a factual question, such as: "What is a food chain?" So, we would say, "No, that is a factual question that is answered in the book." We would follow this up by asking them: "So, what’s the big idea about the fact? What does the idea of 'food chain' help us to see or understand better?”

Our hope was that this additional step might ease the transition from focusing only on “content” to focusing on learning content for understanding. Alas, some people heard the phrase differently: they thought the phrase “big idea” was synonymous with “understanding” Or “question.” Others, who had no trouble coming up with questions and understandings, then wondered if they had somehow missed something by not also coming up with big ideas. So, they would ask: “Why is there no box in the template for big ideas?”

"Big idea" doesn’t have its own template box because many boxes in the template should refer directly or indirectly to big ideas. If I say “audience and purpose” that’s a phrase representing a big idea in writing and reading. If I ask: “What is my purpose and who is my audience?” I am acknowledging the importance of that idea and framing it as an essential question. If I say “Great writing, like great art, is a function of utter clarity about purpose and audience,” then I am proposing a specific understanding about that idea. If I ask you to write the same piece for two different audiences, I am asking you to transfer your grasp of the idea in writing. (Note, therefore, that we both may agree on the importance of “audience and purpose” as an idea but propose different “understandings” about it.)

So, what makes an idea *big*? An idea is *big* if it helps us make sense of lots of otherwise meaningless, isolated, inert, or confusing facts. A big idea is a way of usefully seeing connections, not just another piece of knowledge. It is more like a lens for better looking than something additionally seen; more like a theme than the facts of the story.

In the language of UbD, a *big idea* is a powerful intellectual tool, from which we can derive more specific and helpful understandings and facts.

A true idea doesn’t end thought, it activates it. It has the power to raise questions and generate learning. So, build your unit around one idea with power, an idea that helps learners make sense of otherwise isolated content and which cannot help but bring inquiry to the fore.

What is Transfer?

By - Grant Wiggins
Mar 27, 2010

Transfer as the goal of education

When I was a soccer coach, I learned about transfer the hard way. The work we did in the drills everyday in practice did not seem to transfer into fluid, flexible, and fluent performance in games. I slowly began to see that, indeed, the real game situations were "messier" and "swifter to change" than we were preparing for. I thought I had made my drills realistic and helpful, but the results were still disturbingly poor. It often appeared, in fact, as if all the work in practice was for naught as players either wandered around purposelessly or only reacted to the most obvious, immediate needs.

An epiphany came in a game, from the mouth of my co-captain. In my increasing frustration, I started yelling loudly, "Give-and-go, 3-on-2, use it, use it, all the drills we just worked on!" My co-captain stopped dribbling the ball in the middle of the field, and yelled back at me, "I can't SEE it now; they won't line up like the way we did the drill!"

That's both a clear picture of the problem and the road to the solution. Too many "clean" sideline drills; not enough practice in learning to play the "messy" game, intelligently. Too great a gap between what the (simplified) drill was "teaching" and what the complex performance demanded that they learn. The theoretical links between our drill and game situation were certainly obvious to me – but not obvious to players, given the messiness and speed of the game; there was insufficient realistic rehearsal way.

My soccer problem is not unique. It is like the second-grade teacher's challenge in trying to get students to learn to read for meaning on their own or the college professor's challenge of trying to help students understand physics in context. You can provide students with training in a dozen reading strategies or physics problems (drills), provide helpful verbal cues, etc. and yet, when asked to read on their own, they may neither activate the strategies by themselves nor make meaning of unfamiliar material:

> Both the meaning and the challenge of `"transfer of learning" are well-expressed in a story told to one of us by a disappointed professor of physics at a nearby college. Among the stock problems explored in the physics course was one like this: "A ball weighing three kilograms is dropped from the top of a hundred meter tower. How many seconds does it take to reach the ground?" (Aficionados of physics will recognize that the weight of the ball has nothing to do with the problem; it is a distraction. The answer depends only on the acceleration of gravity.)
>
> On the final exam, the professor included a problem like this: "There is a one-hundred meter hole in the ground. A ball weighing three kilograms is rolled off the side into the hole. How long does it take to reach the bottom?"
>
> Some students did not recognize the connection between the "tower" problem and the "hole" problem. One student even came up after the exam and accosted the professor with a complaint. "I think that this exam was unfair," the student wailed. "We never had any hole problems!"[2]

What the research on transfer reveals is that this failure of intelligent use and adaptation of what we 'know' is depressingly common: students will typically not cue themselves to use all their prior learning or recognize how the "new" situation reflects prior learning unless they have been given lots of training and practice in thus cueing themselves and in being weaned from simplified exercises and teacher scaffolds: "Unfortunately, achieving significant transfer of learning has proven to be a difficult chore. Dating back to the beginning of this century, the research literature on transfer is replete with reports of failure."[3]

Transfer doesn't just happen as a result of a typical regimen of teaching and testing, no matter how rigorous the course of study. Transfer happens only when we aggressively teach and test for understandings that are applied in situations. As the authors of *How People Learn* put it:

A key finding in the learning and transfer literature is that organizing information into a conceptual framework allows for greater "transfer"; that is, it allows the student to apply what was learned in new situations and to learn related information more quickly…. Transfer is affected by the degree to which people learn with understanding rather than merely memorize sets of facts or follow a fixed set of procedures; the research also shows clearly that "usable knowledge" is not the same as a mere list of disconnected facts.[4]

Teaching for transfer

Below are a set of tips for planning, teaching, and assessing to make transfer happen more by design than by luck:

- Establish and keep highlighting clear transfer goals: Explicitly and regularly alert learners to the goal of transfer. Why? Because most students do not realize that this is the goal of learning in school. They are quite convinced – from prior experience and, especially typical tests – that the aim is to recall and plug in what was previously taught. Make clear that the "transfer" game is very different from the "recall" and "plug in" game.

  Initially, make this clear through think-alouds and explicit reminders of what we are now doing and what its purpose is. Spend time going over the kinds of transfer performance they will need to be able to do well by the end of the unit/course. Examples: "By the end of the unit, you'll have to do this product on your own, with no prompts or cues from me. Here are a few model student papers from past years, and a rubric describing the end-goal." Or: "Initially, you will just mimic some approaches I teach you. But later, you will have to invent your own approach or adapt one you have learned to a new task," etc.

- Always work on a Gradual Release of Responsibility sequence – in units, and in the course as a whole. The Gradual Release of Responsibility (GRR) model was first articulated for reading instruction by Pearson (1983): I do, you watch; I do, you help; you do, I help; you do, I watch. More formally: Model, Guided Practice, Independent Practice, Independent use of all Strategies. But GRR can also be thought of as the common flow used in athletic training: simple drill, game situation, game-like conditions, the game. Note that in both cases – reading and athletics – the movement to the final stage of self-regulated complex performance is done in each unit of study. Independent and self-regulated behavior is practiced all the time, not postponed until many discrete "sideline" activities are done over many lessons. You have to practice transfer to master it!

- Highlight Essential Questions to suggest the kinds of connections students will have to make all year: Knowing that essential questions will be used to explore connections between units will make students more likely to make connections on their own – particularly if the assessments regularly involve the questions. Examples: "How should this data be modeled?" when problem solving in math and science. "Who is an American? Says who?" when considering each major topic in US history. "What should we eat?" in health. "What is the author saying without stating?" in English/language arts, etc.

- Have learners practice judgment, not just skill. Transfer is about judging which skill and knowledge to use when. Transfer is thus not about plugging in a "skill" but "judgment" - smart strategy - in the use of a repertoire of skills. (Psychologists refer to this as "conditional" knowledge as opposed to "declarative" and "procedural" knowledge). Make sure learners have opportunity to hear think-alouds of your problem-solving or text-interpreting. Give students practice and get feedback on their attempts to judge which skill or knowledge might be best here. Have learners do think-alouds and provide reports of why they did what they did when they did it. Learning to self-monitor in this way improves both self-assessment and self-adjustment. Thus –

- Assess (without grading) student self-cueing, knowledge retrieval, self-assessment, and self-adjustment on their own, i. e. minus teacher cues. As in sports and independent reading, there have to be countless opportunities for the student to self-prompt, self-assess, and self-adjust – with teacher feedback on the attempts. What does the student do when teachers don't supply the graphic organizers or a big hint that they should use the writing process we studied yesterday? The research is clear, alas: many students do not self-prompt, in the absence of explicit direction. "You didn't say to use it!" is a common comment.

  The irony here is that this is precisely where students often fall down on standardized tests! Now, there are no teacher or textbook cues as to where the item comes from in the course content, and no overt cues about what content applies are typically given. So, constantly "test" (without necessarily grading them and/or entering the grade in the grade-book) student ability to self-cue. Examples: Give them unfamiliar looking items, writing prompts, problems, etc. – with no mention of which knowledge is being tapped and which strategies and tools they should use. See what they do on their own, then go over the assessment carefully in class soon after – debrief like a coach: What kind of task did they think it was? Why didn't they think to use Graphic Organizer X or Strategy Y since it should have seemed so clearly related to the task? etc.

- Change the set-up so that students realize that a possible use of prior learning comes in many guises: The research on transfer stresses that students need to be given tasks in which the setting/format/context/mode/language is sufficiently varied over time that students learn they have to think more flexibly in tapping their knowledge. The student too often thinks that – and wishes that! – a recipe or plug-in formula will solve all future needs. Make clear that the initial recipe/structure/scaffold is just that – a scaffold or crutch to be eventually replaced by fluid decision-making. Examples: After learning about gravitational force using balls dropped from towers, give a problem about a ball of a different size and material dropped down a big tunnel in the earth. (See Perkins and Salomon 1989). Teach 2-3 ways to solve every major kind of problem. Give students increasingly odd 'looks' at a task or problem that requires the same knowledge (e.g. increasingly non-routine and unobvious problems involving the Pythagorean theorem).

- Have students constantly generalize from (increasingly challenging) specific instances and cases: Transfer is about using helpful ‘big ideas’ to find familiarities and connections where others see only newness and difference. Ask students to generalize from their experience and immediate past lessons to more widely applicable principles, rules, and ideas. Example: After studying westward expansion, ask, "What big generalizations about human migration does this movement west suggest? Can you support your generalizations by other evidence you know of?" Then, ask the same question after studying early 20th-century immigration, and help them understand that this kind of transfer will be more and more requested of them – i.e. using ideas to see connections and transfer.

- Practice the whole/part/whole development of transfer early and often. Think of what coaches do to break the complex game down into easier but game-like games, e.g. 3 v 3 and 6 v 6 in soccer, to practice the full 11 v 11 game in a more manageable way. In the arts the play or musical piece is broken down into its elements and practiced in chunks, then put back into the whole. Reading instruction proceeds similarly, as does the best problem-solving instruction in mathematics.

- Make sure that any tool or technique is seen as one of many: Too often students work too rigidly or mechanically in applying their learning, rather than seeing application as use of an idea. Example: Teach the 5-paragraph essay, the 3-paragraph essay and the no-paragraph argument (i.e. a powerful advertisement). Make clear that the transfer goal is “rational persuasion,” not “plug in the 1 tool called 5 paragraphs.”

- Provide many examples of ‘think-alouds’ in transfer situations: Talk out, demonstrate, model the kind of pro-active thinking that needs to take place in one’s head if transfer goals are to be achieved. Example: A math teacher demonstrates how a problem might be solved by "thinking aloud" to reveal strategic thinking and efficient reframing of the problem based on prior knowledge.

- Shift perspective: After any lesson in teaching a particular skill or approach, shift gears. Challenge the prior assumptions, look at the problem or situation from a new point of view, read a different opinion – anything to help students see that the goal is active learning and understanding, not merely taking in the “official” single (glib) answer.

- Require self-assessment and self-adjustment as part of all major assessments. Learning to transfer is greatly facilitated by learning to self-monitor, self-assess, and self-adjust. Initially, make the accuracy of the self-assessment and the self-adjustment more central to scoring than the answer. Example: 5 points for doing the task on your own; 3 points for getting it based on 1 teacher hint; 2 points for getting it after 2 hints, etc.

- Require students to constantly re-word/re-phrase/re-present what they learn: Whether in just taking notes or creatively placing a complete text in a new genre, time, and place: making learners re-cast what they have learned in their own terms is a significant aid to long-term memory and flexible use of knowledge, according to the research on learning and transfer.

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2 D.N. Perkins and Gavriel Salomon, "The Science and Art of Transfer," Harvard University Web site, http://learnweb.harvard.edu/alps/thinking/docs/trancost.htm (accessed September 21, 2005).

3 Anne McKeough, Judy Lupart, and Anthony Marini, eds., Teaching for Transfer: Fostering Generalization in Learning, (Mahwah, NJ: Lawrence Erlbaum Associates, 1995), 1. (Also cited at http://www.questia.com/PM.qst?a=o&d=59527464)

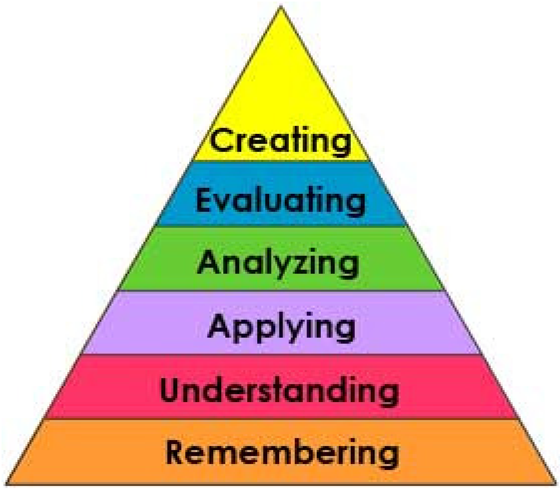
4 John D. Bransford, Ann L. Brown, and Rodney R. Cocking, eds., How People Learn: Brain, Mind, Experience, and School (Washington, D.C.: National Academy Press, 1999), 17. (Available free online from the publisher at http://www.nap.edu/openbook/0309065577/html/index.html)

Bloom's Taxonomy

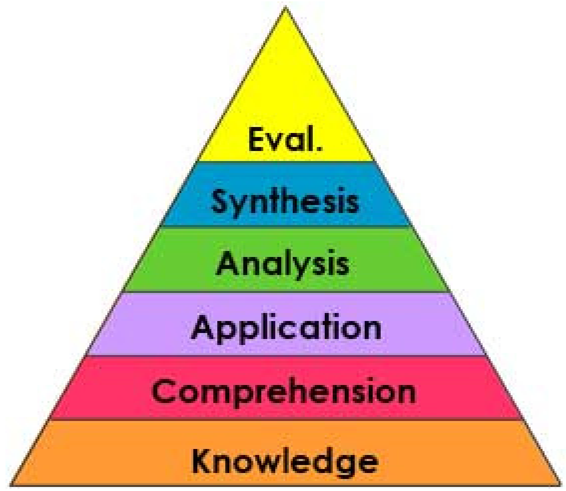
By - Richard C. Overbaugh & Lynn Schultz
Old Dominion University

In 1956, Benjamin Bloom headed a group of educational psychologists who developed a classification of levels of intellectual behavior important in learning. During the 1990's a new group of cognitive psychologist, lead by Lorin Anderson (a former student of Bloom's), updated the taxonomy reflecting relevance to 21st century work. The graphic is a representation of the NEW verbiage associated with the long familiar Bloom's Taxonomy. Note the change from Nouns to Verbs to describe the different levels of the taxonomy.

Note that the top two levels are essentially exchanged from the Old to the New version.



New Version



Old Version

Remembering: can the student recall or remember the information?	Knowledge: define, duplicate, list, memorize, recall, repeat, reproduce state
Understanding: can the student explain ideas or concepts?	Comprehension: classify, describe, discuss, explain, identify, locate, recognize, report, select, translate, paraphrase
Applying: can the student use the information in a new way?	Application: choose, demonstrate, dramatize, employ, illustrate, interpret, operate, schedule, sketch, solve, use, write.
Analyzing: can the student distinguish between the different parts?	Analysis: appraise, compare, contrast, criticize, differentiate, discriminate, distinguish, examine, experiment, question, test.
Evaluating: can the student justify a stand or decision?	Synthesis: appraise, argue, defend, judge, select, support, value, evaluate
Creating: can the student create new product or point of view?	Evaluation: assemble, construct, create, design, develop, formulate, write.

		Levels of Technology Integration into the Curriculum				
	Technology Integration Matrix	**Entry** The teacher uses technology to deliver curriculum content to students.	**Adoption** The teacher directs students in the conventional use of tool-based software. If such software is available, this level is the recommended.	**Adaptation** The teacher encourages adaptation of tool-based software by allowing students to select a tool and modify its use to accomplish the task at hand.	**Infusion** The teacher creates a learning environment that infuses the power of technology tools throughout the day across subject areas.	**Transformation** The teacher creates a rich learning environment in which students regularly engage in activities that would have been impossible to achieve without technology.
Characteristics of the Learning Environment	**Active** Students are actively engaged in using technology as a tool rather than passively receiving information from the technology.	**Indicator:** Students use technology for drill and practice and computer based training.	**Indicator:** Students begin to utilize technology tools to create products, for example using a word processor to create a report.	**Indicator:** Students have opportunities to select and modify technology tools to accomplish specific purposes, for example using colored cells on a spreadsheet to plan a garden.	**Indicator:** Throughout the school day, students are empowered to select appropriate technology tools and actively apply them to the tasks at hand.	**Indicator:** Given ongoing access to online resources, students actively select and pursue topics beyond the limitations of even the best school library.
	Collaborative Students use technology tools to collaborate with others rather than working individually at all times.	**Indicator:** Students primarily work alone when using technology.	**Indicator:** Students have opportunities to utilize collaborative tools, such as email, in conventional ways.	**Indicator:** Students have opportunities to select and modify technology tools to facilitate collaborative work.	**Indicator:** Throughout the day and across subject areas, students utilize technology tools to facilitate collaborative learning.	**Indicator:** Technology enables students to collaborate with peers and experts irrespective of time zone or physical distances.
	Constructive Students use technology tools to build understanding rather than simply receive information.	**Indicator:** Technology is used to deliver information to students. .	**Indicator** Students begin to utilize constructive tools such as graphic organizers to build upon prior knowledge and construct meaning.	**Indicator:** Students have opportunities to select and modify technology tools to assist them in the construction of understanding.	**Indicator:** Students utilize technology to make connections and construct understanding across disciplines and throughout the day.	**Indicator:** Students use technology to construct, share, and publish knowledge to a worldwide audience.
	Authentic Students use technology tools to solve real-world problems meaningul to them rather than working on artificial assignments.	**Indicator:** Students use technology to complete assigned activities that are generally unrelated to real-world problems.	**Indicator:** Students have opportunities to apply technology tools to some content-specific activities that are based on real-world problems.	**Indicator:** Students have opportunities to select and modify technology tools to solve problems based on real-world issues.	**Indicator**: Students select appropriate technology tools to complete authentic tasks across disciplines.	**Indicator:** By means of technology tools, students participate in outside-of-school projects and problem-solving activities that have meaning for the students and the community.
	Goal Directed Students use technology tools to set goals, plan activities, monitor progress, and evaluate results rather than simply completing assignments without reflection.	**Indicator:** Students receive directions, guidance, and feedback from technology, rather than using technology tools to set goals, plan activities, monitor progress, or self-evaluate.	**Indicator:** From time to time, students have the opportunity to use technology to either plan, monitor, or evaluate an activity.	**Indicator:** Students have opportunities to select and modify the use of technology tools to facilitate goal-setting, planning, monitoring, and evaluating specific activities.	**Indicator:** Students use technology tools to set goals, plan activities, monitor progress, and evaluate results throughout the curriculum.	**Indicator:** Students engage in ongoing metacognative activities at a level that would be unattainable without the support of technology tools.

Produced by the Florida Center for Instructional Technology, College of Education, University of South Florida © 2009

Curriculum Mapping Template		
Content Area:		
Course Title:		**Grade Level:**
Unit Plan 1 **Title:** **Objective:** **Summary Assessment:**	**Timeframe:**	
Unit Plan 2 **Title:** **Objective:** **Summary Assessment:**	**Timeframe:**	
Unit Plan 3 **Title:** **Objective:** **Summary Assessment:**	**Timeframe:**	
Unit Plan 4 **Title:** **Objective:** **Summary Assessment:**	**Timeframe:**	
Unit Plan 5 **Title:** **Objective:** **Summary Assessment:**	**Timeframe:**	
Unit Plan 6 **Title:** **Objective:** **Summary Assessment:**	**Timeframe:**	

Unit Plan 7 **Title:** **Objective:** **Summary Assessment:**	**Timeframe:**
Unit Plan 8 **Title:** **Objective:** **Summary Assessment:**	**Timeframe:**
Unit Plan 9 **Title:** **Objective:** **Summary Assessment:**	**Timeframe:**

Unit Planning Template

Content Area:		
Unit Title:		
Target Course/Grade Level:		
Unit Overview		
Unit Summary **Primary interdisciplinary connections:** **21st century themes:**		
Standard(s)		
Strand(s)		
Content Statements		
CPI #	**Cumulative Progress Indicator (CPI)**	
Unit Essential Questions • •	**Unit Enduring Understandings (Big Ideas)** • •	
Unit Learning Outcomes *Students will be Able To:* • •		
Evidence of Learning		
Summative Assessment (X days) **Equipment needed:** **Teacher Resources:**		

Lesson Planning Template		
Content Area:	**Grade:**	**Unit:**
Lesson Title:		**Timeframe:** X hours/days
Lesson Components (*As Applicable)		
***21st Century Themes & Skills:**		
***Interdisciplinary Connections:**		
***Integration of Technology:**		
***Equipment Needed:**		
***Cognitive Level (Bloom's Taxonomy):**		

CPI #	Cumulative Progress Indicator (CPI)

Learning Outcomes (Note: Each outcome should include a formative assessment)	Learning Activities/Instructional Strategies (Based on Hunter Model)
Students Will Be Able To: Learning: Behavior: Condition: Formative Assessment: Summative Assessment (if appropriate): -------- Add additional objectives as needed: Learning: Behavior: Condition: Formative Assessment: Summative Assessment (if appropriate):	**Lesson Sequence:** Opening: Presentation: Guided Practice: Closure:

Differentiation: **Content:** **Process:** **Product:**
Resources Provided to Students: • •

LESSON REFLECTION

Reflect on the lesson you have developed and rate the degree to which the lesson ***Strongly, Moderately*** or ***Weakly*** meets the criteria below.

Please keep these sheets for use during future revisions to this curriculum. Please feel free to share any suggestions for revisions with the Director of Curriculum and Instruction.

Lesson Activities:	**Strongly**	**Moderately**	**Weakly**
Are challenging and require higher order thinking and problem solving skills			
Allow for student choice			
Provide scaffolding for acquiring targeted knowledge/skills			
Integrate global perspectives			
Integrate 21^{st} century skills			
Provide opportunities for interdisciplinary connection and transfer of knowledge and skills			
Foster student use of technology as a tool to develop critical thinking, creativity and innovation skills			
Are varied to address different student learning styles and preferences			
Are differentiated based on student needs			
Are student-centered with teacher acting as a facilitator and co-learner during the teaching and learning process			
Provide means for students to demonstrate knowledge and skills and progress in meeting learning goals and objectives			
Provide opportunities for student reflection and self-assessment			
Provide data to inform and adjust instruction to better meet the varying needs of learners			

Other Ideas:

Lesson Planning Reminders

OBJECTIVE
Remember:
-to be sure that the Behavior in the Objective also appears as part of the Guided Practice in the Instructional Strategies section and as a Formative Assessment in the Assessment section of the lesson plan.

- to include the cognitive level (Bloom's Taxonomy) of the lesson and make sure that level(s) is addressed in the Instructional Strategies section

- to list specific, relevant indicators (CPI's) in the CCCS not just the broad content standard.

INSTRUCTIONAL STRATEGIES
Remember:
- to number each step in the Instructional Strategies.

- to label each step by placing a description in parentheses after it. For example: (Input) or (Guided Practice).

- for Assessment of Background Knowledge and Closure to list teacher's questions and anticipated student responses

- to indicate that you, the teacher, will "monitor" and if necessary "adjust" if it appears that the students are not achieving the objective, for example, on a Venn Diagram students are confusing similarities and differences.

-to achieve closure is more than merely closing the lesson. You should bring together past, present, and future learning. (see Glossary for details)

ASSESSMENT
Remember:
- to include all formative assessments, for example, the Behavior, class discussion, etc.

- to be sure that the Behavior is individually measurable so that you are certain each student is achieving the learning before they work collaboratively where the ideas of others may affect an individual student.

- if there is homework in your lesson, include the homework in the Assessment section as well as in the Instructional Strategies section.

DIFFERENTIATION
Remember:
- to include differentiation of content, process, and product to meet the needs of individual students.

- to refer to and label each type of differentiation (Content, Process, and Process) in the Instructional Strategies section as well as in the Differentiation section.

Lesson Planning Reminders
(Continued)

TECHNOLOGY
Remember:
- to indicate the technology infused in the lesson and the technology that is used by both teacher and students by labeling it in the Instructional Strategies section as well as in the Technology section.

Sample Unit Plan & Sample Lesson Plans

*****Please Note: We recognize that the development of great lesson plans is an art form that requires much trial-and-error experimentation and practice. The samples below are not all "perfect" exemplars. Each one simply illustrates a number of the elements that should be included in an "ideal" lesson.**

Sample Unit Plan

Unit Overview: Electricity
Content Area: Physics
Unit Title: Electricity
Target Course/Grade Level: 12
Unit Summary The CASTLE approach (Capacitor-Aided System for Teaching and Learning Electricity) is used as a hands-on investigations approach to teach electricity through circuits and model construction. **Primary interdisciplinary connections:** Mathematics, Reasoning, Logic **21st century themes:** Civic literacy
Unit Rationale To improve the preparation for our students for college or university courses in science and engineering and to improve the comprehension of electricity concepts for all students. Understanding of electricity concepts will help all students live in our modern technological world.
Learning Targets
Standards **5.1 Science Practices:** All students will understand that science is both a body of knowledge and an evidence-based, model-building enterprise that continually extends, refines, and revises knowledge. The four Science Practices strands encompass the knowledge and reasoning skills that students must acquire to be proficient in science. **A.** Understand Scientific Explanati**ons**: Students understand core concepts and principles of science and use measurement and observation tools to assist in categorizing, representing, and interpreting the natural and designed world. **B. Generate Scientific Evidence Through Active Investigations:** Students master the conceptual, mathematical, physical, and computational tools that need to be applied when constructing and evaluating claims. **C. Reflect on Scientific Knowledge:** Scientific knowledge builds on itself over time. **D. Participate Productively in Science:** The growth of scientific knowledge involves critique and communication, which are social practices that are governed by a core set of values and norms. **5.2 Physical Science:** All students will understand that physical science principles, including fundamental ideas about matter, energy, and motion, are powerful conceptual tools for making sense of phenomena in physical, living, and Earth systems science. **D. Energy Transfer and Conservation**: The conservation of energy can be demonstrated by keeping track of familiar forms of energy as they are transferred from one object to another. **E. Forces and Motion**: It takes energy to change the motion of objects. The energy change is understood in terms of forces. **8.1 Educational Technology:** All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaboratively and to create and communicate knowledge. **A. Technology Operations and Concepts** **B. Creativity and Innovation**

Content Statements

5.1.12.A.1 Mathematical, physical, and computational tools are used to search for and explain core scientific concepts and principles.

5.1.12.A.2 Interpretation and manipulation of evidence-based models are used to build and critique arguments/explanations

5.1.12.A.3 Revisions of predictions and explanations are based on systematic observations, accurate measurements, and structured data/evidence.

5.1.12.B.1 Logically designed investigations are needed in order to generate the evidence required to build and refine models and explanations.

5.1.12.B.2 Mathematical tools and technology are used to gather, analyze, and communicate results.

5.1.12.B.3 Empirical evidence is used to construct and defend arguments.

5.1.12.B.4 Scientific reasoning is used to evaluate and interpret data patterns and scientific conclusions.

5.1.12.C.1 Refinement of understandings, explanations, and models occurs as new evidence is incorporated.

5.1.12.C.2 Data and refined models are used to revise predictions and explanations.

5.1.12.C.3 Science is a practice in which an established body of knowledge is continually revised, refined, and extended as new evidence emerges.

5.1.12.D.1 Science involves practicing productive social interactions with peers, such as partner talk, whole-group discussions, and small-group work.

5.1.12.D.2 Science involves using language, both oral and written, as a tool for making thinking public.

5.2.12.D.4 Energy may be transferred from one object to another during collisions.

CPI #	**Cumulative Progress Indicator (CPI)**
5.1.12.A.1	Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations.
5.1.12.A.2	Develop and use mathematical, physical, and computational tools to build evidence-based models and to pose theories.
5.1.12.A.3	Use scientific principles and theories to build and refine standards for data collection, posing controls, and presenting evidence.
5.1.12.B.1	Design investigations, collect evidence, analyze data, and evaluate evidence to determine measures of central tendencies, causal/correlational relationships, and anomalous data.
5.1.12.B.2	Build, refine, and represent evidence-based models using mathematical, physical, and computational tools.
5.1.12.B.3	Revise predictions and explanations using evidence, and connect explanations/arguments to established scientific knowledge, models, and theories.
5.1.12.B.4	Develop quality controls to examine data sets and to examine evidence as a means of generating and reviewing explanations.
5.1.12.C.1	Reflect on and revise understandings as new evidence emerges.
5.1.12.C.2	Use data representations and new models to revise predictions and explanations.
5.1.12.C.3	Consider alternative theories to interpret and evaluate evidence-based arguments.
5.2.12.E.4	Measure and describe the relationship between the force acting on an object and the resulting acceleration.
8.1.12.A.1	Construct a spreadsheet, enter data, and use mathematical or logical functions to manipulate data, generate charts and graphs, and interpret the results.
8.2.12.B.1	The design process is a systematic approach to solving problems.

Unit Essential Questions	**Unit Enduring Understandings**
• What makes charge move in a circuit? • How are the values of circuit variables	• Matter contains charge. • There are two kinds of charge: positive and negative.

<table>
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measured?

What is the connection between moving charge and a magnetic field?
What is alternating current?
What is the purpose of fuses or circuit breakers in our homes?
How do motors and generators work?
How are electromagnetic fields created and used?

</td>
<td>

A circuit can be described as being “open” (no charge flow) or “closed” (charge flows).
Charge will flow in a closed circuit when there is a difference in “electric pressure” from one part of the circuit to a different part.
Birds perched on a high voltage un-insulated wire can do so because there is no significant difference in electrical potential between their feet.
Circuits can be wired in series, parallel, or in combination.
Resistors resist charge flow and capacitors store charge.
Increasing the load on parallel circuits results in increasing charge flow.

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</table>

Unit Learning Targets

Students will ...

- Using wires, bulbs, and batteries find what arrangement allows for the bulbs to light.
- In a closed loop, provide evidence that charge flows in one direction using a compass.
- Describe the differences observed when testing conductors and insulators.
- Identify resistors as objects that hinder charge flow in a circuit.
- Draw schematic diagrams of simple circuits.
- Provide evidence that a wire has negligible resistance.
- Describe both a battery and a hand-operated generator as pumps that move charge in a circuit.
- Explain how the same steady flow rates become established in series circuits.
- Explain how adding a parallel branch reduces the overall resistance in a circuit.
- Demonstrate that a voltmeter measures electric pressure differences.
- Demonstrate that an ammeter measures the flow rate of moving charge.
- Determine whether a resistor obey Ohm’s Law.
- Define power as the rate of energy transfer, and perform power calculations using P = VI
- Explain how both conductors and insulators can become polarized in the presence of external charge.
- Relate electric field strength to the “push” on a charge at a point in space.
- Relate electric field in a capacitor to energy storage in a capacitor.
- Investigate the relationship to force, magnetic fields, and moving charge and relate to motors and generators.

Evidence of Learning

Summative Assessment (30 days)

Unit test: Series, parallel, combined circuits, Ohm’s Law, power, generators and motors.

Lab practicum: demonstrate ability to make a closed circuit with a variety of imposed conditions: overall resistance, current, power requirements.

Equipment needed: CASTLE Kits (leads, battery holders, bulbs and holders, resistors, compasses, capacitors), hand-generator, batteries, digital multimeters, neon bulbs, acrylic plastic, LEDs, balloons, water bottles, miscellaneous materials (insulators and conductors).

Teacher Resources: ***Electricity Visualized*** Student Manual and Teacher Resources (no cost), published and distributed by PASCO Scientific. This publication is a product of the CASTLE Project, which is supported by the National Science Foundation and the US Department of Education National Diffusion Network. Copyright 2009 by Dr. Melvin S. Steinberg. Additional problem sets on circuits, and Ohm’s law.

Formative Assessments

- Make a bulb light with one battery and a small
- Demonstrate ability to use and discharge capacitors, digital

piece of insulated wire.

- Build a variety of series and parallel circuits.
- Perform Ohm's Law and power calculations.

multimeters, hand generators.

- Find how many devices would cause circuit overload in a parallel circuit.
- Show the relationship between force and moving charge using the right hand rule.

Teacher Notes:

Teacher Notes:

CASTLE 2009 Teacher's Manual : good source for demonstration ideas that add to student's understanding of electricity.

Curriculum Development Resources

Click the links below to access additional resources used to design this unit:

For teacher and student manuals for the CASTLE system:

http://www.pasco.com/featured-products/castle/

For an excellent Modelling Physics website developed by Marc Shober, physics teacher:
http://science.jburroughs.org/mschober/em3-circuits/sframe.htm

Sample Lesson Plan #1		
Content Area: Mathematics	**Grade: 1**	**Unit: Operations & Alg. Thinking**
Lesson Title: Acting Out Addition Word Problems		**Timeframe:** 40 minutes
Lesson Components		
Interdisciplinary Connections:		
21st Century Skills and Themes:		
Integration of Technology:		
Equipment needed: dice, card stock with digits 0 through 18, card stock with plus, equal signs, and unknown symbol.		

Learning Outcomes (Note: Each outcome should include a formative assessment)	Learning Activities/Instructional Strategies
Students: • SWBAT add two whole numbers whose sum is less than or equal to 12, as measured by their success with steps 3 and 4 of the lesson. • SWBAT add three whole numbers whose sum is less than or equal to 18, as measured by their success with step 6 of the lesson. • SWBAT solve word problems with two addends, as measured by partner presentations in step 8 of the lesson.	**Lesson Sequence** 1. Teacher will read addition anchor text to show importance of word problems. 2. Teacher states, "Today we are going to act out word problems using dice, cards, and our classmates." 3. Teacher will select a student to roll two dice (Ex: a 2 and a 3 are rolled.) Have a group of 2 students and 3 students stand at the front of the room; and a student with the plus sign separate them. Another student will hold the equal sign. 4. Ask the class, how many students need to come to the front of the room to show balance on both sides of the equal sign. 5. The teacher will repeat steps 3 and 4 until class demonstrates understanding. 6. Teacher will then introduce a third die and repeat procedure with three addends. (Number cards can be used to represent addends or the sum.) 7. Students will then work with partners and a die to write a word problem with two addends. 8. **Partners will present** their word problems for the class to solve.

Differentiation: For gifted and talented students, three addends should be used when writing their word problems or, alternatively, they could write a word problem using subtraction.
Resources Provided • Anchor text, focusing on word problems or addition.

Sample Lesson Plan #2		
Content Area: Music	**Grade:** 8	**Unit:** Music Reading & Performing
Lesson Title: Rhythm & Notation Reading		**Timeframe:** 5 hours/days

Lesson Components [Each * Item is Optional, and "As Needed"]							
***21st Century Themes**							
	Global Awareness		Financial, Economic, Business, and Entrepreneurial Literacy		Civic Literacy		Health Literacy
***21st Century Skills**							
	Creativity and Innovation		Critical Thinking and Problem Solving		**Communication and Collaboration**		Information Literacy
	Media Literacy		ICT Literacy		Life and Career Skills		
***Interdisciplinary Connections: Technology**							
***Integration of Technology: Computer-based quizzes, Keyboards, SmartBoard**							
***Equipment needed: computers, keyboards, SmartBoard, Worksheets**							

Learning Outcomes (Note: Each outcome should include a formative assessment)	Learning Activities/Instructional Strategies
Students Will Be Able To: • Identify beat, meter, and rhythm • Read and identify note durations • Transcribe rhythms • Perform basic rhythms on drums • Identify notes on a staff • Identify notes on the treble and bass clef •	**Lesson Sequence** 1. Beat-finding listening introduction 2. Discussion of pitch vs. rhythm on a graph 3. Tapping drum sticks to the beat 4. Playing on the off beat 5. Playing different parts in an ensemble 6. Listening and identifying the number of beats in uncommon meters. 7. Independent reading on note duration and questions. 8. Playing basic note rhythms on drums alone and in an ensemble. 9. Playing complex note rhythms on drums alone and in an ensemble. 10. Labeling note rhythms worksheet (in pairs). 11. Perform labeled rhythms. 12. Sixteenth note notation introduction. 13. Musical rests introduction. 14. Musical math worksheet. 15. Listening to rhythms. 16. Transcribing rhythms.

	17. Drum set parts worksheet. 18. Playing drum set part rhythms. 19. Playing together as a class drumset. 20. Computer lab rhythm quizzes. 21. Intro to Staff, Notes, and Pitches 22. Treble clef reading worksheet (in cooperative groups) 23. Bass clef reading worksheet (in cooperative groups) 24. Grand staff reading worksheet (in cooperative groups) 25. Group presentation and demonstration on SmartBoard.

Differentiation

Students will paired with partners and placed in groups of varying ability to complete reading assignments Computer-based quizzes allow extra time and practice for students who need it.

***Resources Provided**

- www.musictechteacher.com
- Rhythm & Note-reading worksheets

Lesson Plan Sample #3

Lesson Plan		
Content Area: Science	**Grade:** 4	**Unit:** Animal Habitats
Lesson Title: Relationship Between Animal Population & Habitat		**Timeframe:** 120 minutes – Day 1 of 1
Lesson Components		

Student Learning Objective	
Cognitive Level of Lesson:	Analysis, Synthesis, Evaluation
Students will be able to:	Draw conclusions about the relationship between an animal's population and its habitat by individually completing a scenario response journal (see attached) after reading Jean Craighead George's "Look to the North" and participating in the Wolf Population Game in class.
Learning:	Draw conclusions about the relationship between an animal's population and its habitat
Behavior:	By individually completing a scenario response journal (see attached)
Condition:	After reading Jean Craighead George's "Look to the North" and participating in the Wolf Population Game in class.

NJCCCS: 5.5, 4.4, 3.2, 1.2

Activities:
1. Upon entering class, students will be asked to sit on the reading rug. The teacher will show the students the cover of the book "Look to the North" by Jean Craighead George. (Directions) (2 minutes)
2. Teacher will take students through a picture walk of the book. Upon completion of the picture walk, the teacher will read the book to the students while displaying the pictures. (Anticipatory Set) (Related) (10 minutes)
3. Teacher will introduce new terms and will assist students in developing definitions for them as a class: Habitat; Survival; Famine; Drought; Hunting; Predator; Prey. Definitions should be written on the board. (Activate and Assess Prior Knowledge) (Related) (10 minutes)
4. Teacher will begin a class discussion: What is your own personal habitat? What do you need to survive? How are the wolves similar/different? What is the wolves' habitat like? What do they need to survive? Anticipated Responses: My house; water, food, my bed, my house; wolves need the same things; the woods; water, food, a place to rest. (Related) (5 minutes)
5. Teacher will take the students outside the classroom to a prepared area cordoned off by cones. (Directions) (2 minutes)
6. The students will count off by fours. All students with the same number will form groups. The "1s" will be wolves, the "2s" will be food, the "3s" will be water, and the "4s" will be shelter. All "1s" will line up against the wall of the building. All other numbers will disperse to anywhere within the coned area. Each number beside the "1s" needs to identify itself with a signal: "2s" must put their hands over their stomach for food, "3s" must put their hands out to the sides and wiggle them for water, and "4s" must put their hands over their heads for shelter. At the start of each round, the wolves will go collect **one** part of their "habitat" and bring it back to the wall. The captured habitats will become wolves for the next round. Once all the parts of the habitat are collected in subsequent rounds, any wolf that cannot collect at least one piece of the habitat "dies" and becomes part of the habitat for the next round. Students should note the number of wolves and habitats at the beginning and the teacher will record this number. (Directions) (7 minutes)
7. Teacher will let students play out 10 rounds. Between each round, the students will count the number of wolves and habitats there are and the teacher will record this number. (Relevant) (20 minutes)
8. During the final rounds of play, the Teacher will begin to randomly take away parts of the habitat due to

drought, famine, hunters, or other destructive occurrences. (Directions)
9. Teacher will continue to let students play out 5 more rounds. Between each round, the students will continue to count the number of wolves and habitats there are and the teacher will record this number. (Relevant) (10 minutes)
10. Class will return to the room. (Directions) (2 minutes)
11. Using the SmartBoard, the Teacher will begin to plot the number of wolves at each round in one color. The teacher will then begin to plot the number of habitats at each round in a different color. After looking at the graph, the teacher will lead a class discussion: What do you notice about the wolf population? When does it decline? When does it grow? What does this tell you about the relationship between the wolves and their habitat? (Model the New Learning) (Relevant) (5 minutes)
12. Teacher will split students into their “computer groups” (previously differentiated) and will have each group congregate around a computer. Each student in each group will be handed a paper with the scenario of the lynx and the rabbit (see attached). (Directions) (2 minutes)
13. Using the scenario and its data, the groups must create graphs using the computer software called *Dynamic Bargrapher*. (Relevant) (10 minutes)
14. Once the graphs are complete, copies of the graphs will need to be printed for each student in a group. (Directions) (3 minutes)
15. Using the graphs created on the computer, students must analyze the graph and individually complete a scenario response journal. The questions are located on the bottom of the lynx/rabbit paper (see attached). (Behavior) (Relevant) (20 minutes)
16. Teacher should monitor the students while they work and address any questions. (Monitor and Adjust)
17. Have students put away their journals; incomplete ones can be finished for homework. (Directions) (2 minutes)
18. Teacher will explain homework assignment. (Directions) (5 minutes)
19. Teacher will ask the class: What happens when a population grows too large? What happened when it grows too small? What did you learn about the relationship between habitats and animals? *Anticipated Responses*: the habitat gets smaller and animals start to die; the habitat gets larger and animals start to make more of themselves; drew conclusions about how they affect each other; when one goes up the other goes down. (Closure) (Related) (5 minutes)

Assessments:
Formative:
Students will individually complete a scenario response journal.
 Summative:
For homework, students may choose from the following options. Instructions and rubrics for each are located on colored paper at the front of the classroom: 1. **Fine Arts**-Think about an animal you like. Find some information on where it lives. On a piece of drawing paper, draw a picture of the habitat it should live in. Make sure you include all the parts of its habitat. (Hint: what it eats and drinks, where it sleeps, if people live nearby.) 2. **Language Arts**-Think about an animal you like. Find some information on where it lives. On a piece of lined paper or on a computer, write a story about a day in the life of your animal. Talk about where it lives, what it eats, and any problems it might have in the wild (Hint: Think about the last few rounds of the Wolf Game when the teacher started taking things away.)

Sample Lesson #4

Lesson Plan		
Content Area: Science	**Grade:** 7/8	**Unit:** Earth Systems
Lesson Title: Positions & Motions of Sun, Earth & Moon		**Timeframe:** 1 week – Five 40-minute Periods
Lesson Components		

Standard 5.4 Earth System Science: The Earth operates as a set of complex and dynamic interconnected systems, and is a part of the all encompassing system of the Universe.	**By the end of Grade 8**
Strand A. Objects in the Universe: *Our Universe has been expanding and evolving for 13.7 billion years under the influence of gravitational and nuclear forces. As gravity governs its expansion, organizational patterns, and the movement of celestial bodies, nuclear forces within stars govern its evolution through the processes of stellar birth and death. These processes also governed the formation of our Solar System 4.6 billion years ago.*	
Essential Questions	**Enduring Understandings**
What predictable, observable patterns occur as a result of the interaction between the Earth, Moon, and Sun? What causes these patterns?	Observable, predictable patterns of movement in the Sun, Earth, Moon system occur because of gravitational interaction and energy from the Sun.
Content and Cumulative Progress Indicators	**Instructional Guidance**
Content The relative positions and motions of the Sun, Earth, and Moon result in the phases of the moon, eclipses, and the daily and monthly cycle of tides.	**Instructional Guidance** ***To assist in meeting this CPI, students may:*** • Create their own diagrams to illustrate explanations for tidal anomalies. See NOVA on Teachers Domain: Tidal Curiosities at: http://www.teachersdomain.org/resource/phy03.sci.phys.matter.curiosities • Engage in Catch A Wave, an educational project for students that uses online real time data, to guide student discovery of the causes and effects of ocean waves and tides. See Catch A Wave at: http://www.ciese.org/curriculum/tideproj/index.shtml • Participate in a kinesthetic classroom activity designed to help better understand moon phases and eclipses. See NASA Educator's Guide to Moon Phases at: http://www.solarviews.com/eng/edu/moonphas.htm • Generate scale models of the Earth, Moon and Sun both in size and distances, when given data tables. • Model how moon phases, eclipses, and tides occur while using materials

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<tr><td><u>CPI</u>

5.4.8.A.1
Analyze moon phase, eclipse and tidal data to construct models that explain how the relative positions and motions of the Sun, Earth, and Moon cause these three phenomena.</td><td><u>Sample Assessments</u>
To show evidence of meeting this CPI, students may answer the following questions:

1. The search for a planet that was causing Uranus to move in unexplained directions led to the discovery of Pluto. Which of the following MOST LIKELY explains why another planet could cause Uranus to move in unexplained directions?

A. Uranus has moons with active interiors.
B. Uranus has no atmosphere to change its direction.
C. Another planet could move Uranus with its gravity.
D. Another planet would keep Uranus from drifting away.
(MS)

2. Sometimes the Moon looks like a full circle, sometimes it looks like a half circle, and sometimes it looks like a crescent. Explain why the Moon appears to be different shapes at different times. You may use labeled drawings in your explanation.
(NAEP)

<u>Resources</u>
• National Science Digital Library, Science Digital Literacy Maps
The Physical Setting: Solar System
http://strandmaps.nsdl.org/?id=SMS-MAP-1282
• Historical Perspectives : Classical Mechanics
http://strandmaps.nsdl.org/?chapter=SMS-CHP-1094
• NSDL Collection K-12 Short Cuts: Middle School
http://nsdl.org/resources_for/k12_teachers/middle-school.php
• Science Curriculum Topic Study
Earth, Moon, and Sun System, p.194</td></tr>
<tr><td><u>Content</u>

The Earth's tilt, rotation and revolution around the Sun cause changes in the height and duration of the Sun in the sky. These factors combine to explain the changes in the length of the day and seasons.</td><td><u>Instructional Guidance</u>
To assist in meeting this CPI, students may:

• Engage in a globally collaborative project, such as The Noon Day Project, where students from around the world collect and share data that will be used to measure the circumference of the earth using a method that was first used by Eratosthenes over 2000 years ago. See The Noon Day Project at: http://www.ciese.org/curriculum/noonday/

• Explore the question Why is there day and night? See NASA's Starchild for background information and a short activity describing why there are nights and days.</td></tr>
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http://starchild.gsfc.nasa.gov/docs/StarChild/questions/question31.html

- Utilize activities, background information, books and Audio/Visual resources to develop an understanding of the mechanics of seasons. See NASA's Seasons at: http://www.lpi.usra.edu/education/skytellers/seasons/activities/sequences.shtml

- Model how the Earth rotates on its tilted axis as it revolves around the Sun.

- Explain how the concept of time is derived from Earth's rotation and revolution.

- Identify the relationship between Sun angle and shadows on the Earth and annual variations in temperature in the mid-latitudes.

CPI

5.4.8.A.2
Use evidence of global variations in day length, temperature, and the amount of solar radiation striking Earth's surface, to create models that explain these phenomena and seasons.

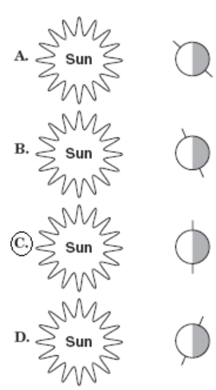
Sample Assessments
To show evidence of meeting this CPI, students may answer the following questions:

1. It is summer in the Northern Hemisphere when it is winter in the Southern Hemisphere. Which of the following causes this difference in seasons between hemispheres?

   A. *Earth's axis is tilted in relation to the Sun.*
   B. The speed of Earth's rotation on its axis.
   C. The curvature of Earth's surface prevents seasons from occurring simultaneously.
   D. The distance from the Sun varies due to Earth's elliptical orbit.

(MS)

2. The diagrams below show the tilt of a planet's axis relative to a star it is orbiting. This planet has an orbit that is similar to Earth's. In which diagram does the planet have no seasons?



(MS)

3. If you go outside on a sunny day, you will make a shadow. At some times of day your shadow is longer than you are. At other times of day it is shorter

	than you are. How can this difference in the length of your shadow be explained? (You can use a drawing to help explain your answer.) (NAEP) 4. Suppose that for a science project you wanted to find exactly how much the length of a shadow changes during the day. Describe both the materials and the procedures you would use to make these observations. (NAEP) 5. If you measured your shadow at noon during the summer and at noon during the winter, would the measurements be the same or would they be different? (NAEP) **Resources** • National Science Digital Library, Science Digital Literacy Maps The Physical Setting: Weather and Climate http://strandmaps.nsdl.org/?id=SMS-MAP-1698 • NSDL Collection K-12 Short Cuts: Middle School http://nsdl.org/resources_for/k12_teachers/middle-school.php • *Science Curriculum Topic Study* Seasons, p.185 Earth, Moon, and Sun System, p.194
Content Gravitation is a universal attractive force by which objects with mass attract one another. The gravitational force between two objects is proportional to their masses and inversely proportional to the square of the distance between the objects. **CPI** **5.4.8.A.3** Predict how the gravitational force between two bodies would differ for bodies of	**Instructional Guidance** ***To assist in meeting this CPI, students may:*** • Compare the experience of gravity on Earth with that of the astronauts' perceived weightlessness in space. See Teachers Domain, Gravity on Earth and in Space at: http://www.teachersdomain.org/resource/phy03.sci.phys.mfe.gravity/ • Model the relationships (basic Newtonian mechanics) between the orbiting motions of the planets around the Sun, and moons around the planets. • Apply the components of Newton's formula for his Law of Universal Gravitation to explain how the force of gravity depends on how much mass the objects has and how far apart they are. ✓ **Note**: Students at this level should be focusing on conceptual understandings. Quantitative exploration of Kepler's Laws and Gravity will take place in a later grade band cluster. **Sample Assessments** ***To show evidence of meeting this CPI, students may answer the following question:*** Astronauts can jump higher on the Moon than they can on Earth. Which of the following BEST explains why astronauts can jump higher on the Moon?

different masses or different distances apart.	A. *The Moon has less mass than Earth.* B. The Moon has more mass than Earth. C. The Moon's atmosphere has less oxygen. D. The Moon's atmosphere has more oxygen. **Resources** • National Science Digital Library, Science Digital Literacy Maps The Physical Setting: Gravity http://strandmaps.nsdl.org/?id=SMS-MAP-1372 • NSDL Collection K-12 Short Cuts: Middle School http://nsdl.org/resources_for/k12_teachers/middle-school.php • *Science Curriculum Topic Study*: Gravity in Space, p.195
Content The regular and predictable motion of objects in the solar system (Kepler's Laws) is explained by gravitational forces.	**Instructional Guidance** ***To assist in meeting this CPI, students may:*** • Create an orrery model of the Solar System that illustrates the relative motions and positions of bodies in the Solar System. Works together as a class to create a human-powered orrery to model the movements of the four inner planets. Assist in setting up this moving model of the Solar System and take turns playing the roles of Mercury, Venus, Earth, and Mars. See NASA's Planetary Motions. A classroom activity centered around a Human Orrery: http://kepler.nasa.gov/ed/pdf/HumanOrrery.pdf ✓ **Note:** The name comes from Charles Boyle, the 4th Earl of Orrery, for whom one of these models was made. The first orreries were mechanical, but a computer model of the Solar System is also called an orrery. See GEMS located at: http://kepler.nasa.gov/ed/activities/gems.html for a detailed lesson plans and resources. • Observe the orrery in motion, and then form conclusions about the orbital periods of the inner planets. Afterwards, predict as a class, the orbital periods of the outer planets using the mapped scale model. • Investigate and debate how Galileo's observations of the phases of Venus persuade him of the true nature of the solar system. o Extension: Do some research on the public's reaction to Galileo's "Dialogue Concerning the Two Chief World Systems." What were the dominant political structures in place at the time of publication and what repercussions did he face? ✓ **Note:** Students at this level should be focusing on conceptual understandings. Quantitative exploration of Kepler's Laws and Gravity will take place at a later grade band.

CPI	Sample Assessments
5.4.8.A.4 Analyze data regarding the motion of comets, planets and moons to find general patterns of orbital motion.	***To show evidence of meeting this CPI, students may answer the following question:*** The dwarf planet Pluto takes much longer to revolve around the Sun than do other planets. This is because Pluto A. *is farther from the Sun than other planets.* B. is smaller than other planets. C. has fewer satellites than other planets. D. has a very slow rotation as compared to other planets. (ME) **Resources** • National Science Digital Library, Science Digital Literacy Maps Historical Perspectives: Copernican Revolution http://strandmaps.nsdl.org/?id=SMS-MAP-2312 • NSDL Collection K-12 Short Cuts: Middle School http://nsdl.org/resources_for/k12_teachers/middle-school.php • *Science Curriculum Topic Study*: Motion of Planets, Moons, and Stars, p.197