

# Unit 02: The Atom\_Structure & Theory (Weeks 21 - 27)

Content Area: **Template**

Course(s):

Time Period: **Full Year**

Length: **FY**

Status: **Published**

## Standards Alignment

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### New Jersey Student Learning Standards

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#### Practice 1. Asking questions (for science) and defining problems (for engineering)

Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.

Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information.

Ask questions that arise from examining models or a theory, to clarify and/or seek additional information and relationships.

Ask questions to clarify and refine a model, an explanation, or an engineering problem.

Evaluate a question to determine if it is testable and relevant.

Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.

Ask and/or evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design.

SCI.HS-PS1	Matter and Its Interactions
SCI.HS-PS1-1	Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.
LA.K-12.NJSLSA.R1	Read closely to determine what the text says explicitly and to make logical inferences and relevant connections from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
LA.K-12.NJSLSA.R2	Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.
LA.K-12.NJSLSA.R3	Analyze how and why individuals, events, and ideas develop and interact over the course of a text.
LA.K-12.NJSLSA.R4	Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.
LA.K-12.NJSLSA.R5	Analyze the structure of texts, including how specific sentences, paragraphs, and larger portions of the text (e.g., a section, chapter, scene, or stanza) relate to each other and the whole.
LA.K-12.NJSLSA.R6	Assess how point of view or purpose shapes the content and style of a text.
LA.K-12.NJSLSA.R7	Integrate and evaluate content presented in diverse media and formats, including visually

and quantitatively, as well as in words.

LA.K-12.NJSLSA.R8	Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.
LA.K-12.NJSLSA.R9	Analyze and reflect on how two or more texts address similar themes or topics in order to build knowledge or to compare the approaches the authors take.
LA.K-12.NJSLSA.R10	Read and comprehend complex literary and informational texts independently and proficiently with scaffolding as needed.
	Key Ideas and Details
LA.RST.11-12.1	Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.
LA.RST.9-10.1	Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.
LA.RST.9-10.2	Determine the central ideas, themes, or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
LA.RST.9-10.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
LA.RST.11-12.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
	Craft and Structure
LA.RST.11-12.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.
LA.RST.9-10.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
LA.RST.9-10.5	Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).
LA.RST.9-10.6	Determine the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.
	Integration of Knowledge and Ideas
LA.RST.11-12.7	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
LA.RST.9-10.7	Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
LA.RST.9-10.8	Determine if the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
LA.RST.11-12.8	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
LA.RST.9-10.9	Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.
LA.RST.9-10.10	By the end of grade 10, read and comprehend science/technical texts in the grades 9-10

	text complexity band independently and proficiently.
LA.RST.11-12.10	By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently.
SCI.HS-PS4	Waves and Their Applications in Technologies for Information Transfer
SCI.HS-PS4-1	Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
SCI.HS-PS4-3	Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.

## **Integration of Career Readiness, Life Literacies and Key Skills**

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CRP.K-12.CRP1	Act as a responsible and contributing citizen and employee.
CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP3	Attend to personal health and financial well-being.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP5	Consider the environmental, social and economic impacts of decisions.
CRP.K-12.CRP6	Demonstrate creativity and innovation.
CRP.K-12.CRP7	Employ valid and reliable research strategies.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP8.1	Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem. They are aware of problems when they occur and take action quickly to address the problem; they thoughtfully investigate the root cause of the problem prior to introducing solutions. They carefully consider the options to solve the problem. Once a solution is agreed upon, they follow through to ensure the problem is solved, whether through their own actions or the actions of others.
CRP.K-12.CRP9	Model integrity, ethical leadership and effective management.
CRP.K-12.CRP10	Plan education and career paths aligned to personal goals.
CRP.K-12.CRP11	Use technology to enhance productivity.
CRP.K-12.CRP12	Work productively in teams while using cultural global competence.

## **Technology / Integration of Computer Science and Design Thinking**

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TECH.8.1.12	Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
TECH.8.1.12.A	Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations.
TECH.8.1.12.A.4	Construct a spreadsheet workbook with multiple worksheets, rename tabs to reflect the data on the worksheet, and use mathematical or logical functions, charts and data from all worksheets to convey the results.

## Interdisciplinary Connections: NJSLs for ELA, Social Studies, Science and/or Math Section

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### Key Ideas and Details

LA.K-12.NJLSA.R1 Read closely to determine what the text says explicitly and to make logical inferences and relevant connections from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

LA.K-12.NJLSA.R2 Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.

### Craft and Structure

LA.K-12.NJLSA.R4 Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.

LA.K-12.NJLSA.R8 Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.

LA.K-12.NJLSA.W Writing

LA.RI.9-10.1 Accurately cite strong and thorough textual evidence, (e.g., via discussion, written response, etc.) and make relevant connections, to support analysis of what the text says explicitly as well as inferentially, including determining where the text leaves matters uncertain.

LA.RI.9-10.2 Determine a central idea of a text and analyze how it is developed and refined by specific details; provide an objective summary of the text.

### Text Types and Purposes

LA.K-12.NJLSA.W1 Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

LA.K-12.NJLSA.W2 Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

LA.RI.9-10.4 Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the cumulative impact of specific word choices on meaning and tone (e.g., how the language of a court opinion differs from that of a newspaper).

LA.K-12.NJLSA.W5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach.

LA.K-12.NJLSA.W6 Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

LA.RI.9-10.8 Describe and evaluate the argument and specific claims in a text, assessing whether the reasoning is valid and the evidence is relevant and sufficient; identify false statements and reasoning.

LA.K-12.NJLSA.W9 Draw evidence from literary or informational texts to support analysis, reflection, and research.

LA.W.9-10.1 Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

LA.K-12.NJLSA.SL Speaking and Listening

LA.W.9-10.1.A Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among claim(s), counterclaims, reasons, and evidence.

### Comprehension and Collaboration

LA.K-12.NJSLSA.SL1	Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.
LA.W.9-10.1.C	Use transitions (e.g., words, phrases, clauses) to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
LA.W.9-10.1.D	Establish and maintain a style and tone appropriate to the audience and purpose (e.g., formal and objective for academic writing) while attending to the norms and conventions of the discipline in which they are writing.
LA.W.9-10.1.E	Provide a concluding paragraph or section that supports the argument presented.
	Presentation of Knowledge and Ideas
LA.W.9-10.2	Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.
LA.K-12.NJSLSA.SL4	Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.
LA.W.9-10.2.A	Introduce a topic; organize complex ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
LA.W.9-10.2.B	Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
LA.W.9-10.2.D	Use precise language and domain-specific vocabulary to manage the complexity of the topic.
LA.W.9-10.2.F	Provide a concluding paragraph or section that supports the information or explanation presented (e.g., articulating implications or the significance of the topic).
LA.W.9-10.5	Develop and strengthen writing as needed by planning, revising, editing, rewriting, trying a new approach, or consulting a style manual (such as MLA or APA Style), focusing on addressing what is most significant for a specific purpose and audience.
LA.W.9-10.6	Use technology, including the Internet, to produce, share, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.
LA.W.9-10.9	Draw evidence from literary or nonfiction informational texts to support analysis, reflection, and research.
LA.SL.9-10.1	Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
LA.SL.9-10.1.A	Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.
LA.SL.9-10.4	Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.

see Crosswalks

## **21st Century Life and Careers**

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### **INFORMATION LITERACY:**

**OUTCOME:** Students are able to locate reliable scientific information in reputable reference books, back issues of journals and magazines, on websites, and in computer databases.

**EXAMPLE:** Students compare databases of health-related information (e.g., blood pressure) to determine patterns of distribution and implications of those patterns to different populations. They then take their own blood pressure readings, graphically represent those readings, and compare them to the public databases.

### **MEDIA LITERACY:**

**OUTCOME:** Students are able to identify and critique arguments in which the claims are not consistent with the evidence given.

**EXAMPLE:** Student teams research a local environmental issue and prepare editorial essays in the style of a media release, making sure to include evidence of the problem and specific claims they make based on that evidence. Students develop criteria for peer review, then exchange their products and critique each other's work for consistency of claim and evidence.

### **FLEXIBILITY AND ADAPTABILITY:**

**OUTCOME:** Students can identify the difference between scientific theories (which can be improved through new evidence and expanded through exceptions to observed patterns) and beliefs (which may or may not be based on evidence).

**EXAMPLE:** Students examine satellite images of the Earth and distinguish geologic structures from signs of plant and animal activity—including human-created patterns—then compare those patterns to images of other planets and their moons. This information is used as the basis for discussion on what evidence for life on other planets we might be able to detect.

**OUTCOME:** Students can provide examples that show how people often rely on scientific information to inform personal choices and societal practices, and that changes in scientific understanding can affect those choices.

EXAMPLE: Students research the historical development of a safety technology such as car seat belts or bike helmets, and examine product test data and actuarial data from online resources. Students present their findings, including multimedia charts and graphs, and discuss the implications of laws that require the use of these devices.

## **Stage I: Desired Results**

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### **Transfer/Overview/Rationale**

<b>Transfer / Overview / Rationale</b>
Unit Rationale The purpose of this unit...  is to investigate the development of atomic structure.

### **Meaning**

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### **Essential Questions**

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Essential Questions

- How do the atoms of one element differ from those of another element?
- How have scientists impacted the development of modern atomic theory?
- How are trends, patterns, or relationships expressed on the periodic table?
- How do valence electrons influence an elements behavior?

### **Enduring Understanding/Indicators of Understanding**

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## Enduring Understanding/Indicators of Understanding

Students will understand that:

- The structure of the atom defines its properties and influences its interactions
- The inquiries and experiments of scientists have shaped modern day chemistry
- An object's characteristics and behavior are determined by the outermost electrons in an atom
- The periodic table displays the relationships between different elements

## **Acquisition (Student Learning Objectives)**

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### **Knowledge**

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Knowledge

Students will know...

- atom
- Dalton
- Atomic theory
- Thomson
- Rutherford
- Millikan
- Chadwick
- Cathode ray
- Electron
- Neutron
- Proton
- Nucleus
- Atomic mass unit
- Atomic number
- isotope
- mass number
- atomic weight
- Periodic table
- group
- family
- alkali metals
- alkali earth metals
- transition metals
- Inner transition metals
- Halogens
- Noble gases
- Representative/ Main group elements
- Metals/nonmetals/metalloids
- period
- ion
- energy levels
- quantum

- quantum mechanical model
- atomic orbitals
- Bohr
- electron configurations
- condensed electron configurations/ noble gas configurations
- valence electrons
- orbital box diagrams
- aufbau principle
- Pauli exclusion principle
- Hund's rule
- wavelength
- waves
- frequency
- speed of light
- hertz
- wave-particle duality
- electromagnetic radiation
- atomic emission spectrum
- ground state
- photons
- periodic law
- atomic radius
- ions
- cations
- anions
- ionization energy
- electronegativity
- group properties

Students will know the following:

- how the understanding of the atom has changed over time
- how to determine the number of subatomic particles based on atomic number
- how to use the periodic table to find information
- how to determine the electron configuration for an element using the periodic table
- to draw an orbital box diagram
- Hund's Rule
- Pauli Exclusion principle
- how to sort elements into groups
- trends on the periodic table
- relationship between wavelength, frequency and speed of light
- how to recognize the wavelength of different radiation
- Bohr model of the atom
- electrons move as particles and waves
- shapes of orbitals
- how the periodic table is arranged

## Skills

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Skills

Student will be skilled at ...

- characterize each scientist's contribution to modern atomic theory
- derive numbers of protons, neutrons & electrons from atomic number and mass
- calculate atomic weight
- calculate average atomic mass
- identify elements in certain families
- manipulate the speed of light formula to solve for frequency or wavelength
- describe Bohr's atomic theory
- describe the orbital shapes
- write full electron configurations for certain elements/ions
- write condensed configurations
- write orbital box diagrams
- identify unpaired electrons
- identify valence electrons
- arrange atoms in order of increasing/decreasing atomic size
- arrange atoms in order of increasing/decreasing ionization energy
- arrange atoms in order of increasing/decreasing electronegativity
- organize elements based on periodic properties
- use the periodic table to predict properties
- identify an element based on its flame test color
- determine frequency based on light spectrums
- organize unknown elements based on periodic properties

### **Stage 3: Learning Plan**

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### **Resource and Mentor Texts**

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Resources and Mentor Texts

Wilbraham, A.C., Staley, D.D., Matta, M.S. & Waterman, E.L. *Chemistry*. Massachusetts: Boston, Pearson Education Inc. 2008.

Animations at learnerstv.org

Video clip: "Atomos" <https://www.youtube.com/watch?v=WK7wuTwAiBU>

FLINN lab: Structure of an Atom: A Metaphor

Candium Lab

Atomic mass simulation: <http://phet.colorado.edu/en/simulations/isotopes-and-atomic-mass>

Flame Test Lab

I See the Light! Lab

FLINN Lab: Metal, Nonmetal, or Metalloid?

National Geographic article: "The Element Hunters"

FLINN Lab: Periodic Trends and the Properties of Elements

## **Formative Assessment Strategies**

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Formative Assessment Strategies

Daily Do Nows & Class Review

Teacher questioning

Student questioning

Thumbs up/Thumbs down

Checkpoints

Demo questions

Lab checks

Exit ticket

Door Quizzes

Homework checks

Classwork assignments

## **Learning Activities/Unit of Study**

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Learning Activities/Unit of Study

### **Activities**

- History of the Atom Jigsaw Project/Presentations
- Practice Problems
- Candium Mini-lab
- POGIL ~ Average Atomic Mass
- POGIL ~ Isotopes
- Light Spectra
- Hog Hilton
- Electron Configuration Practice
- Periodic Trends
- Element Hunter ~ Annotation
- Game ~ What Element am I?

### **Demos**

- Orbital Models
- Flame Tests

### Labs

- Atomic Structure: A Metaphor
- Quantum Leap
- I See the Light
- Flame Tests
- Metal/Nonmetal/Metalloid
- Trends Graphing Lab
- Periodic Trends & the Properties of Elements

### Assessments:

- Quiz ~ History of Chemistry
- Quiz ~ Chart Problem
- Quiz ~ Average Atomic Mass
- Chapter 4 Test
- Quiz ~ Light
- Quiz ~ Electron Configurations
- Chapter 5 Test
- QuizAm ~ Trends
- Benchmark

## **Modifications and/or Accommodations**

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### **Suggested Modifications (ELL, Sp. Ed, Gifted, At-risk of Failure)**

#### **English Language Learners**

Native language support: The teacher provides auditory or written content to students in their native language.

Adjusted Speech: The teacher changes speech patterns to increase student comprehension. This could include facing the students, paraphrasing, clearly indicating the most important ideas, and speaking more slowly.

Visuals: The teacher uses graphics, pictures, visuals, and manipulatives. This helps ELL students

better understand and comprehend the subjects at hand.

**Front-Loading Vocabulary:** The teacher front loads vocabulary. This means providing students with a list of important vocabulary words they will need to know for a book, lesson, etc. prior to the lesson being taught. Including pictures to go with the vocabulary words is also very beneficial for the students.

## **Special Education Students**

**Chunking:** The teacher presents information in a way that makes it easy for students to understand and remember. Chunking is based on the presumption that our working memory is easily overloaded by excessive detail. The best way to deliver information is to organize it into meaningful units. Because students with special needs get overloaded easily, chunking is an effective strategy to use with them.

**Checking for Understanding:** It is important to constantly check for understanding, especially for students who have accommodations. Teachers want to make sure students understand the concepts being covered in a way that makes sense to them.

**Extra time:** The teacher provides students with special needs extra time to complete work or answer questions. It is important to give students enough time to process their thoughts.

**Oral Reading:** The teacher will read work orally to students. Class work such as tests and literature circles may need to be read aloud to the student.

**Timers:** The teacher will use timers as an instructional tool. The use of timers is beneficial for students who have trouble completing tasks. Timers can be helpful so the student is aware of how much time they have to complete an assignment.

## **Students with 504 Plans**

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## **Gifted & Talented Strategies**

**Extensions/Enrichments:** Teachers will provide gifted and talented students with

extension/enrichment projects. Students will be challenged to further their understanding, to apply acquired knowledge, and/or to produce something in reference to acquired knowledge.

**Modify/Change Activities:** Teachers will monitor and modify activities to accommodate those students who need to be challenged further. Additional reading, problem-solving, writing, or project work is necessary for those students who are ready to move on at a rate more accelerated than their peers. In this way, G & T students are provided the same opportunity for support as special needs students.

## Students at Risk of School Failure

**Directions or Instructions:** Make sure directions and/or instructions are given in limited numbers. Give directions/instructions verbally and in simple written format. Ask students to repeat the instructions or directions to ensure understanding occurs. Check back with the student to ensure he/she hasn't forgotten.

**Peer Support:** Peers can help build confidence in other students by assisting in peer learning. Many teachers use the 'ask 3 before me' approach. This is fine, however, a student at risk may have to have a specific student or two to ask. Set this up for the student so he/she knows who to ask for clarification before going to you.

**Alternate or Modified Assignments:** Always ask yourself, "How can I modify this assignment to ensure the students at risk are able to complete it?" Sometimes you'll simplify the task, reduce the length of the assignment or allow for a different mode of delivery. For instance, many students may hand something in, the at-risk student may jot notes and give you the information verbally. Or, it just may be that you will need to assign an alternate assignment.

**Increase One to One Time:** When other students are working, always touch base with your students at risk and find out if they're on track or needing some additional support. A few minutes here and there will go a long way to intervene as the need presents itself.

**Contracts:** It helps to have a working contract between you and your students at risk. This helps prioritize the tasks that need to be done and ensure completion happens. Each day write down what needs to be completed, as the tasks are done, provide a checkmark or happy face. The goal of using contracts is to eventually have the student come to you for completion sign-offs.

**Hands On:** As much as possible, think in concrete terms and provide hands-on tasks. This means a child doing math may require a calculator or counters. The child may need to tape record comprehension activities instead of writing them. A child may have to listen to a story being read instead of reading it him/herself.

**Tests/Assessments:** Tests can be done orally if need be. Break tests down in smaller increments by having a portion of the test in the morning, another portion after lunch and the final part the next day.

**Seating:** Seat students near a helping peer or with quick access to the teacher. Those with hearing or sight issues need to be close to the instruction which often means near the front.

