

Differentiated Instruction Teaching/Learning Examples



GRADE 9 SCIENCE, APPLIED (SNC 1P) CHEMISTRY: CHEMICAL PROPERTIES INVESTIGATION—SCIENCE

Two to three 75-minute periods

1. Classification (Identifying Similarities and Differences)*
2. Frayer Model (Non-linguistic Representations)*
3. Teacher Demonstration Lab
4. Think-Pair-Exit Card
5. (Student Lab) Chemical Properties Investigation
6. (Student Lab) Chemical Properties Investigation: Pairs-Square—Drawing Conclusions
7. Unknown Elements Cards
8. Imagine all the Elements/Gallery Walk
9. Comparison of Metals Multiple Intelligences (MI) Choice Board**
10. Comparison of Metals Frayer Model Summary or Comparison of Metals Learning Contract**

*Marzano's Categories of Instructional Strategies (See Resources, below.)

**Differentiated Instruction Structure

DIFFERENTIATED INSTRUCTION DETAILS

Knowledge of Students

Differentiation based on student:

- Readiness Interests Preferences: Styles Intelligences Other (e.g., environment, gender, culture)



Need to Know

- Multiple intelligences of students in order to design the Comparison of Metals Multiple Intelligences (MI) Choice Board (Appendix H) and Learning Contract options (Appendix J)

How to Find Out

- Students complete a multiple intelligences inventory, reflect on their results and refine a list of their preferred intelligences
- Ongoing discussion of preferred multiple intelligences and observation of students

Differentiated Instruction Response

- Topic, Entry Point (content) Ways of learning (process) Ways of demonstrating learning (product) Learning environment

CURRICULUM CONNECTIONS

Big Ideas: Elements and compounds have specific properties that determine their uses

Fundamental Concepts: Matter, Structure, and Function

Overall Expectations: (A) Scientific Investigation Skills and Career Exploration; (C) Chemistry: Exploring Matter

A1. Demonstrate scientific investigation skills (related to both inquiry and research) in the four areas of skills (initiating and planning [IP], performing and recording [PR], analysing and interpreting [AI], and communicating [C])

C2. Investigate, through inquiry, physical and chemical properties of common elements and simple compounds

C3. Demonstrate an understanding of the properties of common elements and simple compounds, and general features of the organization of the periodic table.

Specific Expectations: (A1) Scientific Investigation Skills; (C2) Developing Skills of Investigation and Communication; (C3) Understanding Basic Concepts

A1.10 Draw conclusions based on inquiry results and research findings, and justify their conclusions (AI)

A1.11 Communicate ideas, plans, procedures, results, and conclusions orally, in writing, and/or in electronic presentations, using appropriate language and a variety of formats (C)

C2.5 Investigate and compare the chemical properties of representative elements within groups in the periodic table families of elements [PR, AI]

C3.4 Explain the relationships between the properties of elements and their position in the periodic table

Learning Goals:

- Understand the chemical properties of metals
- Explain how elements within a group on the periodic table are related to each other
- Draw conclusions based on inquiry results
- Communicate using scientific conventions

ASSESSMENT AND EVALUATION

Assessment/Success Criteria

Knowledge and Understanding

- Describes the chemical properties of elements
- Explains the similarities and differences between the chemical properties of various metals
- Explains the relationship between properties of elements and their location on the periodic table

Thinking and Inquiry

- Justifies conclusions based on analysis of observations:
 - o Records observations on a data table
 - o Identifies relevant relationships and patterns
 - o Analyses information to draw a conclusion

Communication

- Expresses and organizes ideas and information clearly:
 - o Uses scientific terminology appropriately
 - o Uses accurate symbols and graphic representations (e.g., Bohr-Rutherford diagrams, chemical notation for elements)

Assessment Tools:

- Anecdotal Comments
- Checklist
- Rubric

PRIOR LEARNING

Prior to this lesson, students will have:

- Learned the difference between the physical properties of metals and non-metals
- Learned the features of the periodic table relating to period, group and atomic structure
- Described the characteristic physical and chemical properties of common elements
- Conducted an inquiry, using materials safely, collecting and recording data

MATERIALS AND RESOURCES

Materials:

Metals for use in the investigations—sodium, lithium, aluminum, magnesium, copper, calcium, and tin (or similar transitional metal)
Equipment for the Chemical Properties Investigations (see Appendix E)
Two large index cards per student (for Exit Card and Element Card)
Chart paper and markers
Masking tape

Appendix A (pp. 1 & 2): Classifying Properties: Physical or Chemical—see instructions on Appendix A

Appendix B: Frayer Model: Metals—one per small group and one for teacher use on chart paper

Appendix C: Teacher-Demonstrated Investigation of Alkali Metals and Aluminum (Teacher Reference)

Appendix D: Assessment Checklist for Chemical Properties Tasks

Appendix E (pp. 1–3): Investigating the Chemical Properties of Four Metals (Student Lab)—one per student

Appendix F1 (pp. 1 & 2): Unknown Elements: To Whom Am I Related?—one per student

Appendix F2: Unknown Elements: To Whom Am I Related? (Teacher Reference)

Appendix G: Imagine all the Elements—one per student

Appendix H: Comparison of Metals Multiple Intelligences (MI) Choice Board—one per group

Appendix I: Comparison of Metals Frayer Model Summary—one for each student who chooses this option

Appendix J: Comparison of Metals Multiple Intelligences (MI) Learning Contract—one for each student who chooses this option

Appendix K: Chemical Properties Rubric for Frayer Model/Learning Contract—one per student

Internet Resources:

Manitoba Education. Multiple Intelligences Inventory Checklist: www.edu.gov.mb.ca/k12/cur/cardev/gr10_found/blms/blm26.pdf

McKenzie, Walter (1999). The One and Only Surfaquarium Multiple Intelligences Inventory: www.surfaquarium.com/Mi/inventory.html (This survey may be printed, used and/or modified by educators as long as the copyright tag remains intact.)

Ministry of Education (2004). Think Literacy: Subject-Specific Documents, Mathematics, Grades 7–9. (Frayer Model, p. 38). See Think Literacy Library: www.edu.gov.on.ca/eng/studentssuccess/thinkliteracy/library.html

Resources:

Hume, Karen. (2008). *Start Where They Are: Differentiating for Success with the Young Adolescent* (with CD-ROM). Toronto, ON: Pearson Education Canada (Multiple Intelligence Inventory—Black Line Master 4.6)

Marzano, Robert J., Pickering, Debra, and Pollock, Jane E. (2001). *Classroom Instruction that Works: Research-Based Strategies for Increasing Student Achievement*. Alexandria, VA: ASCD.

Ministry of Education. (2008). *The Ontario Curriculum, Grades 9–10, Science*. (Scientific Investigation Skills, pp. 19–21)

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Teaching/Learning Sequence: Grade 9 Science, Applied (SNC1P) Chemistry: Chemical Properties Investigation—Science

<p>MINDS ON</p> <ul style="list-style-type: none"> Establishing a positive learning environment Connecting to prior learning and/or experiences Setting the context for learning <p>Prior to this lesson, students will have completed a Multiple Intelligences (MI) inventory, reflected on their intelligence preferences and created a chart or profile that illustrates their preferences. (See Materials and Resources on the reverse of this folder.)</p> <p>Individuals, Pairs or Small Groups (Three or Four) → Classification Ask students to select, based on their intelligence profile, one of the three options for classifying properties as physical or chemical—see Classifying Properties: Physical or Chemical (Appendix A). Students:</p> <ul style="list-style-type: none"> Work alone (intrapersonal) or in pairs/small groups (interpersonal) to classify properties as physical or chemical by: <ol style="list-style-type: none"> Completing a card sort (bodily-kinesthetic), Using coloured highlighters (visual-spatial), or Indicating with the letter P or C (logical-mathematical). <p>Each student should be able to explain each choice and explain chemical and physical properties. If samples are available, provide groups with a tray of metal samples and have them describe each of the metals using physical properties vocabulary and, if possible, name the metal.</p> <p>Whole Class—Small Groups → Frayer Model—Definition of a Metal Ask students to recall what a metal is and create a class definition together. Have small groups complete, to the extent that they are able, the various sections of Frayer Model: Metals (Appendix B) and share their responses with the class. Facilitate a discussion to clarify and provide feedback. Post a similar Frayer model in the classroom as a reference. Explain that different metals have different chemical properties and that the class will be investigating the chemical properties of metals. Discuss why it is important to know the chemical properties of metals (e.g., metals have a multitude of uses in our everyday world that are best determined based on their chemical properties).</p>	<p>CONNECTIONS</p> <p>L: Literacy ML: Mathematical Literacy AfL, AoL: Assessment for/of Learning SIS: Scientific Investigation Skills</p> <p>L: Subject-specific vocabulary/ Classification</p> <p>AfL: Frayer Model—Definition/ Anecdotal Comments</p>
<p>ACTION</p> <ul style="list-style-type: none"> Introducing new learning or extending/reinforcing prior learning Providing opportunities for practice and application of learning (guided → independent) <p>Whole Class → Teacher Demonstration (Alkali Metals and Aluminum) Demonstrate the chemical properties of lithium, sodium and aluminum using water, acid and a flame. See instructions (Appendix C). Distribute and discuss the Assessment Checklist for Chemical Properties Tasks (Appendix D).</p> <p>Pairs → Think-Pair-Exit Card Students practise analyzing and interpreting data in preparation for their student lab. Students:</p> <ul style="list-style-type: none"> Individually, consider the observations they recorded during the teacher demonstration and note any similarities observed among the three metals (lithium, sodium and aluminum) Share their thoughts with a partner, discuss and refine as necessary In pairs, draw a Bohr-Rutherford diagram for each metal Discuss and organize evidence to prove that two of the metals are related elements (lithium and sodium) Indicate their conclusions on an Exit Card (index card) by responding to the questions: <ul style="list-style-type: none"> Which two of the metal elements are similar? How are they similar? Why do these metals belong in the same Periodic Table Group? <p>Use the Exit Card information to identify gaps in understanding so that support can be provided prior to and during the student lab. Provide feedback to students on their use of scientific terminology and symbols (e.g., chemical notation for elements).</p> <p>Pairs → (Student Lab) Chemical Properties Investigation Distribute and review the student lab—see Investigating the Chemical Properties of Four Metals (Student Lab) (Appendix E). Students follow the procedures for the Chemical Properties of Four Metals lab as outlined in Appendix E. Note: Students must wait for teacher direction to begin the investigation of magnesium. All students work through this investigation at the same time for safety reasons.</p> <p>Circulate and provide feedback to students as required.</p> <p>Groups of Four → (Student Lab) Chemical Properties Investigation: Pairs-Square—Drawing Conclusions Students work with another pair to analyze and interpret the results of their investigations and make conclusions. Remind them to look for patterns and relationships justified by their data. Student pairs join with another pair to:</p> <ul style="list-style-type: none"> Compare and discuss the chemical properties investigation results from their data tables Address discrepancies in the observations Answer, in point form, the Analyzing and Interpreting questions in Appendix E to draw conclusions Hand in data tables and answers to the questions to the teacher <p>Provide feedback on the data tables and the questions to the groups of four based on the criteria in the Assessment Checklist for Chemical Properties Tasks (Appendix D). Consolidate learning by adding to and/or deleting from the class Frayer model (Appendix B) started in the Minds On activity.</p>	<p>SIS: Analyzing and Interpreting</p> <p>AfL: Exit Cards/Anecdotal Comments</p> <p>SIS: Initiating and Planning, Performing and Recording AfL: Investigation/Checklist</p> <p>SIS: Analyzing and Interpreting, Communicating</p> <p>AfL: Pairs Square/Checklist</p>
<p>CONSOLIDATION AND CONNECTION</p> <ul style="list-style-type: none"> Helping students demonstrate what they have learned Providing opportunities for consolidation and reflection <p>Students consolidate their understanding through the Unknown Elements: To Whom Am I Related (Appendices F1 and F2) and Imagine All the Elements (Appendix G) activities. There is detailed information in Appendix F2 (Teacher Reference) regarding these activities.</p> <p>Groups of Four → Unknown Elements Cards Post headings for the Periodic Table Groups of the Unknown Elements (i.e., groups 1, 2, 7, and 10) around the room. Distribute Unknown Elements: To Whom Am I Related? (Appendix F1). Students, in groups of four:</p> <ul style="list-style-type: none"> Individually, select one of the four unknown elements, read the description and complete an Element Card for it Work together to identify each element, respond to the Chemical Properties Questions (Appendix F1) and post the Element Cards under the correct Periodic Table Group headings <p>Circulate and provide feedback as required for clarification.</p> <p>Individual → Imagine All the Elements/Gallery Walk Students:</p> <ul style="list-style-type: none"> Follow instructions in Imagine All the Elements (Appendix G) to create a “designer” element. Note: The designer element must fit into the same Periodic Table Group as the “unknown elements” in Appendix F1 (i.e., Periodic Table Groups 1, 2, 7, or 10). Post the designer Element Cards on the wall, participate in a gallery walk to view the “new” elements and to check that their original card was placed in the correct group Remove the card if it has been classified incorrectly and give it to the teacher <p>Lead a class discussion to re-classify the elements that were classified incorrectly. Provide feedback as required.</p> <p>Groups (Three or Four) → Comparison of Metals Multiple Intelligences (MI) Choice Board Set up four Multiple Intelligences area signs around the room for each choice on the Comparison of Metals Multiple Intelligences (MI) Choice Board (Appendix H). Students:</p> <ul style="list-style-type: none"> Individually, select a Choice Board option, move to that area of the room As a group, using their selected intelligence preferences, summarize their knowledge of metals, their chemical properties, their relationships to each other, and their location on the periodic table Complete the activity for their option and hand in, display, or present (e.g., musical-rhythmic) their work for assessment and feedback <p>Provide feedback to students based on the criteria in the Assessment Checklist for Chemical Properties Tasks (Appendix D).</p> <p>Individual → Comparison of Metals Frayer Model Summary or (MI) Learning Contract As an evaluation task, individual students select either the Comparison of Metals Frayer Model Summary (Appendix I) or Comparison of Metals Multiple Intelligences (MI) Learning Contract (Appendix J). Prior to discussing the options with the class, distribute and review the assessment criteria in the Chemical Properties Rubric for Frayer Model/Learning Contract (Appendix K) amending as necessary to reflect student input. Students individually:</p> <ul style="list-style-type: none"> Summarize their learning using the Comparison of Metals Frayer Model Summary (Appendix I) and hand in for evaluation OR Complete the Comparison of Metals Multiple Intelligences Learning Contract (Appendix J) and submit their product for evaluation 	<p>SIS: Analyzing and Interpreting</p> <p>AfL: Unknown Elements/ Anecdotal Comments</p> <p>AfL: Imagine All the Elements/ Anecdotal Comments</p> <p>AfL: Choice Board/Checklist</p> <p>AoL: Frayer Model Summary or Comparison of Metals Multiple Intelligences Learning Contract/Rubric</p>