

# Grade 9: Figuring Outer Space

## Curriculum Connections

### Earth and Space Science: The Study of the Universe/Space Exploration

IP = Initiating and Planning, PR = Performing and Recording, AI = Analysing and Interpreting, C = Communicating

Science Curriculum Connections	Mathematics Curriculum Connections
<b>Activity 1: The Evolution of Stars</b>	
<p><b>Earth and Space Science: The Study of the Universe/Space Exploration<sup>1</sup></b></p> <ul style="list-style-type: none"> <li>– <b>D1.1</b> assess, on the basis of research, and report on the contributions of Canadian governments, organizations, businesses, and/or individuals to space technology, research, and/or exploration (e.g., as part of the International Space Station mission; in the fields of telecommunications and satellite technology) [IP, PR, AI, C] (Academic)</li> <li>– <b>D2.1</b> use appropriate terminology related to the study of the universe, including, but not limited to: <i>celestial objects</i>, <i>orbital radius</i>, <i>retrograde motion</i>, and <i>satellite</i> [C] (Academic)</li> <li>– <b>D2.1</b> use appropriate terminology related to space exploration, including, but not limited to: <i>astronomical units</i>, <i>gravitational pull</i>, and <i>universe</i> [C] (Applied)</li> <li>– <b>D2.3</b> use a research process to compile and analyse information on the characteristics of various objects in the universe (e.g., planets, stars, constellations, galaxies) [PR, AI] (Applied)</li> <li>– <b>D2.5</b> compare and contrast properties of celestial objects visible in the night sky, drawing on information gathered through research and using an appropriate format (e.g., compare the size of planets; represent the distance of stars from Earth using scientific notation; compare star temperatures and colour) [PR, AI, C] (Academic)</li> <li>– <b>D3.1</b> describe observational and theoretical evidence relating to the origin and evolution of the universe (e.g., evidence supporting the big bang theory) (Academic)</li> <li>– <b>D3.1</b> describe the major components of the universe (e.g., planets, moons, stars, galaxies), the motion of the different types of celestial objects, and the distances between certain objects, using appropriate scientific terminology and units (e.g., astronomical units, light years) (Applied)</li> <li>– <b>D3.3</b> describe the major components of the solar system and the universe (e.g., planets, stars, galaxies), using appropriate scientific terminology and units (e.g., astronomical units, scientific notation, light years) (Academic)</li> </ul>	<p><b>Number Sense and Algebra</b></p> <p><i>Solving Problems Involving Proportional Reasoning</i></p> <ul style="list-style-type: none"> <li>– solve problems involving ratios, rates, and directly proportional relationships in various contexts (e.g., currency conversions, scale drawings, measurement), using a variety of methods (e.g., using algebraic reasoning, equivalent ratios, a constant of proportionality; using dynamic geometry software to construct and measure scale drawings) (Applied)</li> <li>– solve problems requiring the expression of percents, fractions, and decimals in their equivalent forms (e.g., calculating simple interest and sales tax; analysing data) (Applied)</li> </ul> <p><i>Manipulating Expressions and Solving Equations</i></p> <ul style="list-style-type: none"> <li>– solve problems requiring the manipulation of expressions arising from applications of percent, ratio, rate, and proportion (Academic)</li> </ul>

1. Where one heading follows another, separated by a “/”, the first is the Academic heading, the second Applied.

Science Curriculum Connections	Mathematics Curriculum Connections
<b>Activity 2: How to Find an Exoplanet</b>	
<p><b>Earth and Space Science: The Study of the Universe/ Space Exploration</b></p> <ul style="list-style-type: none"> <li>– <b>D1.2</b> assess some of the costs, hazards, and benefits of space exploration (e.g., the expense of developing new technologies, accidents resulting in loss of life, contributions to our knowledge of the universe), taking into account the benefits of technologies that were developed for the space program but that can be used to address environmental and other practical challenges on Earth (e.g., radiation monitors and barriers, sensors to monitor air and water quality, remote sensing technology, fire-resistant materials) [AI, C] (Academic)</li> <li>– <b>D1.2</b> assess the contributions of Canadians to space exploration (e.g., as astronauts; in research and development) [AI, C] (Applied)</li> <li>– <b>D2.1</b> use appropriate terminology related to the study of the universe, including, but not limited to: <i>celestial objects</i>, <i>orbital radius</i>, <i>retrograde motion</i>, and <i>satellite</i> [C] (Academic)</li> <li>– <b>D2.1</b> use appropriate terminology related to space exploration, including, but not limited to: <i>astronomical units</i>, <i>gravitational pull</i>, and <i>universe</i> [C] (Applied)</li> <li>– <b>D2.2</b> investigate patterns in the night sky (e.g., constellations) and the motion of celestial objects, (e.g., the sun, our moon, planets, stars, galaxies), using direct observation, computer simulations, and/or star charts, and record the information using a graphic organizer or other format [PR, AI, C] (Applied)</li> <li>– <b>D2.3</b> plan and conduct a simulation that illustrates the interrelationships between various properties of celestial objects visible in the night sky (e.g., set up flashlights of various intensities at different distances from an observation point to help illustrate why the brightness of a star viewed from Earth is a function of both its actual brightness and its distance from Earth) [IP, PR, AI] (Academic)</li> <li>– <b>D2.3</b> use a research process to compile and analyse information on the characteristics of various objects in the universe (e.g., planets, stars, constellations, galaxies) [PR, AI] (Applied)</li> <li>– <b>D3.1</b> describe the major components of the universe (e.g., planets, moons, stars, galaxies), the motion of the different types of celestial objects, and the distances between certain objects, using appropriate scientific terminology and units (e.g., astronomical units, light years) (Applied)</li> <li>– <b>D3.5</b> explain the causes of astronomical phenomena (e.g., the aurora borealis, solar eclipses, phases of the moon, comets) and how various phenomena can best be observed from Earth (e.g., solar eclipses should be viewed through a suitable solar filter or by projection, not with the naked eye) (Academic)</li> </ul>	<p><b>Linear Relations</b></p> <p><i>Using Data Management to Investigate Relationships</i></p> <ul style="list-style-type: none"> <li>– design and carry out an investigation or experiment involving relationships between two variables, including the collection and organization of data, using appropriate methods, equipment, and/or technology (e.g., surveying; using measuring tools, scientific probes, the Internet) and techniques (e.g., making tables, drawing graphs) (Academic)</li> <li>– carry out an investigation or experiment involving relationships between two variables, including the collection and organization of data, using appropriate methods, equipment, and/or technology (e.g., surveying; using measuring tools, scientific probes, the Internet) and techniques (e.g., making tables, drawing graphs) (Applied)</li> <li>– describe trends and relationships observed in data, make inferences from data, compare the inferences with hypotheses about the data, and explain any differences between the inferences and the hypotheses (e.g., describe the trend observed in the data. Does a relationship seem to exist? Of what sort? Is the outcome consistent with your hypothesis? Identify and explain any outlying pieces of data. Suggest a formula that relates the variables. How might you vary this experiment to examine other relationships?) (Academic &amp; Applied)</li> </ul> <p><i>Connecting Various Representations of Linear Relations</i></p> <ul style="list-style-type: none"> <li>– describe a situation that would explain the events illustrated by a given graph of a relationship between two variables (Academic)</li> </ul>

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<b>Activity 3: Take a Tour of the Milky Way</b>	
<p><b>Earth and Space Science: The Study of the Universe/ Space Exploration</b></p> <ul style="list-style-type: none"> <li>– <b>D2.1</b> use appropriate terminology related to the study of the universe, including, but not limited to: <i>celestial objects</i>, <i>orbital radius</i>, <i>retrograde motion</i>, and <i>satellite</i> [C] (Academic)</li> <li>– <b>D2.1</b> use appropriate terminology related to space exploration, including, but not limited to: <i>astronomical units</i>, <i>gravitational pull</i>, and <i>universe</i> [C] (Applied)</li> <li>– <b>D2.2</b> investigate patterns in the night sky (e.g., constellations) and the motion of celestial objects (e.g., the sun, our moon, planets, stars, galaxies), using direct observation, computer simulations, and/or star charts, and record the information using a graphic organizer or other format [PR, AI, C] (Applied)</li> <li>– <b>D3.1</b> describe the major components of the universe, the motion of the different types of celestial objects (e.g., planets, moons, stars, galaxies), and the distances between certain objects, using appropriate scientific terminology and units (e.g., astronomical units, light years) (Applied)</li> <li>– <b>D3.3</b> describe the major components of the solar system and the universe (e.g., planets, stars, galaxies), using appropriate scientific terminology and units (e.g., astronomical units, scientific notation, light years) (Academic)</li> </ul>	<p><b>Number Sense and Algebra</b></p> <p><i>Solving Problems Involving Proportional Reasoning</i></p> <ul style="list-style-type: none"> <li>– solve problems involving ratios, rates, and directly proportional relationships in various contexts (e.g., currency conversions, scale drawings, measurement), using a variety of methods (e.g., using algebraic reasoning, equivalent ratios, a constant of proportionality; using dynamic geometry software to construct and measure scale drawings) (Applied)</li> <li>– solve problems requiring the expression of percents, fractions, and decimals in their equivalent forms (e.g., calculating simple interest and sales tax; analysing data) (Applied)</li> </ul> <p><i>Manipulating Expressions and Solving Equations</i></p> <ul style="list-style-type: none"> <li>– solve problems requiring the manipulation of expressions arising from applications of percent, ratio, rate, and proportion (Academic)</li> </ul>
<b>Activity 4: The History of the Universe</b>	
<p><b>Earth and Space Science: The Study of the Universe/ Space Exploration</b></p> <ul style="list-style-type: none"> <li>– <b>D1.1</b> research the challenges associated with space exploration, and explain the purpose of materials and technologies that were developed to address these challenges and how these materials and technologies are now used in other fields of endeavour (e.g., robotic arm technology developed for the space program is used in industry to handle hazardous chemicals; synthetic materials developed to protect astronauts are used in fire-fighting equipment) [IP, PR, AI, C] (Applied)</li> <li>– <b>D2.1</b> use appropriate terminology related to the study of the universe, including, but not limited to: <i>celestial objects</i>, <i>orbital radius</i>, <i>retrograde motion</i>, and <i>satellite</i> [C] (Academic)</li> <li>– <b>D2.1</b> use appropriate terminology related to space exploration, including, but not limited to: <i>astronomical units</i>, <i>gravitational pull</i>, and <i>universe</i> [C] (Applied)</li> <li>– <b>D2.3</b> use a research process to compile and analyse information on the characteristics of various objects in the universe (e.g., planets, stars, constellations, galaxies) [PR, AI] (Applied)</li> <li>– <b>D3.1</b> describe observational and theoretical evidence relating to the origin and evolution of the universe (e.g., evidence supporting the big bang theory) (Academic)</li> <li>– <b>D3.1</b> describe the major components of the universe, the motion of the different types of celestial objects (e.g., planets, moons, stars, galaxies), and the distances between certain objects, using appropriate scientific terminology and units (e.g., astronomical units, light years) (Applied)</li> <li>– <b>D3.3</b> describe the major components of the solar system and the universe (e.g., planets, stars, galaxies), using appropriate scientific terminology and units (e.g., astronomical units, scientific notation, light years) (Academic)</li> </ul>	<p><b>Number Sense and Algebra</b></p> <p><i>Solving Problems Involving Proportional Reasoning</i></p> <ul style="list-style-type: none"> <li>– solve problems involving ratios, rates, and directly proportional relationships in various contexts (e.g., currency conversions, scale drawings, measurement), using a variety of methods (e.g., using algebraic reasoning, equivalent ratios, a constant of proportionality; using dynamic geometry software to construct and measure scale drawings) (Applied)</li> <li>– solve problems requiring the expression of percents, fractions, and decimals in their equivalent forms (e.g., calculating simple interest and sales tax; analysing data) (Applied)</li> </ul> <p><i>Manipulating Expressions and Solving Equations</i></p> <ul style="list-style-type: none"> <li>– solve problems requiring the manipulation of expressions arising from applications of percent, ratio, rate, and proportion (Academic)</li> </ul>

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<b>Activity 5: Crab Nebula Expansion</b>	
<p><b>Earth and Space Science: The Study of the Universe/ Space Exploration</b></p> <ul style="list-style-type: none"> <li>– <b>D2.1</b> use appropriate terminology related to the study of the universe, including, but not limited to: <i>celestial objects</i>, <i>orbital radius</i>, <i>retrograde motion</i>, and <i>satellite</i> [C] (Academic)</li> <li>– <b>D2.1</b> use appropriate terminology related to space exploration, including, but not limited to: <i>astronomical units</i>, <i>gravitational pull</i>, and <i>universe</i> (Applied)</li> <li>– <b>D2.2</b> use direct observation, computer simulation, or star charts to determine the location, appearance, and motion of well-known stars and other celestial objects that are visible in the night sky (e.g., the stars Polaris, Sirius, Betelgeuse; the planet Venus) [PR, AI] (Academic)</li> <li>– <b>D3.1</b> describe the major components of the universe, the motion of the different types of celestial objects (e.g., planets, moons, stars, galaxies), and the distances between certain objects, using appropriate scientific terminology and units (Applied)</li> <li>– <b>D3.3</b> describe the major components of the solar system and the universe, using appropriate scientific terminology and units (e.g., astronomical units, scientific notation, light years) (Academic)</li> </ul>	<p><b>Linear Relations</b></p> <p><i>Using Data Management to Investigate Relationships</i></p> <ul style="list-style-type: none"> <li>– design and carry out an investigation or experiment involving relationships between two variables, including the collection and organization of data, using appropriate methods, equipment, and/or technology (e.g., surveying; using measuring tools, scientific probes, the Internet) and techniques (e.g., making tables, drawing graphs) (Academic)</li> <li>– carry out an investigation or experiment involving relationships between two variables, including the collection and organization of data, using appropriate methods, equipment, and/or technology (e.g., surveying; using measuring tools, scientific probes, the Internet) and techniques (e.g., making tables, drawing graphs) (Applied)</li> <li>– describe trends and relationships observed in data, make inferences from data, compare the inferences with hypotheses about the data, and explain any differences between the inferences and the hypotheses (e.g., describe the trend observed in the data. Does a relationship seem to exist? Of what sort? Is the outcome consistent with your hypothesis? Identify and explain any outlying pieces of data. Suggest a formula that relates the variables. How might you vary this experiment to examine other relationships? (Academic &amp; Applied)</li> </ul> <p><b>Number Sense and Algebra</b></p> <p><i>Manipulating Expressions and Solving Equations</i></p> <ul style="list-style-type: none"> <li>– solve problems requiring the manipulation of expressions arising from applications of percent, ratio, rate, and proportion (Academic)</li> </ul> <p><i>Manipulating Expressions and Solving Equations/Simplifying Expressions and Solving Equations</i></p> <ul style="list-style-type: none"> <li>– simplify numerical expressions involving integers and rational numbers, with and without the use of technology (Academic &amp; Applied)</li> </ul> <p><i>Solving Problems Involving Proportional Reasoning</i></p> <ul style="list-style-type: none"> <li>– solve problems involving ratios, rates, and directly proportional relationships in various contexts (e.g., currency conversions, scale drawings, measurement), using a variety of methods (e.g., using algebraic reasoning, equivalent ratios, a constant of proportionality; using dynamic geometry software to construct and measure scale drawings) (Applied)</li> </ul>

Science Curriculum Connections	Mathematics Curriculum Connections
<b>Activity 6: The Search for Exoplanets</b>	
<p><b>Earth and Space Science: The Study of the Universe/ Space Exploration</b></p> <ul style="list-style-type: none"> <li>– <b>D2.1</b> use appropriate terminology related to the study of the universe, including, but not limited to: <i>celestial objects, orbital radius, retrograde motion, and satellite</i> [C] (Academic)</li> <li>– <b>D2.1</b> use appropriate terminology related to space exploration, including, but not limited to: <i>astronomical units, gravitational pull, and universe</i> (Applied)</li> <li>– <b>D2.2</b> investigate patterns in the night sky (e.g., constellations) and the motion of celestial objects (e.g., the sun, our moon, planets, stars, galaxies), using direct observation, computer simulations, and/or star charts, and record the information using a graphic organizer or other format [PR, AI, C] (Applied)</li> <li>– <b>D2.3</b> plan and conduct a simulation that illustrates the interrelationships between various properties of celestial objects visible in the night sky (e.g., set up flashlights of various intensities at different distances from an observation point to help illustrate why the brightness of a star viewed from Earth is a function of both its actual brightness and its distance from Earth) [IP, PR, AI] (Academic)</li> </ul>	<p><b>Number Sense and Algebra</b></p> <p><i>Operating with Exponents</i></p> <ul style="list-style-type: none"> <li>– substitute into and evaluate algebraic expressions involving exponents (i.e., evaluate expressions involving natural-number exponents with rational-number bases [e.g., evaluate <math>\left(\frac{3}{2}\right)^3</math> by hand and <math>9.8^3</math> by using a calculator]) (Academic)</li> </ul> <p><i>Manipulating Expressions and Solving Equations</i></p> <ul style="list-style-type: none"> <li>– solve problems requiring the manipulation of expressions arising from applications of percent, ratio, rate, and proportion (Academic)</li> </ul> <p><b>Linear Relations</b></p> <p><i>Understanding Characteristics of Linear Relations/Determining Characteristics of Linear Relations</i></p> <ul style="list-style-type: none"> <li>– construct tables of values, scatter plots, and lines or curves of best fit as appropriate, using a variety of tools (e.g., spreadsheets, graphing software, graphing calculators, paper and pencil), for linearly related and non-linearly related data collected from a variety of sources (e.g., experiments, electronic secondary sources, patterning with concrete materials) (Academic &amp; Applied)</li> </ul> <p><b>Measurement and Geometry</b></p> <p><i>Solving Problems Involving Perimeter, Area, Surface Area, and Volume/Solving Problems Involving Perimeter, Area, and Volume</i></p> <ul style="list-style-type: none"> <li>– solve problems involving the areas and perimeters of composite two-dimensional shapes (i.e., combinations of rectangles, triangles, parallelograms, trapezoids, and circles) (Academic &amp; Applied)</li> </ul> <p><b>Linear Relations</b></p> <p><i>Using Data Management to Investigate Relationships</i></p> <ul style="list-style-type: none"> <li>– pose problems, identify variables, and formulate hypotheses associated with relationships between two variables. (Academic &amp; Applied)</li> </ul>