**The Number Strand: Outcome N7.6**

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| **Outcome** | **Indicators** |
| N7.6 Demonstrate an understanding of addition and subtraction of integers, concretely, pictorially and symbolically.  [C, CN, PS, R, V]  *In support of the K-12 Mathematics goals of Number Sense, Spatial Sense, Logical Thinking and Mathematical Attitude.* | 1. Represent opposite integers concretely, visually and symbolically and explain why they are called opposite integers. 2. Explain, using concrete materials such as integer tiles and diagrams, that the sum of opposite integers is zero, e.g., a move in one direction followed by an equivalent move in the opposite direction results in no net change in position. 3. Illustrate, using a number line, the results of adding or subtracting negative and positive integers 4. Add two integers using concrete materials or pictorial representations and record the process symbolically. 5. Subtract two integers using concrete materials or pictorial representations and record the process symbolically. 6. Investigate patterns in adding and subtracting integers to generalize personal strategies for adding and subtracting integers. 7. Solve problems involving the addition and subtraction of integers. |
| **Learning Space**  [**Top**](#top) | |
| Although students have been formerly introduced to the concept of integers in grade 6, and they have had many encounters with making sense of negative numbers in the context of temperature, the concept of adding and subtracting integers is often perplexing for students. It is important to start with concrete, visual, and physical movement representations and let the students look for patterns, generalize strategies, and verify the results of adding and subtracting integers. With appropriate contextual and concrete examples, the students will then be able to develop their own rules and understanding of integers. It is at that point that students will be ready to carry out addition and subtraction of integers at an abstract level using only the symbolic notation for the numbers. Some students may continue to do illustrations on scrap paper or to the side of their work to confirm their solution. This is an important step in the process of abstraction for many students and should not be discouraged.  The addition and subtraction of integers also involves the very important notion of the additive inverse. Students need to explore this idea in a variety of ways to develop their understanding of how the integers are the only set of numbers that they have learned about that allow for an additive inverse.  The notions of directionality and movement are very closely tied to integers and the addition and subtraction of integers. Teachers should provide experiences and contexts for the students that emphasize these notions and how they relate to the students’ developing an understanding of integers. Physical Education classes could incorporate these notions in the students’ learnings by having the students track their overall movement within a set time period.  The students will also make use of this understanding in their identifying and generalizing of patterns, solving of linear equations, graphing of linear relations, explorations of the preservation of equality, the Cartesian plane, and the determination of the measures of central tendency. Within these contexts, students should be reflecting regularly on the effect of addition or subtraction of integers on the over all total. | |

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| **What Students Should…**  [**Top**](#top) | | |
| **Know**   * A negative sign in front of a number designates a negative value. | **Understand**   * With the exception of zero, every integer has an additive inverse. * The addition or removal of additive inverses to an amount changes the representation of the quantity, but not the actual quantity (e.g., 3 is equivalent to 3 + 4 – 4 because 4 and -4 are additive inverses and thus have a sum of 0 – this can also be shown concretely). | **Be Able to Do**   * Use illustrations, physical movement and/or concrete objects to demonstrate the addition or subtraction of integers. * Identify and explain patterns that occur within the addition and subtraction of integers. * Add and subtract integers using personal strategies. * Describe a situation that could be represented by the addition or subtraction of two integers. * Use the addition or subtraction of fractions to describe a situation or solve a problem. |
| **Key Questions**  [**Top**](#top) | | |
| * In what ways is zero important in the integers as well as in finding sums and differences of integers? * Where do sums and differences of integers occur in everyday life? * What patterns did you find when adding and subtracting integers? * Do all whole numbers have an additive inverse? | | |
| **Suggestions for Assessment:** [**Top**](#top) | | |
| **Big Idea:**  Adding and subtracting integers.  **Suggestions for assessment tasks:**   1. Give the students a description of a type of integer sum or difference. For example, the sum of a whole number and a negative number. Have the students write an expression that is an example of this type of integer sum or difference. Next, ask the students to describe a situation in which the expression that they have written could be used to solve a problem. Finally, ask the students to solve a problem. 2. Provide the students with an expression for each of the eight types of sums and differences (positive plus positive, negative plus negative, positive plus negative, negative plus positive, positive minus positive, negative minus negative, positive minus negative, and negative minus negative). Ask the students to solve each of the questions, and to model any four of the questions (or four selected by you) using concrete objects or pictures and to explain how that model confirms their answers. 3. Ask the students to provide an example of additive inverses and ask them to provide examples of how additive inverses can be used in evaluating sums and differences of integers.   **What to look for:**   * See [*Adding and Subtracting Integers*](file:///C:\Users\kw426\AppData\Local\Temp\Adding%20and%20Subtracting%20Integers%20Rubric.doc) *Rubric.* | | |
| **Suggestions for Instruction:**  [**Top**](#top) | | |
| **Big Idea:**  Adding and subtracting integers.  **Suggestions for instructional activities**   1. Have the students brainstorm contexts in which they experience integers. Use these contexts to begin the development of the concept of additive inverses. For example, if the students mention temperature (very likely), ask them questions like “if the temperature went up one degree and then down one degree, what would be the difference between the original and final temperatures?” and “If the temperature rose 10° during the day, how much would it need to fall to get back to the original temperature for the day?”. As the students answer questions such as these, ask them to relate these problems to expressions involving integers. It is very important that the students are thinking about negative numbers as representing movement in an opposite direction, whether that movement is related to temperature, traveling, time or some other quantity. Otherwise, students may think of negative numbers in terms of “not nice” numbers because they are negative, and not recognize the relationships and patterns necessary to understand the adding and subtracting of integers. Debrief the students’ activity by defining additive inverses in terms of the expressions and relationships that they have been discussing. Provide a few more opportunities for students to identify additive inverses and write equations demonstrating additive inverses. Have the students write about what additive inverses are and why they are important in their journals. 2. Introduce the students to many different concrete (such as integer tiles or two-sided counters) and pictorial models (such as thermometers, hot air balloons, postal delivery…) for representing and exploring the addition and subtraction of integers. Students may also develop their own concrete or pictorial models. Be sure to have the students share these new models with the class and explain why the models are effective. 3. Using different models, have the students represent different additive inverses (or zero equivalents). Have the students explore adding additive inverses to a given quantity (e.g., 3 + (-7 + 7)), being sure that they can represent it concretely or pictorially as well as symbolically. Have the students discuss the impact of adding additive inverses to a quantity. Have the students explore different arrangements of the terms (e.g., 3 + 7 – 7) to determine if the operations are commutative. Ask the students how these different forms result in different concrete or pictorial representations. 4. Divide the class into seven groups, and assign them each one new type of sum or difference to determine:  * Group 1: negative plus negative * Group 2: positive plus negative * Group 3: negative plus positive * Group 4: positive minus positive * Group 5: negative minus negative, * Group 6: positive minus negative * Group 7: negative minus negative   Tell the students that each group is to use concrete or pictorial (or both) models to explore the type of sum or difference expression that they have been assigned. Through their exploration, the students are to come up with description of patterns in the answers, strategies for determining the sums or differences (including explanations of why those strategies are used and how they work), and any rules that they generate for solving their type of question symbolically. Remind the students that they need to be considering expressions that have the largest number in either the first or second position in the expression.   1. Once the groups have summarized their findings about their type of expression either a jigsaw strategy or a full class discussion can be used to share their results. Encourage the students to ask questions of each other for purposes of clarification and understanding. 2. Next, show the students pairs of equations that illustrate properties such as adding a negative number is the same as subtracting a positive number and vice versa and subtracting a negative number is the same as adding a positive number. Have the students find all of the sums and differences and note what is common about each pair in terms of the answers. Then, ask the students to think about, and later discuss whether it is just coincidence that they are all equal. Work with the class to have them discover that these properties are true (tell the students that they are using “inductive reasoning” to reach this conclusion where they are generalizing a pattern that they have seen). 3. Give the students a series of problems and questions involving the addition and subtraction of integers. Tell the students to try to answer as many of them as possible symbolically using ideas they have learned, but if they are struggling with a question or if they are having to check back on a “rule”, they should be going back to representing the question concretely or pictorially first and then recording their work symbolically. | | |