Exemplary Planning Commentary: Secondary Mathematics

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1a. Central focus of the segment

The Central Focus (CF) is: Students will model exponential growth and decay to help them understand real-world situations such as financial investments, population growth, and radioactive decay. Students will develop skills related to evaluating and creating an exponential equation. The central focus leads students to make connections between descriptions of an event and the mathematical concepts and symbols used to describe an event. It is valuable for students to understand exponential growth because an ability to describe real events with mathematics deepens student understanding of the world. In Lesson 1, students practice naming and describing the role of each part of an exponential model. The parts are necessary to understand the model. Lesson 2 builds upon Lesson 1, with a focus on identifying the exponential rate of growth/decay from real world data. The purpose of Lesson 3 is to build upon prior lessons by leading students to evaluate the effect changes in the starting value and constant multiplier have on the graph of an exponential function. Through inquiry, students gain new skills and conceptual knowledge by modifying an exponential situation and seeing how this affects the original exponential model values. The purpose of Lesson 4 is for students to engage in both self-assessment and summative assessment of this unit's prior learning targets (i.e. learning objectives) related to the CF. Students self-assess by reviewing/sharing problem solving strategies. Then, students will demonstrate their levels of mastery of the LTs with a summative assessment.

1b. Linking concepts, skills, and problem solving

In the learning segment, the standards and LTs used to plan the segment address all three types of student knowledge and skills. The first state standard is: "Solve problems that can be represented by exponential functions and equations." This requires students to problem solve by solving "problems that can be represented by exponential functions." Furthermore, this standard addresses conceptual understanding because students apply knowledge of parts of an exponential equation to solve a problem. This standard requires procedural fluency because solving a problem related to exponential equations requires understanding exponents, the order of operations, and balancing equations. The second state standard is "Sketch the graph for an exponential function of the form $y = ab^n$ where n is an integer, describe the effects that changes in the parameters of a and b have on the graph, and answer questions that arise in situations modeled by exponential functions." This standard addresses conceptual understanding because students describe the effects of changes in the parameters on the graph. It addresses procedural fluency when students practice graphing. It addresses mathematical reasoning by directing students to describe the effects on the graph and "answer questions that arise in situations modeled by exponential functions." In Lesson 1, the learning target (LT, i.e. lesson objective) is: Students will be able to name and describe the role of each part of an exponential model. This requires students to engage in conceptual understanding of how the parts fit into an exponential model. This LT addresses procedural fluency because students must follow the correct steps to interpret mathematical syntax to identify each equation value. In Lesson 2, the LT is: Students will be able to identify the exponential rate of growth/decay from real world data. This addresses conceptual understanding because students must understand what a 'rate' is, how to graph ordered pairs, and that equations can approximate data. This LT addresses procedural fluency because students must know how to calculate a rate of growth/decay and how to take an average. This LT addresses mathematical reasoning because students must conclude if the calculations demonstrate a linear or exponential rate growth/decay. This requires judgment, since the data has outliers and issues that engage students in problem solving. In Lesson 3, the LT is: Students will be able to evaluate the effect changes in the starting value and constant multiplier have on the graph of an

exponential function. This engages students in conceptual understanding because students must understand what a starting value is. Furthermore, students must understand the concept of a constant multiplier. Students correctly graphing the function address procedural fluency. This LT engages students in mathematical reasoning because students "evaluate the effect," and evaluation is high-level on Bloom's Taxonomy. Students use prior knowledge and draw conclusions from mathematical patterns. Students must determine the cause and effect relationship, which requires reasoning. In Lesson 4, students review the LTs, which engage them in evaluating their conceptual understanding, procedural fluency, and mathematical reasoning/problem solving skills.

1c. Explaining how lessons build and link to other skills

Each lesson depends heavily on the others. I sequenced lessons with conceptual information before applications of the knowledge and the exploration of more authentic understandings. In Lesson 1, "students practice naming and describing the role of each part of an exponential model." The relevant language used in this lesson is "constant multiplier," "starting value" or "initial value," "rate of growth/decay", and "stage factor." Some of these terms are familiar. I reintroduce "constant multiplier" and "starting value" first by making a clear connection to students' prior knowledge of geometric sequences. Students develop conceptual and procedural understanding of this language by completing a guided inquiry (Instructional Material 1.2). This prepares them for independent problem solving in Lessons 2, Lesson 3, and Lesson 4. The students engage in mathematical reasoning in Lesson 1 to understand the ratio pattern created by a "constant multiplier." For example, in the bug population investigation, students identify the ratio between populations each week and answer the prompt, "Explain what the ratios tell you about the bug population growth." In Lesson 2, students use this conceptual understanding, along with the procedure of calculating this value to look at approximate "constant multipliers" in real world data. After the Lesson 1 investigation, students learn the vocabulary "exponential function", "initial value", "rate of growth/decay", and "stage factor". Language demands for these terms are included in Lesson 2, Lesson 3, and Lesson 4. Finally, the exit ticket in Lesson 1 influences the plan for what to emphasize in the Lesson 2 warm-up. In Lesson 2, students work to "identify the exponential rate of growth/decay in real world data." The warm up reviews the procedure from Lesson 1 to calculate a "constant multiplier". This skill is extended in Lesson 2 to use deeper mathematical reasoning/problem solving when students discover the ratios between data points are not equal. Students must come up with a strategy to calculate an approximate "constant multiplier." This leads students to the recall how to take an "arithmetic average." Students use this skill in Lesson 2 with analyzing data, and will use it continually in the Unit Task. Practice with conceptual understanding of how a constant multiplier fits into the exponential model and the procedure of identifying the constant multiplier is necessary to prepare students for Lesson 3 and the summative assessment in Lesson 4. To support this, homework for Lesson 2 is to read and take notes on new vocabulary & examples.

Lesson 3 builds upon Lesson 1 and Lesson 2 by leading students to evaluate the effect of changes in the "starting value" and "constant multiplier" on a graph. The main activity is a guided inquiry, which leads students to apply knowledge of the parts of an exponential model to create their own exponential model. For example, students are asked in the Zombie Investigation worksheet, "Which one of the equations below would correctly model the number of zombies turned each day if you start with 5 zombies?" Later in the investigation, the students gain new skills and conceptual knowledge by modifying the situation and seeing how this affects the original exponential model. Evidence of this is shown in the completion of the Zombie Investigation worksheet. Students will use the conceptual understanding of how changes in the "starting value" and "constant multiplier" affect the graph of an exponential function to complete the unit project started in Lesson 1. Lesson 4 builds upon Lesson 1, Lesson 2, and Lesson 3. The lesson begins with time dedicated to review / revise thinking on the previous LTs. This formative assessment allows the teacher to identify gaps in learning. The final lesson in the learning sequence provides evidence to teachers and students whether they fully understand the CF. In Lesson 4, students view prior LTs and self-assess which ones they feel confident about. The targeted homework after the assessment in Lesson 4 intends for students to fill in gaps and review concepts that will be necessary in future learning segments.

1d. Opportunities to express learning targets (Washington State only).

Students have multiple opportunities to express their understandings of the LTs and why the LTs are important to learn at the beginning and at planned breaking points in each lesson. Students express their understandings with student

voice. At the start of Lesson 1, the LT is introduced and some students "share their own interpretation of the LT with the class." At the end of Lesson 1, complete this exit ticket (see Formative Assessment 1.3) including the question "(3) Why is it important to master this LT?" This allows students to reflect on why the LTs are important. In Lesson 2, students have two opportunities to individually express their understanding of the LT by "covertly self-assessing with a fist-to-five." I give students an opportunity to express why it is important to understand how to "identify the exponential rate of growth/decay from real world data" during the 25 minute Lesson 2 Inquiry. At this time, I "ensure students are making connections with the warm up." In Lesson 3, students have an opportunity to express their understanding of the LT by writing the LT and describing to a partner what the LT means. Later in the session the students engage in Group Discussion / Closure Assessment of Student Voice. For example, students discuss "(2) What factors affect how quickly a disease spreads?" and "(4) How do the graphs of exponential equations change with a larger or smaller starting value?" Students express why the LTs are important by answering on the Lesson 3 exit ticket: Why is it important to master this LT? In Lesson 4, students have an opportunity to express their understanding of the LTs by using "self-confidence as a criterion to self- assess." Students express an understanding of the LT in the quiz with Formative Assessment 4.1. For example, students are prompted to answer: "Rate your level of confidence on this assessment from 1 to 5. Why did you select that level?"

2a. Summary of students' prior knowledge

Two days before the learning segment I administered a formative (not graded) preassessment to gather data on prior academic learning and prerequisite skills related to the central focus. The preassessment contained questions that each related to each LT. The data showed that students on average knew 16% of the information relating to the LTs. Looking at the questions related to LT 1: "Students will be able to name and describe the role of each part of an exponential model," four students knew how to do this, and others guessed, based on their knowledge of geometric sequences. The students with these conceptual and procedural knowledge students fit into the high-achievers group. Looking at the questions related to LT 2, about 1/3 of students of varying ability levels understood the procedure for calculating a rate of growth/decay. Only one or two students explained the meaning of the "constant multiplier" and "starting value" from a contextual problem. Looking at the questions related to LT 3: "Students will be able to evaluate the effect changes in the starting value and constant multiplier have on the graph of an exponential function," most students did not respond to the question related to this LT. As for general trends, underperforming students and my students with Student Learning Plans (SLP) responded to the preassessment reflection with a low level of confidence, often writing, "I don't know any of this." The highest performing students (Including my student with a 504 for dyslexia) responded with statements like "I understand some, but did not have time to finish." From this, I know my students have a range of prior knowledge and skills.

With respect to the CF, students are learning to do things described by the three LTs listed in Lesson 1, Lesson 2, and Lesson 3. The first LT requires students to know academic language and concepts related to exponential models. For example, students practice identifying and calculating the "constant multiplier." The second LT requires students to "identify the exponential rate of growth/decay from real world data." Skills required to do this include taking ratios and averaging numbers. These skills have been taught in prior units, but not in this context. The third LT will require student to learn how to create and compare/contrast graphs.

2b. Summary of student assets

One community asset at our school is the upcoming science fair. Second, as a culture we value money. This everyday experience is an opportunity to relate to students how inflation of products cost is modeled. Another personal/cultural assets related to the CF includes a general pop culture interest in zombies. I know that students watch shows about zombies and are motivated to talk about such scenarios. Additionally, students each bring a shared knowledge of how disease in general spreads and the effects it can have on a population. Using this knowledge as a common context is an asset to providing a common entry point for students in each of the following categories: ELL, underperforming, students with math Student Learning Plans (SLP) gifted, and struggling readers. Several students have an interest in drawing and are willing to draw pictures for me.

2c. Dispositions toward learning math

From my preassessment, about one-third of my students perceive mathematics as “sensible, useful, and worthwhile.” These students fit into the category of gifted and/or show significant effort to learn the material by asking questions and visiting after class. The other third of the class has varying levels of focus on a given day. The latter third of the class does not readily engage with the subject and requires significant prompting during our group activities. The level of interest students have in the “usefulness” of the math depends greatly on the context. Real world connections tend to lead students to see it as useful. These students are for the most part from families that expect them to attend college or pursue higher education. In general, these students understand that algebra will help them sometime in their future, as demonstrated in exit tickets saying, “I will need this in the future.” From prior interactions, in this focus class I would categorize five students as having little interest or persistence in applying mathematics. Most other students work well together to be persistent. Students are notably less persistent when collaboration is not incorporated in the lesson. Students who are self-motivated in this class are often willing to actively peer-tutor and encourage other students with less confidence in their ability. As middle school students, self-confidence in mathematics varies widely. From the pre-assessment, I could see that many students wrote comments such as “I really don’t understand how to do this.” The general level of confidence has increased from the beginning of the year, but students do experience anxiety about learning new information and testing.

3a. Selecting learning activities based on prior knowledge and other assets

I am able to use the data on prior academic learning and dispositions from my preassessment to support my students’ learning. I organized my learning tasks using schemata, or conceptual framework. According to Pressley and McCormick (2007), taking advantage of schemata to organize ideas supports student understanding. I sequenced my LTs to start with a familiar LT and branched to LTs that depended on mastery of the previous ones. Breaking down the LTs is beneficial to students with Student Learning Plans, since “focusing students’ attention on successful attainment of concrete and immediate goals, such as getting today’s problems correct increases student self-efficacy” (Pressley and McCormick, 2007, p. 251). Because I know that students have a prior knowledge of geometric sequences, I use this connection to lead into the analogous parts of an exponential model. I knew that students had not previously related the academic language of “constant multiplier” and “starting value” to a function, so I chose learning tasks in Lesson 1, Lesson 2, and Lesson 3 that guided students to understand the conceptual information and procedures needed to identify and calculate these values. Additionally, introduction of the Unit Task allowed students to practice mathematical problem solving. Since students did not have prior knowledge of graphing exponential functions, I planned a learning task in Lesson 3 that allowed them to practice this. The student groups are picked to have a variety of ability levels. Research supports that cooperative learning works better than many other types of learning (Pressley and McCormick, 2007, p. 276).

The materials I used in my learning segment are strongly guided by my students’ personal/cultural/community assets. Research suggests that “the world has a powerful effect on a child’s thinking and behavior” and that “culture can affect more broadly how minority children relate to school, including how much they value it” (Pressley and McCormick, 2007, p. 181). Additionally my use of “multisensory presentations” is guided by Medina (2008) who suggests multimedia exposure effects on learning are significant and "multisensory presentations are the way to go" (Medina, 2008, p. 208). The is seen in my use of PowerPoint with relevant and colorful images, the students writing on the desks, in addition to the verbal peer to peer and whole group discussions planned in all of the lessons. To support differing learning styles, PowerPoints 2 and 3 contain slides that reference what the syntax of an exponential model translates to in English words. To support struggling readers, we also discuss the meaning of the new terms at the start of class in Lesson 1, Lesson 2, and Lesson 3. For example, I have students “verbally share their interpretations” of the LT in Lesson 1. The numerous new academic language guides me to frequently formatively assess student understanding of the language demands and functions as a support. In Lesson 3, I used my knowledge student interest in zombies as a context for my learning task. Additionally, students each bring a shared knowledge of how disease in general spreads and the effects it can have on a population. Pressley and McCormick (2007) explain that effective learning occurs within students’ zone of proximal development (ZPD). Using a common knowledge of disease is an asset to providing a common entry point for students in each of the following categories: ELL, underperforming, gifted, and struggling readers. To support visual learners, I incorporated student-made graphs into the learning task in Lesson 3. Several students have a strong interest in drawing, and I can use this to encourage them to draw representations of exponential growth or decay. These are shared with the class as an alternate representation support.

I planned for several group discussions on the subject. Research shows that "group discussions can be useful for encouraging critical thinking, for engaging learners in the learning process, and for promoting the cooperative reasoning that is necessary in a democratic society (Brookfield & Preskill, 2005; Dillion, 1995; Gall & Gall, 1990; Hale and City, 2006, as cited in Borich, 2011 p. 283). For example, in Lesson 2, we discuss how this model might apply to disease and how each part of the function/equation affects the resulting graph. Since I know that several students are interested in pursuing science, I planned for this time to allow for a more open-ended discussion where students hear what their peers are thinking. Pressley and McCormick (2007) write that working in partners is beneficial for academic learning and social development. This knowledge guides my task structure throughout each lesson, since I know from prior lessons that my students are productive collaborators. This supports all learners (Student Learning Plans (SLP), high-achievers, and underperforming students) since students must work together. For example, in the Zombie activity, I assigned student roles (PowerPoint 3, slide 5), which we have used consistently this year. For the students who do not readily engage in the tasks, I plan to circulate the room and provide questions and feedback. This is part of my scaffolding, which is when "students are provided with help on an as-needed basis"; through this interaction students are said to "develop mature thought processes" (Pressley & McCormick, 2007, p.158). Because my students prefer to collaborate, I planned to play a facilitator role during the learning tasks. Since many of my students waver in self-confidence, I planned to make myself available to ask supportive leading/probing questions. For example, in Lesson 1, Formative Assessment 1.1, I planned questions to help students identify misconceptions and make clear connections.

3b. Selecting learning activities for the whole-class and individuals

In this learning sequence I use the following instructional strategies and planned supports: a preassessment, practice with academic language at the beginning/ closure of each lesson, previewing, multiple planned formative assessments based on the LT in each lesson, guided inquiry, direct instruction, questioning, peer-to-peer and whole group discussions, independent practice, and opportunities for students to use student voice throughout each lesson. The use of a formative preassessment provides an opportunity to determine on an individual basis what concepts/procedures students struggle with so that I can differentiate my supports. In Lesson 1, I begin with practice identifying and evaluating student understanding of academic language. This is appropriate for the whole class, individuals, and especially students who are struggling readers or my student with a 504 for dyslexia. Pressley and McCormick (2007) indicate that providing students a chance to think about language (metalinguistics) is imperative for students to develop their vocabularies. The introduction of the LT in each lesson invites students to practice with new academic language. To engage the class, and individuals, I also use a warm-up in lessons 2, 3, and 4. This strategy is called previewing. Marzano (2007) indicates that previewing is helpful for engaging students in the content. After a warm-up, I continue to support individuals, groups, and the class as a whole, with formative assessments, such as the fist-to-five (used in Lesson 2, Lesson 3, and Lesson 4) that allows me to gather quantitative and qualitative data on student confidence levels. Black and William's research indicates that formative assessment increases what students learn (as cited in Popham, 2014). To support student learning for the whole class, individuals, and groups, I use a variety of research-based strategies. For example, my learning task for Lesson 1 is a guided inquiry about bug populations, and my learning task for Lesson 3 is a guided inquiry about zombie populations. Borich (2011) describes how inquiry leads to "alternate paths and solutions in the process of exploring and discovering new information" (p. 271). This supports the whole class because it allows the class to engage in the material instead of passively listening. It supports groups and individuals because different groups and individuals (such as my student with autism) process information uniquely. Being able to find alternate solutions allows students of different abilities to master the LTs through different modes. I do use some direct instruction, and Borich (2011) indicates that it best to use direct instruction when "your purpose is to disseminate information that is not readily available" (p. 226). I use direct instruction to give the class information necessary for their inquiry tasks. For example, in Lesson 1, I spend 10 minutes describing the exponential model. To support groups and individuals I provide practice after class. In Lesson 4, I assign differentiated practice based on student mastery demonstrated on Quiz 1. Students are assigned to practice specific problems based on their performance. Borich indicates that independent practice supports "unitization and automaticity" (p. 240). Borich, G. D. (2011). Effective teaching methods: Research-based practice. Boston, MA: Pearson/Allyn & Bacon Pressley, M. & McCormick, C. B. (2007). Child and adolescent development for educators. New York, NY: Guilford Press. Popham, W. J. (2014). Classroom assessment: What teachers need to know. Boston: Pearson.

3c. Resources for getting help on learning targets (Washington state only)

Students will identify resources to support their progress by reflecting on the question: "What resources could you use to improve your skills and knowledge related to mastering the LT?" This reflection appears on exit tickets or reflections in Lesson 1, Lesson 3, and Lesson 4. Additionally, I will instruct students to take notes on Chapter 6, Lesson 2 for Lesson 3 homework to support their progress toward learning. Borich (2011) indicates that note taking is "the most practical way to help your learners elaborate and organize new knowledge" (p. 348).Another way students can identify resources is that outside of the classroom is a paper that lists resources for students on the web. Finally, I will prompt students to ask questions throughout the Lesson to let them know that I am a resource. Particularly, in Lesson 4 I dedicate time to be a resource for students to answer questions about the LTs before the quiz.

3d. Anticipating misconceptions

In Lesson 1, Formative Assessment 1.1, I identify the following common errors: students write the ratio in the incorrect order. To address this error I will use Socratic questioning to lead students to discover the error. Additionally students use preconceptions about patterns to mistakenly treat the population growth as a linear model would, with a constant added value each time. I will use Socratic questioning to lead students to discover the error. During the Lesson 1 Group discussion, students will share their results, and students who make mistakes will be able to review their thinking and are encourage to "volunteer opinions and agree upon the value of the constant multiplier". Medina (2008) indicates that people need to review new information repeatedly over time for it to be stored in long-term memory. Because students will likely make these mistakes, these common misunderstandings of procedures and concepts will be reviewed daily through a warm up. For example, after the introduction of these concepts in Lesson 1, Lesson 2 , students practice identifying the constant multiplier in the warm-up. Medina J. (2008). Brain rules. Seattle,WA: Pear Press.

4a. Identifying the language function

One language function essential to this learning segment is Evaluate.

4b. Learning activities enabling practice with the language function

A key learning task from my plans is the Zombie Investigation that occurs on day 3 (Lesson 3).

4c. Additional language demands

There are many additional language demands related to the language function above. The vocabulary words students already know are: ratio, constant multiplier, starting value, predict, equation, and stage. Some underperforming students struggle with the meaning of ratio and the meaning of prediction. Words that are new to students are exponential and exponential graph. These language demands appear as reading written text. The word exponential is subject- specific and requires students to understand the related vocabulary connected to this definition. Additionally, students must attend to mathematical precision related to labeling coordinate plane axes. Some students struggle using a numerically evenly spaced axes scale. This is required on all three pages of the Zombie Investigation. They must also precisely identify which equation matches the data in a table, as on page 1 of the Zombie Investigation. Students already have practice with both of these mathematical precision language demands. For syntax, students already know how to fill in a table, which is a language demand on each of the three pages. They also are familiar with plotting the ordered pairs contained in each of these tables on a coordinate plane. A minority of students struggle identifying from the syntax which value in the ordered pair relates to which axes (x-axis or y-axis). Students must use discourse in the key learning segment from Lesson 3 because they must write an equation to describe exponential data from a table. Students have some practice with this, but a small group of students struggles with this language demand. Additionally creating a table fits under the category of discourse. This is a language demand that students are familiar with from other courses, such as science. Finally, students must create a narrative by answering questions such as "What effect does a larger infection rate (constant multiplier) have on the original graph in question 1?" Students have practice with both oral and written versions of engaging in narrative. They understand that they must use quantitative or qualitative justification to support a response.

4d. Supporting language use

To support the function, evaluate, for the group I have students engage in a warm up to practice procedures and concepts needed to evaluate an exponential model, such as predicting the future values of exponential data. The students reviewed the solution to the warm-up; this allowed students to "compare their process to the solution presented by peers." This helps students because they revise or validate their understandings. To support vocabulary use, I presented a review slide (PowerPoint 3, slide 4) showing the vocabulary necessary to understand the written directions and allow students to agree on common language. This helps my students who are visual learners and students who struggle with connecting the language to symbols, such as my autistic student. I support mathematical precision in the task in a variety of ways, including providing the template (on pages 1 through 3) for a table and multiple choices from which students can pick which equation fits the data. This modification supports my students who need scaffolding to determine which equation fits a data set. It also provides an example for students when they later create an equation because they can make connections between where the different values calculated belong in the equation. I support syntax language demand by pre-labeling the columns in the table to clarify for students where to record values. This supports students who have gaps in prior knowledge of recording ordered pairs. Because students are working in groups, students who have trouble plotting or choosing a scale on a graph are supported by "peer-to-peer discussions to answer both conceptual and procedural questions". Additionally, in Lesson 3, I circulate the room and examine "student responses for independent support." I support the discourse language demand by providing student examples of how to describe exponential data in the warm up of Lesson 3. While I am circulating, I also can monitor student progress and provide feedback on the way in which an answer is written, particularly on questions 6 and 7 on the Zombie Investigation Worksheet.

5a. Assessing student learning

To monitor student learning, I planned numerous informal assessments throughout lessons 1, 2, 3, and 4. I have one formal assessment in Lesson 4. In Lesson 1, throughout the lessons I engage students in Student Voice through both written (exit tickets) and verbal assessments (Socratic Questioning). The verbal assessments address mostly problem solving skills as students answer questions like, "What real world limits are there to this situation?"(Lesson 1 Formative Assessment 1.1). Verbal answers to these questions provide direct evidence to both the student and me of their ability to verbally explain. As for written assessments, Formative Assessment 1.2 has students predict an exponential equation, based on population values. Students record evidence directly in their notebooks for later review. Students engage in conceptual understanding because they recall the parts of an exponential equation, as listed in the LT for Lesson 1. It engages students in procedural fluency because students must create an equation by correctly calculating population values. Students continue to monitor this skill when they complete an exit ticket in Formative Assessment 1.3, answering questions like "What part of the LT did your struggle with…" In Lesson 2, students are monitored through teacher circulation and questioning again throughout the investigation. To support group conceptual/procedural/mathematical reasoning understanding, Formative Assessment 2.1 has students compare their work and answers with other students. This allows students to monitor their own progress and modify their thinking. In Formative Assessment 3.4, students provide evidence of progress with an exit ticket identical to Formative Assessment 1.3. This allows them to make connections back to the prior reflection and self-assess on progress between multiple lessons. The formative assessment throughout the learning segment leads to the Formal Assessment 4.1. It contains conceptual questions (#2b), procedural questions (#1b, 2a, 3), and mathematical problem solving questions (#1c). Additionally, for high-achievers I included a non- graded challenge problem to allow these students to monitor their conceptual understanding and reasoning and provide evidence of this through answers to the problem.

5b. Adapting lessons

Students with specific needs will be able to demonstrate their learning along with other students. I will spend more time with these students (my one student with dyslexia, one student with autism, and 3 students with SLP) monitoring student progress and check in with them during assessments to ensure they understand what is being asked. The layout of each individual lesson provides scaffolding and differentiation for student learning. The multiple forms I use to assess students and provide feedback allow me to support multiple learning needs. For example, students who do not feel comfortable demonstrating learning in front of the class, such as my autistic student, feel comfortable rating with a "fist

to five." My three students with math Student Learning Plans (SLP) are supported by questions that cover familiar topics and have an appropriate level of vocabulary for this age group. For example, in the Formal assessment (#1), I ask about the cost of a box of cereal. Using a familiar problem context also makes it easy for me to provide explanations or to clarify meanings if any of my students have questions on the test. For students with gaps in prior learning, I plan assessments (Formative 2.1) that allow students to work together and contribute what they do know to demonstrate group knowledge. For students who are not strong writers, I use quantitative reflections, such as rating confidence from 1 to 5 on Formative Assessment 1.3 and 3.4. To allow high achievers to demonstrate the full extent of their learning I designed the Formal Assessment 4.1 with a challenge problem that goes beyond the requirement of the LTs.

5c. Student reflection (Washington state only)

I will elicit student voice before/after chunks of information in the lesson. For example, in Lesson 1, I begin with students sharing "their own interpretation of the LT with the class." In Formative Assessment 1.2, I have students predict the "constant multiplier" in their journals, which is academic language introduced in the LT. Near the end of the lesson I have the whole group write a reflection in Formative Assessment 1.3, answer questions such as "what parts of the LT did you struggle with?" In Lesson 2, I use questioning to engage students in student voice by having them volunteer steps to solve the warm up. In Formative Assessment 2.1, I circulate around the room to ask probing questions and make individual students and groups aware of what they can answer related to LTs. After the inquiry, I have students covertly self- assess with a fist-to-five. This provides each individual and me with qualitative and quantitative evidence about their understandings of the LT. In Lesson 3, I begin by having students share with a partner "what the LT means in his or her own words." This is shared with the class and allows students to compare their understanding with others'. After the warm up, I have students rate their confidence on using parts of the LT. I cycle through a variety of assessment types and in Formative Assessment 3.4, I have student complete an exit ticket with reflective questions about the LT. In Lesson 4, I have students reflect on the LTs to be assessed during the quiz and allow students to explain for the class answers to the review homework. At the end of the quiz, students reflect on their understandings by answering questions to gauge student understanding of the LTs.

5d. Strategies to promote student self-assessment (Washington state only)

During the learning segment, students will begin lessons 1, 2, and 3 by writing down the LT for the day. During the lessons, students express their understandings with student voice. For example, in Lesson 2, students individually express their understanding of the LT with two separate "fist to fives" which allows them to monitor progress through the lesson. In general, the learning segment is structured so students are resources for each other to monitor learning. For example, In Lesson 3, students can self-assess by describing to a partner what the LT means. One strategy students can use to monitor their learning process is the use of exit tickets that have them reflect on the same questions. For example, in Lesson 1 and Lesson 3 students write down answers to the question: "What parts of the LT did you struggle with, or do you want to improve upon?" One last important tool for students to monitor their progress is to complete the homework, as in Lesson 3, and engage in the review session to identify/fill-in gaps in understandings related to the LTs.