[The text provided within the notes page is designed to include all major talking points to be covered within this webinar. However, due to differences in audiences, additional information regarding Exploring the Mathematical Reasoning Module of the 2014 GED® test may need to be added for further clarification/understanding.]

Good (morning/afternoon). Welcome to the GED® Testing Service’s webinar series. Today’s webinar on Exploring the Mathematical Reasoning Module of the 2014 GED® test is part of a series of webcasts that will assist you in transitioning to the 2014 GED® Test.
Today’s learning objectives are to:

• Identify similarities and differences between the 2002 Series and 2014 GED® tests
• Explore essential mathematical practices and behaviors
• Discuss beginning strategies for the classroom
• Identify resources that support the transition to the next generation assessment
As we move forward to transitioning to the 2014 GED® test, it is important to remember that this new assessment will:

**Align with college and work expectations**
- Rigorous content and application of knowledge
- Performance standards supported by validity evidence

**Provide evidence of readiness**
- An indicator of readiness to enter workforce training programs or postsecondary education
- Actionable information about a candidate’s academic strengths and weaknesses

**Provide information about a candidate’s strengths and areas of developmental need** through a holistic framework focused on adult learners that facilitates the transition to college and careers.

And of course, ensure that the new 2014 GED® test credential remains meaningful for adult learners, employers, and institutions.
Mathematical reasoning is the logical thinking skills that students develop while learning mathematics. Developing mathematical reasoning skills enables students to solve the problems they encounter on the test and to carry those skills over to problem solving in all areas of their lives.

Through mathematical reasoning, students learn how to evaluate a problem, design a plan to solve the problem, execute that plan, and then evaluate the results and make adjustments as needed. These same reasoning skills can then be applied to real-life problems on the job, at home, within the community, or in higher education and training.
In November, the GED Testing Service® posted an updated Assessment Guide for Educators, which includes a Content Comparison between the 2002 Series GED® test and the 2014 GED® test, as well as an updated Item Sampler.

As we work through today’s webinar, we will be referencing these important tools. You will learn how to access these resources at the end of the webcast.
It has been a decade since the 2002 Series GED® tests were implemented. With that series came changes in test content based on a review of education standards that were currently in place across the country. Those standards were developed in the mid-1990s. In 2002, there were several changes in the content and rigor of the test – including an increase in the percentage of questions that assessed a test-taker’s ability to apply mathematical principles and problem-solving strategies.

As we compare the 2002 Series GED® test to the 2014 GED® test, there are similarities. Number operations/number sense, geometric thinking, and algebra continue to be assessed. However, there has been a dramatic shift in the percentage of the questions in the area of algebraic problem solving - moving from 25% to 55%. The test continues to include both text and graphics, thus requiring a need for students to build their visual literacy skills. The text will also continue to include items that test procedural and fluency skills as well as problem solving.

Test-takers will continue to use a calculator. However, the calculator on the 2014 GED® test will be an on-screen version of the Texas Instruments – TI 30XS Multiview scientific calculator rather than the current Casio fx260-Solar scientific calculator.

Approximately 30% of the items will be aligned to both a content standard and a mathematical practice.
As we compare the 2002 Series GED® test to the 2014 GED® test, there are other items that draw our attention. In 2002, test-takers were introduced to new item types - standard and coordinate plane grids. However, the majority of the test consisted of multiple-choice items.

While 50% of test questions on the 2014 test will continue to be presented as multiple-choice items, the move to a computer-based format enables the use of technology-enhanced items. These items, hot-spots, drag-and-drop, drop-downs, and fill-in-the-blank, allow for assessing content knowledge at different Depth of Knowledge (DOK) levels.

### Item Types

<table>
<thead>
<tr>
<th>2002 Series GED® test</th>
<th>2014 GED® test</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Item types</td>
<td>• Technology-Enhanced Items</td>
</tr>
<tr>
<td>– Multiple choice</td>
<td>– Multiple choice</td>
</tr>
<tr>
<td>– Gridded response</td>
<td>– Fill-in-the-blank</td>
</tr>
<tr>
<td>– Coordinate plane grid</td>
<td>– Hot-spot</td>
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<td></td>
<td>– Drag-and-drop</td>
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<td>– Drop-down</td>
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Looking more closely at the next generation test, it is important to note that test-takers will still need to know and be able to apply procedures in order to solve problems. They will also still need fluency in mathematics - the ability to use mathematics accurately, efficiently, and flexibly. However, test-takers will also need more in-depth problem solving/mathematical reasoning skills.

Statistics and data interpretation will be measured in quantitative problem solving, but these skills/concepts will also be assessed on the social studies and science tests.
Mathematical Reasoning: Similarities between the 2002 and 2014 Tests

<table>
<thead>
<tr>
<th>2002 GED® test</th>
<th>2014 GED® test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Represent and use numbers in a variety of forms</td>
<td>Apply number sense concepts with rational numbers</td>
</tr>
<tr>
<td>Calculate mentally, on paper, and with a calculator</td>
<td>Perform operations on rational number</td>
</tr>
<tr>
<td>Represent, analyze, and apply whole numbers, decimals, fractions, percents in a wide variety of situations.</td>
<td>Solve multistep, arithmetic, real-world problems with rational numbers, ratios or proportions, percents.</td>
</tr>
<tr>
<td>Use Pythagorean Theorem</td>
<td>Use Pythagorean Theorem</td>
</tr>
</tbody>
</table>

There are definitely concerns about how instruction will need to change. Questions from the field often focus on what needs to be taught. What is going to be different? Will I have to toss out everything that I have been using?

Let’s look at some of the similarities between the mathematics content on the 2002 and 2014 tests. One resource you will want to access is the Content Comparison between the 2002 Series GED® test and the 2014 GED® test. This resource clearly outlines the similarities and differences between the two tests.

In this small sample of content within the mathematics test, it is easy to see that basic skills are the same – whether a student is calculating mentally or with a calculator, he/she is performing operations with rational numbers. A student who represents and uses numbers in a variety of forms is able to apply number sense.

To be successful on the next generation assessment, test-takers will still need the fundamentals. However, they will also need a deeper conceptual understanding, procedural skills and fluency, and the ability to apply these fundamentals in realistic situations. It is not enough to briefly review a skill, provide a worksheet of problems to compute, and then move on to the next skill. Students in adult education programs will need more in-depth instruction if they are to be successful.
Looking further at the content, it is clear that test-takers will need to know more than how to calculate the area of a room or the perimeter of a fence. Rather they will have to compute surface area and volume.

It’s also clear from this slide that the assessment targets on the 2014 test are much more specific than on the 2002 Series. For example, the current test specifies that test-takers need to be able to “evaluate formulas” – but no guidance was provided as to what types of formulas those might be. By contrast, the new targets tell you exactly what test-takers need to know and what they will be evaluated on – which can help you structure your instruction accordingly.

Adult educators will need to take a serious look at their current instructional programs and determine where changes in content and strategies will need to change.
There is a greater emphasis on algebraic reasoning skills on the 2014 GED® Mathematics test. As a result, programs will need to focus on helping build students build their skills in algebra.

[Review the basic assessment targets in algebra.]
What’s not on the 2014 Mathematical Reasoning Test?

- Select the appropriate operations to solve problems
- Relate basic arithmetic operations to one another
- Use estimation to solve problems and assess the reasonableness of an answer
- Identify and select appropriate units of metric and customary measures
- Read and interpret scales, meters, and gauges
- Compare and contrast different sets of data on the basis of measures of central tendency
- Recognize and use direct and indirect variation

Equally important is what is not included on the 2014 GED® Mathematical Reasoning test. There are some skills that were assessed on the 2002 test that are not assessment targets on the 2014 version.

As you review the list of items, you may feel that each of these are important skills for students – and they are. However, these skills are foundational to other skills that are being assessed. Students need these skills, but they will not be directly assessed on this test. These skills will be employed in the process of problem-solving that is being assessed at a higher level.
2002 Sample Item

Ms. Nguyen is a real estate agent. One of her clients is considering buying a house in the Silver Lakes area, where 6 houses have recently sold for the following amounts: $160,000; $150,000; $185,000; $180,000; $145,000; $190,000. What should Ms. Nguyen report as the median price of these houses?

1) $160,000
2) $170,000
3) $180,000
4) $190,000
5) Not enough information is given.

This is an example of a question on the 2002 GED® Mathematics test. Take just a moment and review the problem.

To solve this problem, test-takers need to determine the median price of the houses listed. A formula is provided; so students don’t need to remember the process for determining formula. Rather, they need to apply the formula and determine the answer.
This is an example of an item on the 2014 test. This problem also asks test-takers to use data in order to solve a problem and then represent the answer on the number line.

Take a minute to review the problem.

The response requires that the test-taker work backwards in the context of statistics. A partial data set, the median, and the mode are provided in order to determine the missing data points. This item requires mathematical reasoning skills.

Step 1 requires the test-taker to recognize that one data point must be related to the mode of 2.

Step 2 requires the test-taker determine the remaining data point using the value provided for the median.

Step 3 requires the test-taker to complete the line point given.

Notice that the terms “median” and “mode” are not defined and, unlike on the 2002 test, the formula for median and mode is not included on the formula page.
The 2014 GED® Mathematical Reasoning test includes several tools that test-takers can access. They can use a calculator, and if they have difficulty remembering how to operate that calculator, there is a handy calculator reference available to them. As on earlier versions of the test, there is also a formula sheet that is readily available for them to use.

[Go to the Item Sampler to show the different tools that are available.]
The formula sheet has changed to reflect the changes in the content of the test. A copy of the formula sheet is included in the *Assessment Guide for Educators*. Some foundational formulas, such as the area and perimeter of a square and rectangle, circumference, measures of central tendency, distance, and total cost have been removed from the formula sheet. However, the formula sheet includes more algebraic formulas than found on the 2002 test.
Test-takers will be provided with an on-screen calculator, the Texas Instruments TI-30XS Multiview scientific calculator, for use on most items on the 2014 GED® Mathematical Reasoning test. The calculator will also be available for selected items on the Science and Social Studies tests.

Whenever the calculator is present on the test, there will also be a Calculator Reference sheet. This sheet includes the steps necessary to perform different types of calculations, including scientific notation, percentages, fractions, etc.

As adult educators look to the future, they will need to incorporate instruction on the use of the new calculator.

Tutorials and other resources in English and Spanish will be posted on the GED Testing Service web site in the coming weeks and months to help you and your students learn more about the operation of the new calculator to increase your skill and comfort level in using the device.
Mathematical Practices are behaviors that are essential to the mastery of mathematical content. These practices are skills that have been identified from both the Common Core State Standards for Mathematical Practices and the Principles and Standards for School Mathematics developed by the National Council of Teachers of Mathematics.
Mathematical Practices

- Practices
  - Building solution pathways and lines of reasoning
  - Abstracting problems
  - Furthering lines of reasoning
  - Mathematical fluency
  - Evaluating reasoning and solution pathways
- Most practices are not specific to any one particular area of mathematics content

Mathematical Practices focus on the reasoning skills that test-takers need in order to be effective problem solvers. These skills are not specific to one content area. These practices can and should be used whether working with building foundational number sense or algebra.

To be successful problem solvers, students need to do more than just memorize and then apply a long list of mathematical algorithms. Mathematical practices go beyond memorizing multiplication tables or knowing how to divide fractions.

At the core of mathematical practices is the effort to build the skills and habits of thinking logically and mathematically that are essential for real-life problem solving.
George Polya’s *Four Steps to Problem Solving* has stood the test of time and today is still one of the most widely used process for teaching students the process for solving problems.

These steps provide test-takers a framework for building solution pathways when working with mathematical content. Students in adult education classrooms often want to just “do” the problem. This is analogous to the approach students often taken to writing – they just “write.” They do not want to read, plan, organize, edit and revise – they just want to write and move to the next task.

Students need to understand that solving problems requires planning, drafting (trying the plan), checking results, and making “edits and revisions” if the answer is not correct or reasonable. Polya outlines four basic steps.

1. **Understand the Problem**: Determine what is being asked, what information is known, what information is unnecessary to addressing the problem, and what information is missing or not known.

2. **Devise a Plan**: Find a strategy to help in solving the problem.

Sample strategies for problem solving include:

3. **Carry Out the Plan**: Attempt to solve the problem with the chosen strategy. If the strategy does not work, try another strategy.

4. **Look Back**: Check to see if the answer “makes sense.” A good way to look back is to use another strategy to see if the same answer results.
Building the Foundation

Teaching of mathematics requires
• the use of the language of mathematics
• a concrete-to-representational-to-abstract sequence of instruction to ensure conceptual understanding
• a recognition that students must have mathematical fluency in basic operations

It’s not just about teaching how, but rather why!

Success in mathematics hinges on a strong foundation of skills. To build this foundation, adult education teachers need to:

1) Use the language of mathematics in the classroom.
2) Teach by presenting new skills through concrete-to-representational-to-abstract sequence is to ensure students truly have a thorough understanding of the math concepts/skills they are learning.
3) Ensure that students have mathematical fluency, i.e., accuracy and efficiency in the foundational skills.

If students are going to be successful problem solvers, they need to know the steps and why those steps work.
As you move forward to address the need for algebra instruction, you may want to access an excellent resource produced by the National Institute for Literacy in September 2010.

Algebraic Thinking in Adult Education was written by Myrna Manly, Numeracy Consultant, and Lynda Ginsburg, Senior Research Associate for Mathematics Education at Rutgers University.
The paper outlines the steps that adult education programs can take in order to develop algebraic thinking as part of the regular instructional program.
The Challenge Ahead!

- Move past basic arithmetic instruction
- Increase instruction in problem solving strategies
- Increase emphasis on geometric and algebraic thinking
- Provide instruction in higher order mathematics
- Shift focus from “rules or processes” of mathematics to deeper understanding of “why”

[Review each of the bullets on the slide.]
As you get started, you will want to start with a few basic strategies.

[Review each of the strategies on the slide.]

Don’t forget the resources provided through the GED Testing Service® website. A good place to begin is a thorough review of the Assessment Guide and the Item Samplers.
It’s easy to access information that support the transition to the next generation assessment. Just go to gedtestingservice.com and click on the 2014 GED® Test.

[If time permits, access the website to show participants the materials.]
Now that you have an introduction to the GED® 2014 Mathematical Reasoning test, any questions, insights, or suggestions?

[Provide Q and A time period.]
We appreciate your participation!

A special thanks to each of you for being with us today. As we leave, just a few housekeeping items. To obtain a copy of today’s presentation please, [insert process to download presentation, webinar, materials.]

Watch your email for an invitation to our next Webinar. [If date and topic are determined, include it on the slide.]

Thank you again for joining us at today’s webinar. If you have any questions, please contact us at: gedtestingservice.com. Have a great rest of the day.