The webinar will start at 3:30 pm EDT/ 2:30 pm CDT.
If you have a technical question before the webinar, please
type it into the question panel. We will do our best to answer
your question.
When you log on, check your audio to make sure your
headphones are working properly.
If you use your phone to call in, be sure to enter the
appropriate codes.
As you enter the webinar, your audio will be muted to avoid a
lot of background noise.
You will not hear anything until 3:30 p.m. when the webinar
goes live, so please don't think that anything is wrong.
If you haven't downloaded the PowerPoint handout and guide,
please feel free to do so from the handout panel.

Welcome!

• Daphne Atkinson, GED Testing Service
• Debi Faucette, GED Testing Service
• Bonnie Goonen, Consultant to GEDTS
• Susan Pittman, Consultant to GEDTS
Session Objectives

- Explore math and graphic literacy skills assessed on the GED® Science test
- Work with quantitative data to construct and interpret charts, tables, and a wide range of graphics
- Identify strategies to help students build their graphic/visual literacy skills
- Share resources

What do you think of when you hear the word statistics?

Where do we see statistics, data, and math on the Science Test?

- Questions assessing and analyzing statistics and data indicators
- Questions that address the scientific method (including short answer questions)
- Use of calculator and formulas
- Charts, tables, and graphs
Time Out for a Graph Starter!

Let’s get started problem solving with graphics by looking at the following graph. Who is represented by each point?

The Answers!

1 = Dennis 
2 = Alice 
3 = Freda 
4 = Brenda 
5 = Errol 
6 = Cathy 
7 = Gavin
Organizing Data

During the 2005-2006 academic year, a survey of the holdings of university research libraries and rank was done in the United States and Canada. It was found that Syracuse University, in New York, had 2,392,147 holdings, and was figured to rank eighty-first. Harvard University ranked first with 13,369,855 holdings. The University of Connecticut was ranked fiftieth place, and reported 2,626,066 holdings. The Massachusetts Institute of Technology reported 2,448,647 holdings, and was ranked in seventy-third place.

(Source: Association of Research Libraries)

<table>
<thead>
<tr>
<th>Institution</th>
<th>Rank</th>
<th>Holdings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvard University</td>
<td>1</td>
<td>13,369,855</td>
</tr>
<tr>
<td>U. of Connecticut</td>
<td>50</td>
<td>2,626,066</td>
</tr>
<tr>
<td>Mass. Institute Tech.</td>
<td>73</td>
<td>2,448,647</td>
</tr>
<tr>
<td>Syracuse University</td>
<td>81</td>
<td>2,392,147</td>
</tr>
</tbody>
</table>

Tables present data in rows and columns that

• can be compared and contrasted
• can be transferred easily to another graph
• may help determine type of graph to use

Circles, Lines, and Bars – Oh My!

Know which type of graph is best suited for the data
Do your students know...

Data tables
- Present data in a series of rows or columns
- Give easy access to information
- Compare and contrast information
- Set information for transfer to a graphic

<table>
<thead>
<tr>
<th>Plant Group</th>
<th>Soil</th>
<th>Average Plant Growth (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6.0</td>
<td>25.4</td>
</tr>
<tr>
<td>2</td>
<td>6.2</td>
<td>25.3</td>
</tr>
<tr>
<td>3</td>
<td>6.4</td>
<td>50.8</td>
</tr>
<tr>
<td>4</td>
<td>6.6</td>
<td>53.3</td>
</tr>
<tr>
<td>5</td>
<td>6.8</td>
<td>53.3</td>
</tr>
<tr>
<td>6</td>
<td>7.0</td>
<td>30.5</td>
</tr>
<tr>
<td>7</td>
<td>7.2</td>
<td>22.9</td>
</tr>
</tbody>
</table>

Circle graphs (pie charts)
- Represent categorical data or values of variables
- Are divided into segments which reflect proportion of variable to the whole
- Work best if segments are ordered clockwise from largest to smallest (easier to read)

Do your students know...

Line graphs
- Show changes in direction (trends)
- Compare two variables
  - x-axis usually represents time
  - y-axis represents percentage or measures of quantity
- Can forecast results not yet gathered

Do your students know...

Bar graphs
- Present and compare data, time series, frequency distribution
- Can include single, double, or multiple bars
- Include scales on the axes
- Present a numerical or categorical variable for each bar
- Can be vertical or horizontal
Think of the simplest way you can organize the data below, showing the length of nails found in a packet of assorted nails.

<table>
<thead>
<tr>
<th>Length of Nails (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11  22  29  15  17  27  21  23  27  26  19  16  11  10  16  15  21</td>
</tr>
<tr>
<td>21  17  15  23  20  16  17  25  16  17  21  22  23  23  25  26  27  29</td>
</tr>
</tbody>
</table>

One way is to arrange it in increasing order.

<table>
<thead>
<tr>
<th>Nails arranged in order of increasing length (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10  11  11  15  15  15  16  16  16  16  17  17  17  19  20  21  21</td>
</tr>
<tr>
<td>21  21  22  23  23  25  26  27  29</td>
</tr>
</tbody>
</table>

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How Do I Display That?

Use a Tally Table

Nails arranged in order of increasing length (mm)

<table>
<thead>
<tr>
<th>Length</th>
<th>Tally</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>2</td>
</tr>
<tr>
<td>14</td>
<td>2</td>
</tr>
<tr>
<td>15</td>
<td>4</td>
</tr>
<tr>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>17</td>
<td>27</td>
</tr>
<tr>
<td>18</td>
<td>28</td>
</tr>
<tr>
<td>19</td>
<td>29</td>
</tr>
<tr>
<td>20</td>
<td>8</td>
</tr>
<tr>
<td>21</td>
<td>6</td>
</tr>
<tr>
<td>22</td>
<td>10</td>
</tr>
<tr>
<td>23</td>
<td>3</td>
</tr>
<tr>
<td>24</td>
<td>1</td>
</tr>
<tr>
<td>25</td>
<td>1</td>
</tr>
<tr>
<td>26</td>
<td>1</td>
</tr>
<tr>
<td>27</td>
<td>1</td>
</tr>
<tr>
<td>28</td>
<td>1</td>
</tr>
<tr>
<td>29</td>
<td>1</td>
</tr>
</tbody>
</table>

Line Plot or Pictographs

Line Plot

Pictograph

Frequency Table

Frequency Table

<table>
<thead>
<tr>
<th>Length of Nails</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 ≤ L &lt; 15</td>
<td>3</td>
</tr>
<tr>
<td>15 ≤ L &lt; 20</td>
<td>11</td>
</tr>
<tr>
<td>20 ≤ L &lt; 25</td>
<td>8</td>
</tr>
<tr>
<td>25 ≤ L ≤ 30</td>
<td>5</td>
</tr>
</tbody>
</table>

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How Do I Display That?

Histogram

How About a Box Plot?

Let’s Create a Box Plot

• Arrange data in order and divide into quarters
• Find the median of the data set
Let's Create a Box Plot

Find the middle value (Q3) of the lower quartile and the upper quartile
Find the extreme values of the data set

Lower Extreme | Upper Extreme

Q1 | Median | Q3

Let's Create a Box Plot

We now draw a number line to plot all the numbers we identified.

Let's Create a Box Plot

The last step is to draw a box from Q1 to Q3 and lines connecting the extreme values to our box.

Now, we have successfully created a box plot to represent our data.
Measures of Central and Spread

Another way to describe data is to describe its center and/or spread.

**Measures of Central Tendency**
- Mean (Average)
- Median
- Mode

**Measures of Variability**
- Range
- Mean Absolute Deviation
- Standard Deviation

Another way to describe data is to describe its center and/or spread.

Mean, median, and mode . . .

<table>
<thead>
<tr>
<th>Sample</th>
<th>Mass of Sample (g)</th>
<th>Volume of Sample (cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6.9</td>
<td>24.0</td>
</tr>
<tr>
<td>2</td>
<td>7.7</td>
<td>19.4</td>
</tr>
<tr>
<td>3</td>
<td>3.9</td>
<td>12.2</td>
</tr>
<tr>
<td>4</td>
<td>6.2</td>
<td>19.4</td>
</tr>
</tbody>
</table>

What is the average bone density for the data samples provided?
- a. 3.2 g/cm³
- b. 3.39 g/cm³
- c. 3.56 g/cm³
- d. 0.23 g/cm³

It Doesn't Get Much Better

https://www.youtube.com/watch?v=OoNdVynH6hcY
When analyzing data . . .

Ask students questions such as:

- What pattern do you see?
- What does this graph tell you?
- Who could use this data?
- How could they use it?
- Why is this data shown in a line graph, box and whisker graph, scatterplot, etc.?

---

The Basics of Scatter Plots

- Are similar to line graphs
- Have horizontal and vertical axes
- Have two sets of data that are plotted as ordered pairs on a coordinate to show the relationship
- Show how much one variable is affected by another – the correlation
The Vocabulary of Scatter Plots

- Bivariate data
- Independent variable
- Dependent variable
- Line of best fit
- Correlation
  - Positive
  - Negative
  - No
- Causation

Correlation vs. Causation

**Correlation**
- Measures the relationship between two things
- Tells us that two variables are related, but we cannot say anything about whether one caused the other

**Causation**
- Any cause that produces an effect
- Tells us when something happens (cause), something else will also always happen (effect).

Scatter Plots

- As \( x \) increases, \( y \) decreases
- No correlation
- As \( x \) increases, \( y \) increases
However, correlation does not always imply causation

Germs

Causation

Causation

Bad Smells

Correlation

Disease

Clusters and Outliers

A cluster is formed when several data points lie in a small interval. An outlier has a value that is much greater or much less than other data in the set.
Many scientific graphs are made as line graphs.

The lines on scientific graphs are often drawn either straight or curved. These lines do not have to touch all the data points, but they should at least get close to most of them. They are called best-fit lines.

Often, scientific graphs are not drawn in connect-the-dot fashion.

Use the line of best fit to predict how many tornadoes may be reported in the United States in 2020 if the trend continues.

If the trend continues we predict that there will be 1200 tornadoes reported in 2020.
Teach Big Ideas through Graphics

Kinetic Theory of Matter

- Molecules are always moving
- Kinetic energy is measured as temperature
- The greater the material’s internal energy, the higher the temperature of that material
- Heat is the energy flow between objects of different temperatures
- Heat and temperature are not the same

Teach Big Ideas through Graphics

<table>
<thead>
<tr>
<th>SOLID</th>
<th>LIQUID</th>
<th>GAS</th>
<th>PLASMA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tightly packed, in a regular pattern</td>
<td>Close together with no regular arrangement. Vibrate, move about, and slide past each other</td>
<td>Well separated with no regular arrangement. Vibrate and move freely at high speeds</td>
<td>Has no definite volume or shape and is composed of electrical charged particles</td>
</tr>
</tbody>
</table>

Teach Big Ideas through Graphics

Phase Diagram – It’s a Roadmap!

A phase diagram is a graphical way to depict the effects of pressure and temperature on the phase of a substance.

Workbook – p. 25

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Interpreting a Graph

- The slanted portions = temp is changing
  - Single phase is heating up or cooling down

- The flat portions = temp not changing
  - Substance undergoing a phase change

States of Matter – Application

[Image of States of Matter]


Resources for Science

Getting Started
How Do I Display That?

**Resources for Getting Started**

- Data Analysis, Statistics, Probability
- National Science Digital Library (lesson plans and more . . . )
  [https://nsdl.oercommons.org/](https://nsdl.oercommons.org/)
- Using Data in the Classroom – National Science Digital Library
  [http://serc.carleton.edu/usingdata/index.html](http://serc.carleton.edu/usingdata/index.html)

**Resources – Phase Diagrams**

- How Structure Can Affect Properties Through Phase Changes
  [https://florida.pbslearningmedia.org/resource/psu06-nano.sci.phasechanges/how-structure-can-affect-properties-through-phase-changes/](https://florida.pbslearningmedia.org/resource/psu06-nano.sci.phasechanges/how-structure-can-affect-properties-through-phase-changes/)
- Phase Change Diagrams
  [https://www.youtube.com/watch?v=JJSZbfXnBq4](https://www.youtube.com/watch?v=JJSZbfXnBq4)
  States of Matter

**More Resources**

- The Great Graph Math Game
- Graphing Stories
Resources

- Create a Graph
  https://nces.ed.gov/nceskids/createagraph/

- MSP2 - Handling All That Data

Resources – Lesson Plans

- Graphing Lesson Plans
  http://www.ngsslifescience.com/biology_lesson_plans_scientific_method.html

- Senses Lab – A Graphing Lesson Plans – The Senses
  http://www.ngsslifescience.com/science.php?/biology/lessonplans/C411/

Resources – More Lesson Plans

- Science Net Links. What’s in a Graph?

- The Master Teacher Project – Are All Graphs Created Equal?
  https://betterlesson.com/lesson/628519/are-all-graphs-created-equal-day-1-of-2
Resources – More Lesson Plans

**Yummy Math** (Search data lessons related to science) - [https://www.yummymath.com](https://www.yummymath.com)
- Total Solar Eclipse
- Tick Time and Lyme Disease
- Giant Iceberg Breaks Off Antarctica

Resources – Challenges

- Take a Challenge! Does drinking soda affect your health?  
- Analyzing and Interpreting Data – Does It Sink or Float?  
  [https://bscs.org/sites/default/files/_media/community/downloads/analyzing_and_interpreting_data.pdf](https://bscs.org/sites/default/files/_media/community/downloads/analyzing_and_interpreting_data.pdf)

Tuesdays for Teachers

Next Tuesdays for Teachers – October 24th
- More content-based information
- More strategies and activities
- More resources
Questions

Thank you!

Communicate with GEDTS
communications@GEDTestingService.com