

Off-the-Shelf Lesson: Interpreting Graphs



Minimum Teaching Time: 3 Class Periods (assuming 50 minute periods)

Instructional Setting:



- Classroom with a computer, projector and document camera/overhead projector with transparencies
- [Optional] Computer lab (Connect Your Ideas)

Lesson Discovery Question:

- How do I obtain evidence from a graph?

Lesson Key Concepts (DCI & CCC)	• Interpreting graphs is a skill that takes practice. • Using a systematic process can make interpreting graphs easier.
Lesson Key Practices	• Identify the information represented on the axes of a graph • Identify patterns in the data of the graph relevant to the phenomenon under investigation • Use the graph title, legend, and/or key to make sense of patterns in the graph

Learning Performances

1. Students will analyze and interpret a graph to obtain evidence to support a claim.
2. Students will metacognate on the process they used to interpret the graph.
3. Students will develop and revise a tool they can use to interpret graphs.

NGSS Connections		
Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data - Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships. - Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships. - Analyze and interpret data to provide evidence for phenomena.	none	Patterns Graphs, charts, and images can be used to identify patterns in data.

Lesson Introduction:

Many middle school students feel comfortable working with bar graphs, but become unsure when they encounter new, unfamiliar graph formats. This can lead to frustration, overwhelm, and lack of engagement with the material. This lesson has been designed to help students overcome this initial trepidation and give them the tools they need to confidently explore graphs, even unfamiliar graph types or those following unusual conventions.

Students begin by annotating a graph about the winners of a horse vs. human marathon. These annotations are meant to capture student thinking and reveal HOW students are making sense of the graph. They use these annotations to make an initial draft of the steps they think are important to figuring out what the graph means. Then students watch a video of an expert working through the same annotation process of the same graphs, and use this evidence to refine their process.

Once students are confident in their draft process, they test and refine their process on new graphs and phenomena. In the process, they are exposed to graphs like stacked bar charts, double line graphs, and graphs that do not follow typical middle school graphing conventions.



Additional Resources to Support Teacher Background Knowledge:

- [Annotating Visual Text](#) (YouTube)

Advance Preparation

- Prepare copies of student resources as needed (see phase summaries).
- If you plan to use lesson slides, review the [Mi-STAR Slide Guide](#) created for this lesson.
 - These slides are a resource to help guide your classroom instruction. **They are not a comprehensive resource.**
 - **Slides in blue have been provided as additional teacher support.** Some refer to resources within the lesson plan that you will need to review and decide if/how you will use them. (They are not intended to be used with students and are set to “skipped in slideshow mode”.)
 - Use your creativity and the resources and platforms you know and feel comfortable using.
- [Optional] Watch the [Mi-STAR Learning Series recording](#) for an overview of the lesson plan, first-hand from the lesson designers.

- [Optional] Watch the [Annotating Visual Text support video](#) - a video describing how to use the 'text annotation' reading strategy with an image or a graphic as the text, from the Mi-STAR Learning Series session “Engaging Reluctant Readers with Mi-STAR”.
- Choose one of the graph formats provided (A-D) to annotate together as a class for the Uncover Your Ideas activity. Watch this portion of the [Mi-STAR Learning Series session](#) (19:30-28:26) for an overview of the Uncover graphing options, pilot teacher experience, and classroom tips for this activity.
 - [OTS_Graphs_Uncover_Student_GraphA](#) - This double line graph sparks good conversations and scaffolds the graph used in the assessment.
 - [OTS_Graphs_Uncover_Student_GraphB](#) - This highly simplified bar graph may be an option if your students struggle with graphs.
 - [OTS_Graphs_Uncover_Student_GraphC](#) - This bar graph best conveys the most information about who is faster, although students may not deeply interact with the data on the first try.
 - [OTS_Graphs_Uncover_Student_GraphD](#) - This bar graph should be accessible to students, while being complex enough to spark good conversations.



Safety Considerations

- None for this lesson.

Mi-STAR Lesson Structure

Anchoring Experience

Phase Summary:

Students demonstrate their ability to interpret graphs by analyzing a joke graph and explaining the joke. Then students think about where they interpret graphs in their life.

Resources Needed for this Instructional Phase:

- Per Class
 - [OTS Graphs Slides](#)

Student Steps:

1. Students introduced to the importance of interpreting graphs through a simple introduction:
 - *Example Introduction:*
Graphs are a really big deal in science. They are one of the main ways scientists communicate their findings. A big part of a scientist's job is to be able to interpret the graph and figure out the story it tells.

This allows them to see if the evidence on the graph supports or refutes the claim, helps them ask questions and even can help test models. Let's practice our graph interpretation skills and see if we can make some tools to help us figure out the story each graph is trying to tell.
2. Students are introduced to this lesson's skill of graph interpretation. Students interpret a fun graph in [OTS Graphs Slides](#) to provide them with a common initial experience of figuring out the story of a graph.
3. Students work in small groups to analyze the graph and explain the joke to demonstrate their ability to interpret graphs.

Example Guiding Questions

- What is the graph trying to say?
- How do you know?
- What clues were on the graph that led you to your answer?

4. Students describe their own experiences, relevant to interpreting graphs.

Example Guiding Questions

- Do you think all graphs look like this one? What other types of graphs have you seen or used (e.g., bar, pie, points, lines)?
- Have you seen or used graphs in other classes? What were they about?
- Besides school, do you see graphs in your everyday life? Where?
- When do you think it might be important to figure out the story of a graph?
- Have you ever been confused by a graph? When? What did you do?
- Do you know anyone who makes or interprets graphs as part of their job? Who? What do they do?

Uncover Your Ideas

Phase Summary:

Students work together to make sense of a graph with the results from an annual horse vs. human marathon to provide evidence about who is a faster marathoner. Students metacognate on the process by annotating their graph, keeping track of their observations, questions, and thought processes used to make sense of the graph. Students then make an initial draft of a tool they can use to make sense of new, unfamiliar graphs.

Teacher Notes:

- [Optional] Watch the [Annotating Visual Text support video](#) - a video describing how to use the 'text annotation' reading strategy with an image or a graphic as the text, from the Mi-STAR Learning Series session "Engaging Reluctant Readers with Mi-STAR".
- Choose one of the graph formats provided (A-D) to annotate together as a class. Watch this portion of the [Mi-STAR Learning Series session](#) (19:30-28:26) for an overview of the Uncover graphing options, pilot teacher experience, and classroom tips for this activity.
 1. [OTS Graphs Uncover Student GraphA](#) - This double line graph sparks good conversations and scaffolds the graph used in the assessment.
 2. [OTS Graphs Uncover Student GraphB](#) - This highly simplified bar graph may be an option if your students struggle with graphs.
 3. [OTS Graphs Uncover Student GraphC](#) - This bar graph best conveys the most information about who is faster, although students may not deeply interact with the data on the first try.

4. [OTS Graphs Uncover Student GraphD](#) - This bar graph should be accessible to students, while being complex enough to spark good conversations.

Resources Needed for this Instructional Phase:

- Per Class
 - [OTS Graphs Slides](#)
 - Choose one of the following:
 - [OTS Graphs Uncover Student GraphA](#)
 - [OTS Graphs Uncover Student GraphB](#)
 - [OTS Graphs Uncover Student GraphC](#)
 - [OTS Graphs Uncover Student GraphD](#)
- Per Student
 - A copy of the teacher-chosen graph guide (A-D)
- Teacher Resources
 - [Annotating Visual Text support video](#) (YouTube)

Student Steps:

1. Students are introduced to the investigation they will conduct and the purpose of the investigation.

- *Example Introduction:*

If we are going to practice our interpretation skills, we will need some graphs to interpret. Let's use the results from an unusual race that takes place in Wales, in the United Kingdom. It is the horse vs. human marathon, where riders on horses race human runners on a roughly marathon length course.

We want to use the graphs to figure out who is the faster marathoner - horses or humans.

But even more important than answering this question, we want to keep track of how we got the answer. How did we get the evidence from the graph, what did you look at, what did you wonder, what questions did you figure out.

By sharing how we all got evidence from the graph, we will be able to share tips and good ideas that will make interpreting future graphs easier.

2. Students are introduced to the horse vs. human marathon using the video provided in [OTS Graphs Slides](#).

3. Students work together as a class to annotate one of the graphs of the results from the horse vs. human marathon. Class annotations are recorded by the teacher and made visible to students using a document camera or other means.

Teacher Notes:

- If this type of task is new to students, starting as a class works best while encouraging students to make at least one annotation per strategy listed if possible.
- If your students are already familiar with metacognition prompts like annotating a text or image, this activity can be done in groups or pairs.
- Numbering the annotations as they are recorded can help students track the process they used to make sense of the graph.
- For an exemplar annotation, see the corresponding expert video linked in the Share Your Ideas phase.
- For an example of how and why to annotate an image like a graph see [Annotating Visual Text support video](#).

Formative Assessment Opportunity

This discussion is a good time to assess your students' familiarity with graph terminology. If necessary, review the parts of a graph and their names.

4. Once the class finishes annotating the graph, students use evidence they gathered to support a claim about humans or horses being the better marathon runners in their graph guide.
5. Students share their findings, and quickly reach consensus that horses are usually, but not always, the faster marathoners.
6. To prepare sharing in the next phase, students work in pairs or small groups to use the class's annotations to answer the questions in the guide and make an initial draft of their personal graph interpretation tool in their graph guide.

Share Your Ideas

Phase Summary:

Students share their graph interpretation tools and have a discussion focused on how they figured out the information on the graph. Finally as a class, students work to build an initial draft of a tool they can use to figure out graphs in the future.

Teacher Note: In the Student Steps we outline the basic goals of the Share phase; there are many ways to accomplish these goals that teachers may choose for their own classrooms. Some routines may be found in the [Mi-STAR Visible Thinking and Discussion Routines](#) document, as well as in the Phase 2 Productive Talk Canvas or virtual courses.

Resources Needed for this Instructional Phase:

- Per Class
 - [OTS Graphs Slides](#) (videos below embedded in slides)
 - Choose the same video as the graph used in the Uncover Your Ideas phase:
 - [OTS Graphs Share ExpertVideo GraphA](#)
 - [OTS Graphs Share ExpertVideo GraphB](#)
 - [OTS Graphs Share ExpertVideo GraphC](#)
 - [OTS Graphs Share ExpertVideo GraphD](#)
- Per Student
 - Uncover graph guide (A-D)
- Teacher Resources
 - [OTS Graphs Share Teacher ExampleTools](#)
 - [Mi-STAR Visible Thinking and Discussion Routines](#)

Student Steps:

1. Students share their draft Graph Interpretation Tools with each other and make revisions and/or additions to their draft interpretation tools based on other's ideas.

Teacher Note: Consider using **Send Out a Spy** which is described in the [Mi-STAR Visible Thinking and Discussion Routines](#) document, to facilitate the initial sharing and whole-class discussion. Students do not necessarily need to see every interpretation tool, just a good enough sample to get ideas for revisions. Regardless of the routine you choose, including the below guiding questions ensures students encounter the scientific principles necessary to answer the Lesson Discovery Question.

Example Guiding Question	Example Student Answers
What commonalities did our tools share?	Student answers will vary, but may include things like:

	<i>Checking the axes and the title, identifying patterns in the data, etc.</i>
What were any unique or different ideas you saw?	Student answers will vary, such as: <i>X made a flow chart instead of a checklist</i>
What ideas did you incorporate from others? Why?	Student answers will vary, such as: <i>Y described what they thought the axes meant, instead of just checking them</i>

- Students compare the tool they made to the process used by experts to interpret their graph in the videos provided in [OTS_Graphs_Slides](#). Students look for similarities and differences to the process they used compared to the experts. Choose the same video as the graph used in the Uncover Your Ideas phase:
 - [OTS_Graphs_Share_ExpertVideo_GraphA](#)
 - [OTS_Graphs_Share_ExpertVideo_GraphB](#)
 - [OTS_Graphs_Share_ExpertVideo_GraphC](#)
 - [OTS_Graphs_Share_ExpertVideo_GraphD](#)
- Students share the similarities and differences they observed between the expert and their tool with the class.

Example Guiding Question	Example Student Answers
What similarities did you see between your tool and the process the expert used?	Student answers will vary, such as: <i>We both checked the title to find out what type of information the graph was supposed to show.</i>
What differences did you see between your tool and what the expert did?	Student answers will vary, such as: <i>Our tool didn't include looking at both the x- and y-axes, but the expert made sure to examine both.</i>

- As a class, students reach consensus that people think differently, and there may not be one right way to interpret a graph, but good graph interpreters do things like:
 - check the title or legend
 - make sense of the axes
 - look for patterns in the data

5. Finally students decide on any revisions to their graph interpretation tool and make a “final” product in the student guide based on the evidence gathered from the experts.

Teacher Note: Students will have the opportunity to revise their Graph Interpretation Tool in later lesson phases, if they find it lacking.

Connect Your Ideas to Another Context

Phase Summary:

Students practice using their graph interpretation tool in a new context of their choosing. Then students report out how well the tool worked and suggest any revisions to their tool to the class.

Teacher Note: Allowing students to choose the phenomenon they find most interesting incorporates students’ voice and choice into the lessons. You may also decide to assign phenomena or have all students work on the same phenomenon.

Resources Needed for this Instructional Phase:

- Per Class
 - [OTS Graphs Slides](#) (optional videos below embedded in slides)
- Per Group (chosen by students or teacher, at teacher discretion)
 - [OTS Graphs Connect Student Lake](#)
 - [OTS Graphs Connect Student Birthday](#)
 - [OTS Graphs Connect Student BloodType](#)
- [Optional] Per Group
 - [OTS Graphs Connect ExpertVideo Lake](#)
 - [OTS Graphs Connect ExpertVideo Birthday](#)
 - [OTS Graphs Connect ExpertVideo BloodType](#)
- Per Student
 - Graph interpretation tool developed in the Share Your Ideas phase

Student Steps:

1. Students are introduced to the purpose of the Connect Your Ideas phase using an introduction like the one below:
 - *Example Introduction:*
We just made a really useful tool to help us figure out what a graph means. However, we need to test it to make sure it is actually useful. We may find that

we want to make tweaks or changes so it works better for us. So let's look at some new graphs and test out how well our new tool works.

2. Working in small groups, students test how well their tool helps them make sense of an unfamiliar graph. They choose one of the Connect guides and use their graph interpretation tool from the Share Your Ideas phase to make sense of the graph, recording their thinking as annotations.

- [OTS_Graphs_Connect_Student_Lake](#)
- [OTS_Graphs_Connect_Student_Birthday](#)
- [OTS_Graphs_Connect_Student_BloodType](#)

Teacher Note: Allowing students to choose the phenomenon they find most interesting incorporates students' voice and choice into the lessons. You may also decide to assign phenomena or have all students work on the same phenomenon.

3. Once they have made sense of the graph, they use the evidence on the graph to explain the phenomenon in the guide.
4. As a whole class, students share how their interpretation tool helped them make sense of the graph they choose. Students revise or update their interpretation tool as needed.
5. [Optional] Students again compare the tool they made to the process used by experts to interpret their graph in the associated video provided in [OTS_Graphs_Slides](#). Students look for similarities and differences to the process they used compared to the experts.
 - [OTS_Graphs_Connect_ExpertVideo_Lake](#)
 - [OTS_Graphs_Connect_ExpertVideo_Birthday](#)
 - [OTS_Graphs_Connect_ExpertVideo_BloodType](#)

Teacher Note: If all students must watch the same video, we recommend only watching one or two expert videos of your choosing to maintain student engagement.

Check Your Progress

Phase Summary:

Individually, students demonstrate their graph interpretation skills by using the tool they made to make sense of a double line graph about how children grow.

Resources Needed for this Instructional Phase:

- Per Class
 - [OTS_Graphs_Slides](#)
- Per Student
 - [OTS_Graphs_Check_Student_Heights](#)
- Teacher Resources
 - [OTS_Graphs_Check_Teacher_Heights](#)

Student Steps:

1. Students annotate and interpret the graph in [OTS_Graphs_Check_Student_Heights](#) to demonstrate their new ability to use the graph interpretation tool to obtain evidence from a graph.

Sources

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6. National Center for Health Statistics. 2005. "Girls Stature-for-age and Weight-for-age"
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