Creating Accessible Pages and Questions

It is important to consider accessibility when creating text content in MyOpenMath, regardless of whether that content is a link item text page, assessment instructions, a question, a forum post, or any other way of sharing content. Considering accessibility ensures that all students are able to access and use the content you create, regardless of any barriers they may face.

The guide will explore both the basic accessibility approaches needed in all disciplines, as well as the unique concerns in mathematics. In mathematics we face a few challenges:

- **Mathematical formulas.** Unlike standard text, a screen reader used by a blind student can only read mathematical formulas if they are displayed in a way that the screen reader can understand.
- **Graphs.** A screen reader cannot read a graph, so a text-based alternative must be provided. The appropriate alternative often depends on the context.
- **Diagrams.** Likewise, a screen reader cannot read a diagram, so a text-based alternative must be provided.
- **Data tables.** Mathematics often involves tables of values for a function, and statistics often involves tabular representations of data. Without proper formatting, it is hard for a blind student to navigate a data table and understand the relationship between the table cells and the headers.
- **Drawing/Graphing.** In math we often ask students to draw graphs of a function. For blind students and students with motor skill impairment, doing so with a mouse on the screen can be impossible.
- **Videos.** We commonly use videos to guide students through example problems. For deaf students, students trying to watch the video in a noisy room, and lots of other use cases, it is necessary for videos to be captioned. For students with sight impairments, it's important the video describe in audio anything being written or shown visually in the video.

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Accessibility Settings in MyOpenMath

While MyOpenMath strives to be accessible in general, in some areas better accessibility could be achieved by providing special settings to enable alternative behavior. Accessibility options can be enabled by viewing the User Profile page, which you can access by clicking your name in the upper right corner. On the profile page, you’ll be able to adjust your display preferences for math, graphs, drawing entry, text editor, contrast, and auto-preview.

This guide will refer to some of these settings, but for full details on the options available, please refer to the MyOpenMath accessibility statement, which you can also find a link to on the MyOpenMath login page.

Accessibility Basics

This section will explore general accessibility recommendations, mostly not specific to
mathematics.

**Headers**

To make it easier to navigate a page, any grouping of content should be done with proper headers, not just an enlarged font size, bold, or color. Additionally, headers should be sequentially nested, with a Header 2 under a Header 1, a Header 3s under Header 2s, and so forth. Generally MyOpenMath pages have an automatically-generated Header 1, so your content should typically begin with a Header 2.

You can create headers in your text using the text editor buttons. Under the Formats button, select Headings, then the desired Heading level.

**Images - Alt Text**

If you include an image in your content, you should provide a textual description for that image, referred to as "alt text." Recommendations on how to phrase alt text for graphs and diagrams will be discussed in more detail later.

If you are inserting an image using the text editor, then you can specify the alt text by filling in the "Image Description" in the image tool dialog. If you pasted in the image, you can access the image tool dialog by clicking on your image, then clicking the image tool icon in the text editor, ![Image Tool Icon]. If you do not fill in the "Image Description", the image will be treated as decorative by screen readers and completely ignored. This is not accessible, unless the graph truly is decorative.

If you are writing a question, you can insert an image into the question text by clicking the Toggle Editor button to enable the text editor, then follow the procedure above. Alternatively, if you use the Image File upload option in the question editor, a space is provided for a Description of the image, which is used as the alt text.

For some additional guidance on writing alt text, check out the [WebAim alternative text guide](#), or [examples and guidelines for describing STEM images from the National Center for Accessible Media](#)

**Tables**

For tables to be accessible:
They should only be used for data and not for layout
They need to be formatted to include header rows and/or columns.
Tables should have captions to assist all users to contextualize the data, unless the table is captioned by the text content immediately proceeding

You can create a table in the text editor by using the table tool. Once you've made your table, do the following to make it accessible:

1. Click on the table to select it. Then, click on the table icon in the text editor: ✂️
2. Select Table properties and check "caption". Click "Ok".
3. Click at the top of your table to type a caption for the table.
4. Highlight the cells of the header row (or column).
5. Select "Cell", then "cell properties" from the table menu in the text editor.
6. Select "header cells" from the Cell type dropdown menu.
7. From the scope dropdown, select "columns" if you have column headers, or "rows" if you have row headers. Click "Ok".
8. While not necessary for accessibility, if your top row is a header row, you can highlight it, click on the table icon in the text editor, select "Row" then "row properties" from the menu, and change the "Row type" to "Header". Marking a row as a header sometimes change change how it looks visually.

The result will look something like:

<table>
<thead>
<tr>
<th>Grade Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Percentage</strong></td>
</tr>
<tr>
<td>95-100%</td>
</tr>
<tr>
<td>94%</td>
</tr>
<tr>
<td>93%</td>
</tr>
</tbody>
</table>

Tables should only be used for displaying tabular data. In particular, tables should not be used for layout purposes. Using a table for layout not only confuses screen readers, it also causes problems on mobile devices and other small screens where the information in the table might get cut off if it's wider than the screen has room for.

If, when writing questions, you just can't give up using tables for layout, at least add `role=presentation` to the main `<table>` tag, like `<table role=presentation>`. Doing so tells a screen reader to ignore the table, and MyOpenMath will adjust the display of tables marked up this way on smaller screens to reduce issues.
Contrast and Color

For students with lower vision, it is important to ensure sufficient contrast between foreground and background colors. To read more about various vision issues students face, check out Design Accessibly, See Differently: Color Contrast Tips and Tools.

The standards require a 4.5:1 ratio for normal text, and 3:1 for large text, which probably means nothing to you :) To find out whether a color combination is OK, try the WebAIM color contrast checker. For example, these are OK: Sample Text, Sample Text, while these are not: Sample Text, Sample Text. A good rule of thumb is to try to keep contrast as high as possible.

Another good tool for scanning a page for any contrast issues is the tota11y bookmarklet from Khan Academy. This can be installed in your bookmarks bar, then run on any webpage, including your own, to see if there are any contrast or alt text issues.

When choosing colors, also try to keep in mind colorblindness, as some color combinations are not distinguishable for all people. Most importantly, never rely on color as the only way to distinguish things. Don’t, for example, say “the red graph” as a way to refer to one of several graphs; provide some other way, such as text labels, to distinguish the graphs.

Lists

Sighted users can glance at a list and know if it’s long or short. When you create lists, use the bulleted or numbered list formatting tool in the text editor. This will allow a screen reader to identify the number of items in a list before it begins to read the items.

Font Type & Size

Try to use a simple font in a good size. Most importantly, remember not to use size, color, or bold in place of properly formatted headers.

There is some disagreement on whether or not sans-serif (fonts without the "feet" or extensions) are easier to read or not. Do not worry too much about the font - the default font should be fine.

Avoid using too many combinations of fonts and typing long phrases or sentences in ALL CAPS.
Descriptive Hyperlinks

When you are providing a link to something, avoid pasting the full URL onto the page. Instead, you want to embed the URL into descriptive text that will tell the reader where the link will take them. This also means to avoid using phrases like "click here" as that does not give the user much information about what will happen when they click on that link. Instead, use descriptive hyperlinks.

Example:

- Descriptive: Donald Tapscott, in his paper "Growing Up Digital," says these students....

Link Document Formats

When attaching or linking to external documents, it is important to consider the format of those documents. PDF files are generally not accessible; PDF files containing only text can sometimes be made accessible, but the PDF format currently does not provide any way to make math inside PDFs accessible without manually adding alt-text descriptions of each equation manually.

If you are going to link to PDF files, it is recommended to make sure the original source versions are also available, either by providing a secondary link to that file, or by letting students know they can contact you for the source files. To be fully accessible, Word files also need alt-text on images, including graphs, and math should ideally be written in MathType.

Formatting Text / Layout

Often, people will use the tab key or spacebar to indent items. Additionally, many people will add extra blank lines between sections of a document or page in order to distinguish between sections. Manually formatting with the tab key, spacebar, and blank lines is sure to cause you a headache when editing the document at a later date. This type of formatting is incredibly time consuming in addition to being inaccessible.

There are a wide variety of ways to get the layout you want without having to rely on
techniques that wreak havoc on the experience of people with disabilities. If you are indenting because the items are a list, use the list tool. If you are indenting a quote or something similar, you can use the Increase Indent button in the text editor toolbar to indent a paragraph.

Here's a short list of things to avoid and lessons on how to use the appropriate tools to follow:

- Do not use the tab key to create columns (using tab, you're essentially creating vertical lists that will be read horizontally). If the information is tabular, use tables. Otherwise, it's inadvisable to use columns in online text, as they don't adapt well to different screen sizes.
- Avoid text boxes (these may be ignored entirely by assistive technology or may be read out of order).
- Do not use blank lines or spaces to create more white space (it's common for extra space to accumulate at the end of the document, a user may think they've reached the end of the document if their screen reader announces a collection of blank spaces/lines.

Mathematical Expressions

Images of mathematics cannot be read by screen readers, so pictures of math should be avoided. Instead, the built-in math tools in MyOpenMath should be used.

MyOpenMath uses Asciimath as a math input format, which is very similar to calculator-style notation. For example, you could type \((-b+-\sqrt{b^2-4ac})/(2a)\) to get

\[-b \pm \sqrt{b^2 - 4ac} \over 2a\]. Note that Asciimath also understand many basic LaTeX commands, so those can be used as well. Math is displayed using MathJax, which automatically converts the math into an accessible format, as well as providing tools for zooming equations and navigating them.

In the text editor, you can start a new math entry by clicking the \(\Sigma^+\) icon. This will insert a red box with two backtick symbols into the editor. Start typing, using calculator-style notation. When you have completed your expression, use the right arrow key to move out of the red box (or, use a mouse to click out), and you will see the math render. To edit the expression, arrow to move the cursor to the mouse, or click on the expression. If you're not sure how to enter a particular symbol, you can click the \(\Sigma\) button in the editor
to see a selection of symbols and basic expressions.

When writing questions with the text editor disabled, you can indicate what text should be rendered as math by surrounding it with backticks (aka the grave symbol, usually on the key in the upper left corner of a keyboard). For example, you could write Sketch a graph of \( y=1/2x^2 \) shifted two units left.

For more information on the AsciiMath notation, view the [AsciiMath syntax guide](https://www.math.union.edu/~dpvc/CAS/support/AsciiMath.html).

**Graphs**

Like images, graphs need to have alt text for sight-impaired students. Be aware that pasted-in images (like screenshots) have a second disadvantage that if limited-sight student is using screen-zooming technology, enlarged images are often fuzzy and hard to read.

**In the Editor**

If you need a graph in the text editor, and it’s the graph of a basic function, you can use the graphing tool in the editor. Graphs created this way are rendered in the browser using SVG, which are vector graphics. This means that if a student zooms in the screen, the graph stays crisp and clear.

To add a graph using the editor:

- Click the Graph icon, subplot
- Select the equation type.
- Enter the equation.
- If you want to graph on a limited domain, specify the start/end values. Leave these blank if not needed.
- If you want to change the color, width, or style of the graph, use those options. You can also select to start and end the graph with arrows or dots; these only apply if the graph is over a limited domain.
- Click Add Graph to add the graph. If needed, you can make changes and click Replace Selected Graph.
- You can add multiple graphs if needed.
- To enlarge the graph, change the Resize options and click Update
- When done, click Insert to place the graph into your text. A low-resolution
placeholder will show in the editor, which will be replaced with a high-resolution SVG version later.

- You can edit the graph by clicking on it then clicking the Graph icon again.

The result will look like:

Graphs created this way will have automatically generated alt-text added. The auto-generated alt text is not descriptive, but simply states what the graph shows, like:

Graphs on the window x=-7.5 to 7.5 and y=-5 to 5: black graph of y=(x-2)^2-3.

Students unfamiliar with the shape of the graph could explore it using an accessible graph exploration tool like Desmos.

In Questions

When writing questions, if you need a static image (non-randomized) in your question, you can click Toggle Editor to turn on the text editor and use the process described above.

If you need randomized questions, or don’t want the formula for the equation to be exposed to students, you can use the showplot function. For example, you could enter:

\[ g = \text{showplot}("(x-2)^2-3") \]

Then you would place the variable \(g\) into the question text where you want the graph to show. See the question writing help for more details on the syntax options for showplot.

Graphs generated with showplot do not have alt-text, but when a blind student has turned on the "text alternatives" system accessibility option, the graph will be replaced with a table of values for the function, like:

Graphs with window x: -5 to 5, y: -5 to 5. Start Graph, Color black
The table of values is used to prevent the student from seeing the formula of the equation, as often times the formula is the answer to the question! Of course, a table of values is not always useful or sufficient for answering the question. If needed, you can replace the textual description with something more appropriate to the intent of the question, using the replacealttext function:

```latex
$g = showplot("(x-2)^2-3")
$g = replacealttext($g, "A U-shaped graph that decreases to the point (2,-3) then increases")
```

When writing custom alt text, think about what information about the graph is important to answering the question. Are the function values important, or just the shape? How can you describe it in a way that doesn't give away the answer?

**Other Considerations**

If you have multiple graphs and plan to refer to them, do not use color as the only way to distinguish them. For example, a matching question where you have students match equations to graphs based on the color the graph alone will be problematic for colorblind or low-vision students. To address this, you can consider adding labels to the graphs using the addlabel function:

```latex
$g = showplot("(x-2)^2-3")
$g = addlabel($g, 1, 2, "A")
```
Charts / Diagrams

Like graphs, charts and diagrams are not accessible by someone with significant vision impairment.

If the chart or diagram is added as a picture (jpg, png, gif, etc), then there are two approaches you can take:

One option is to add alt text to the image, providing a description of the diagram. Be sure your description includes any information that a student would need to be able to extract or infer from the picture. For example the diagram below might have alt text:

"Two radar dishes are shown located horizontally apart along the shore, labeled A and B. A boat is in the water, between the radar dishes horizontally and away from shore. Lines connecting the radar dishes and boat form a triangle. The angle of the triangle at radar dish A is labeled 70 degrees, and the angle at radar dish B is labeled 60 degrees".

Alternatively, you can duplicate the information from the chart or diagram in a text format elsewhere. For example, you could provide a table that duplicates the data represented in a bar graph, or provide all the relevant information for a problem in the text. In these cases, it is fine to specify in the alt text something like "a bar graph illustrating the data provided in the table following".

When writing questions, most of the chart macros in the "stats" library, like fdbargraph, histogram, and boxplot, will automatically generate a table or textual description in place of the graphical chart when the student enables the textual alternative feature in MyOpenMath. For example, shown below is an automatically generated histogram and the textual alternative.

Graphical histogram:
As another caution, when writing question avoid using the \textonimage macro. This function does not produce an accessible output, and will result in something impossible for a blind student to use, and something that may cause problems for students who enlarge the screen or are working on mobile devices.

**Drawing / Graphing**

Questions that ask students to draw a graph can cause accessibility issues for students with limited sight or limited motor skills or dexterity, such as difficulty moving the mouse precisely. To address this, MyOpenMath has an accessibility option for requesting a text-based entry alternative for drawing questions. When this mode is enabled, MyOpenMath replaces the default mouse-based graphical entry with a fully text-based entry option.

For example, in the standard mouse-based entry, a student might enter a parabola by clicking on the correct tool, clicking on the vertex, then clicking on a second point on the graph:

![Histogram for amount of sugar (mg)](image)
In the text-alternative mode, the student would choose the graph type from a list, then enter the vertex and other point in text format:

Graph to add drawings to:

Graphs with window x: -5 to 5, y: -5 to 5.

Elements to draw:

- Parabola
  Enter the vertex, then another point on the parabola
  
(0.1),(1.0)  Remove

Add new drawing element

For most two-point graphing, this alternative will work well. There are some cases where this drawing entry may be difficulty or impossible for a student to use:

- If you're using "freehand" drawing, or the older line tool to have students draw complex graphs that could not easily be described by a list of points.
- If you're having students draw lines or shapes through points on the background image where a textual alternative wouldn't have sufficient detail to identify the needed coordinates, or if the background was generated using functions that don't produce useful alt text.

**Videos**

When using videos in your course or questions, they must be captioned. Captioning is not
only essential for deaf students, but is also very useful for students trying to watch videos in noisy environments, places where they can't play the audio, and for students learning English.

When searching for questions, you can identify questions with captioned videos associated by looking for the video icon with CC in the corner. If the video does not have the CC badge, it is probably not captioned (though it's possible captions have been added since the video was originally added to the question).

When searching on YouTube for videos, check the video settings for captions. If you only see "English (auto-generated)", those are auto-generated captions, and are not considered good enough to meet accessibility requirements, especially in field like math with a lot of technical vocabulary. You want to verify there is a separate, manually created, set of captions for the video.

A great resource for finding captioned videos is mathispower4u. You will likely recognize James Sousa's videos, as they're used extensively throughout MyOpenMath.

**Making Videos**

If you create your own videos, chunk the material into short segments rather than one long video. Most people tune out around the 5 - 10 minute mark.

If possible work from a script. Using a script will make you talk clearer, slower, and keep you to the point at hand. If you take the time to write a script, not only will your video sound better, but you can load the script into YouTube, where it will automatically be synced to the audio.

If you're doing a screencast or narrating a PowerPoint, keep in mind that captions display at the bottom of the screen. Try to keep the bottom of your screen/slides clear so that you're not covering important info with the captions.

When making a video, try your best to use descriptive language and don't rely on your viewers to read the screen (read it to them). If a viewer has impaired vision then descriptive language will add more value to the video. Avoid statements like "so this and this are like terms" and instead describe what is happening (e.g. "so 3x and 5x are like terms").

If filming yourself, make sure you're in a quiet and clean/simple environment.
Adding Captions in YouTube

Once you've made your video, it's time to add captions. You can do this a variety of ways - most depend on the type of video and whether or not you used a script. The easiest way to make captions requires either money or YouTube - you pick your approach. (If you don't want to use YouTube, but don't have money, create a private YouTube channel and make sure your videos are unlisted - this will keep your videos from being made public.)

NOTE: Many people will simply rely on YouTube's machine generated captions. These are not reliable and do not protect you from an accessibility violation. While they do improve when you speak clearly and slowly, they never contain punctuation, which makes it a confusing reading experience for the viewer.

If you used a script:

If you used a script and have published your video to YouTube, creating captions will be a piece of cake.

1. Go to the Video manager, and in the edit dropdown menu next to your video, select "Subtitles and CC".
2. Select video language.
3. Select "Add new subtitles or CC" (and select the video language again).
4. Select "Transcribe and auto sync".
5. Paste your script into the box, then click "set timings". Wait a few minutes while YouTube runs its magic!
6. Once YouTube syncs the text, you'll see two sets of captions when you look in the "Subtitles and CC" section of the video editor. Click on "English (Automatic)" again. In the "Actions" dropdown menu, select "Unpublish".

If you did NOT use a script:

One option is to follow the steps above, but for step #6, you will listen to your video and transcribe it yourself before hitting "set timings" (anticipate transcription to take 3 - 5 times the length of the video).

The other option is to use YouTube's machine generated captions, then to go through and edit them (there's no evidence that this takes less time than transcribing... so, again, start with a script if you want to do this the quickest way).
1. Upload your video to YouTube.

2. Eventually, when you select "Subtitles & CC" from the edit menu, you will see "English (automatic)" next to your video -- this sometimes takes a while and may not happen at all if there is a lot of silence at the start of the video.

3. Click on "English (Automatic)" to review the machine generated captions.

4. To edit the captions, click "Edit" in the top right corner.

5. Click in the caption boxes to add punctuation (a must) and correct errors. While you type in your changes, the video will pause.

6. Once you are done, click "Publish edits" in the top right corner.

7. You will now see two sets of captions. Click on "English (Automatic)" again. In the "Actions" dropdown menu, select "Unpublish".

SBCTC Caption Hub:

The State Board has recently contracted with 3Play Media to provide captioning services at a reduced cost. Find out from your eLearning office if they have enabled the State Board's Caption Hub. If so, you may be able to submit videos for free or affordable captioning, depending on the characteristics of the video.

Audio Description

While captions go a long way in making videos accessible to people who are deaf or hard of hearing, they don't fulfill the needs of people that are blind or cannot make out the text or fine details in a video. Audio descriptions allow people with visual impairment to hear what's happening or displayed on the screen that they can't see. Audio descriptions are an additional audio file that can be played over a video.

If you're feeling overwhelmed by all of this post-production work, remember that building accessibility into the process from the start will save you lots of time (and money).

First, remember, using a script will save you tons of time when creating captions. Look over your script. See if you can add in some language that describes the screen or identifies who's talking. Avoid phrases like "over here" or "when I do this" and replace them with more descriptive language (e.g. "when I click on the grades tab in the course menu..."). Read your script and see if you can make sense of the language without visuals. If you can, maybe you don't need audio description.

If multiple people are talking in your video, ask them to identify themselves and their position/role. Again, try to represent any text that might be on the screen through audio.
This will minimize the need for additional audio descriptions and can also be beneficial for people using captions, as often times the captions may cover the portion of the screen that contains text.

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