

University of Waterloo

Photosphere Tour Guide

Department of Earth and Environmental Sciences

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Introduction

This document serves as a comprehensive guide for creating and implementing Virtual Reality (VR) into education at the post-secondary level, as well as recommendations for integrating course learning objectives in Virtual Tours. Virtual Tours are assemblies of 360° photospheres and/or panoramas that transition the viewer through a series of 360° environments, which can be static or active (depending on the hardware and software used to capture the environments and construct the Tours). Virtual Tours are an appealing medium for educators to explore due to their inherently immersive and engaging nature as well as their inexpensive entry point to create. They also offer many customisation options to accommodate a wide variety of students, instructors and intended learning outcomes. This document describes the process of creating Virtual Tours using the now discontinued free Google Tour Creator (creation) and Google Poly (viewing) websites as well as the Google Expeditions mobile app. While no longer supported by Google's software, this document offers valuable insight into the design of Virtual Tours that are pedagogically effective for student learning and the next generation of Google Tours (i.e. Google Expedition Pro). This document elaborates on the purpose of specific design choices that can be made in a Virtual Tour creation platform that help support student learning.

This Photosphere Tour Guide has been created and used by Dr. John Johnston and Henry Visneskie to create Virtual Tours for undergraduate geoscience courses in the [Department of Earth and Environmental Sciences](#) at the University of Waterloo, Waterloo, Ontario, Canada. This guide was foundational for Henry Visneskie's 2021 BSc thesis (supervised by Dr. John Johnston and Dr. Jen Parks) where he conducted a literature review of the application and benefits afforded by Virtual Reality (VR) and Virtual Field Experiences (VFEs) in education and implemented VFEs into undergraduate geoscience courses. After studying the qualitative and quantitative effects of these VFEs, Henry concluded that VFEs can be intentionally designed to effectively support students' achievements of geoscience course learning objectives and bridge knowledge gaps between the classroom and field. To learn more about Henry's thesis, please visit in [UWSpace](#). A summary video of the thesis along with a collection of short videos describing Henry and Dr Johnston's creation process can be found on the [UWaterloo Earth and Environmental Sciences YouTube channel](#).

Special thanks to Dr. Bob Lemieux and the [Dean of Science Undergraduate Teaching Initiative](#) at the University of Waterloo for funding our project titled "Using emerging technologies to enhance field, experiential and active based learning in Earth and Environmental Sciences". These funds helped hire Henry as a co-op Emerging Technologies Research Assistant and purchase simple, virtual reality

equipment to experiment with VR in geoscience classes and labs. This helped form the basis for Henry's BSc thesis, in UWSpace, referenced above. A special thank you to the many people that provided professional support and expertise for this funded project (initiating an undergraduate thesis, presented at conferences and creation of videos posted on YouTube) from the University of Waterloo's VR/AR Community of Practice, Centre for Extended Learning, Centre for Teaching Excellence and Library. Also to the Oil, Gas, and Salt Resource Library, Ontario Geological Survey and Geological Survey of Canada.

Teacher- and Self-Guiding Benefits of the Google Expeditions Kit in Geoscience Education

Google's Expeditions app allows users to view Virtual Tours – series of individual static photospheres that can be viewed in 360° from the location at which the photosphere was captured. Text and standard images can be overlain into each photosphere, in order to provide additional sequenced information and context for the viewer. More than 900 Virtual Tours have been created by other organisations and are hosted by Google within the Expeditions app. In addition, anyone can create a Virtual Tour using Google's Tour Creator, which they can then view in Poly, where users can provide public or unlisted viewing access. Not only can these Virtual Tours be viewed individually by users, teachers can also propagate the Tours to other devices on the same router in order to “guide” students or any other people, taking them sequentially through each of the photosphere scenes and overlain text and images that comprise the Tour.

Below is a list of the benefits and capabilities of the Google Expeditions app from an educator's perspective for guiding others (Six Teacher-Guided Benefits) and one's self (Two Self-Guided Benefits).

Part A: Unique Teacher-Guiding Benefits

Teacher-Guided Benefit #1 - Create new points of interest (POI) in real time (or during class)

- While the Tour guide cannot rotate the 360° photosphere or force the views of those being guided, they can see where all viewers are looking in the photosphere and call attention to specific areas of the photosphere by either activating previously created Points of Interest (POI) or creating new POIs in real time. POIs are specific markers which can be placed in the photosphere notifying all Tour viewers to turn their attention towards the selected area in the photosphere. All viewers are shown an arrow that prompts them to rotate their field of view until the selected POI is in the middle of their view. Pressing and holding on an area of the photosphere (from the guiding device) will create a new POI at that location while guiding. With each new real-time POI created, the previous real-time POI is removed. So, these one-time use

POIs can be created and placed in real time (on the spot, as the need arises) by the instructor, while guiding a Virtual Tour. This way, the Tour guide can call attention to specific areas of the photosphere while they are guiding a Tour. This contributes to student-centred teaching and just-in-time teaching (active teaching methods that can be implemented instantly or in the moment).

- As an example, consider, during a Virtual Tour, much of the class begins to focus on an area in a photosphere where the teacher did not create a POI or prepare to discuss, but was related to the learning objective. Would you ignore this or capitalise on this unique opportunity? Using many new POIs, a teacher can sequentially focus the class's attention on certain areas in the photosphere, helping student observations create pathways toward geoscience knowledge and concepts. This is beneficial because it allows teachers to take advantage of an impromptu situation they may have not otherwise considered, especially with different sets of students (i.e. multiple laboratory sections). There may be interesting or noteworthy items the instructor may not have thought of within a 360° photosphere and these things may only become apparent to the instructor because of student interest or inquiry during the guiding of a Tour. With the ability to create a POI during the guiding of the Tour, instructors can better take advantage of these situations focussing the attention of all student viewers to the new area of interest.
- Also consider these impromptu POIs as a means of clarifying or reinforcing concepts built into the Tour or pointing out additional information that may be interesting to know but not at the core of the lesson. Consider a situation where you create a POI to teach students about an unconformity or gap in time between layers of rock, but the class does not completely understand the concept. So, you then decide to create an additional POI at a different location to provide a different perspective. Instructors could also use impromptu POIs to introduce students to key information and concepts in a Tour before students self-guide. This allows the instructor to initially focus on a few important concepts but then expect students to investigate all available text and images (i.e. POIs and scene descriptions) in the Tour afterwards. Please note teachers should keep in mind that any POIs placed in real time during the guiding of a Tour are temporary and will disappear when the teacher-guided Tour ends.

Teacher-Guided Benefit #2 - Draw in real time (or during class)

- The artistic expression of the drawing tool is limited to a single colour and thickness; however, it allows the Tour guide to draw on the 360° photosphere. Unlike the real-time POIs, viewers are

not directed toward the newly drawn feature using an arrow in the student view. Therefore, in-real-time POIs should be created to direct students toward drawings. As with POIs, drawn images and features remain in 360° space and avoid distortion as users change their perspective. The drawing tool can be used to create letters, numbers, words, or simple diagrams, such as an arrow showing Younging direction or strike/dip of a bed. The drawing tool can also be easily toggled on and off by a teacher guiding a Tour. This can contribute to student-centred teaching and just-in-time teaching (in much the same way as creating POIs during class) as well as helping to decrease clutter from added too much text and images in photospheres in pre-built Tour. Teachers, please note that any drawing that is not reset (removed by selecting reset) in a Scene remains in the same place of each Scene until the Tour is finished. And any drawings placed in real time during the guiding of a Tour are temporary and will disappear when the teacher-guided Tour ends.

- Imagine guiding a Virtual Tour and wanting to highlight a specific feature within the photosphere, such as the orientation of bedding or contacts. Perhaps you wish to draw attention to the boundary of a bed that is difficult to discern from the rest of the photosphere. A regular POI marker can draw attention to an area of the photosphere, but the Draw tool provides the ability to directly trace or draw the shape of important, often irregular features. For example, an instructor could draw attention to an age relationship or old to young rock layers using an arrow or younging symbol. Or the drawing tool could be used to trace meander scars preserved in the landscape that relates to a river meandering through time that led to the development of an oxbow lake. Or an instructor may want to draw a certain fossil found in a rock layer. Or draw the orientation of cross-bedding in sandstone or sand dunes.

Teacher-Guided Benefit #3 - Create POI text only visible to the teacher

- When guiding a Tour for others (teacher-guiding), only the Tour guide (the teacher) has access to the text of the POIs created in advance. Students see an arrow directing them toward the POI and the POI symbol but not the text previously created for a specific POI. Tour guides can read the text to students, choose to paraphrase, or use the text as a prompt for ideas or concepts. Each POI added to a photosphere Scene during the creation of a Virtual Tour can include up to 300 characters of text. Instructors please note that text within POIs is available to students if they self-guide (view a Virtual Tour on their own) so please be cognisant, when publishing Virtual Tours, selecting public or unlisted viewing access. If the Virtual Tour is public any student

can find the tour and self-guide. If the Tour is published privately (unlisted), it can only be distributed through a link for teaching guiding and not found by students using Poly's search function.

- For example, a teacher can read a few sentences of the POI text to introduce the Scene and a few facts about the POI and then transition into questions. Answers may be included in the POI text but are only visible to the teacher and not students. By adding text to POIs beforehand instructors can better scaffold specific learning outcomes that they have previously planned but also have the flexibility to incorporate chosen concepts or questions in class. Full sentences, bullet points or even questions can be added to POI's and help instructors when they are teacher-guiding Tours.

Teacher-Guided Benefit #4 - Pause and resume Tour

- When a Tour is being guided by a teacher, the teacher can pause the Tour from their guiding device. This displays a pause message and black screen on all devices being guided. This is an effective way to capture the attention of the students to potentially discuss a misconception, show an experiment or model, or prepare students for the next Scene. It is also an effective way of preventing potential mental and visual fatigue, which may be experienced by some viewers. Being able to pause Virtual Tours allows for the integration of a blended learning approach in classes and labs. We believe that Virtual Tours and associated technology should not be the focus, but rather a complimentary part of a well-thought-out teaching strategy.
- Consider, when guiding a Tour complementary to a lecture, lab or discussion, the benefit of intermittent breaks throughout the Tour. You may create or find a Tour that contains Scenes with concepts that benefit from immersion or an assemblage of ideas and concepts in 360-degree space. With the Pause and Resume feature, not only can you choose points in the Tour that can be most enhanced by additional lecture or discussion content, but you can also ensure students aren't distracted by an in-progress Tour. Pausing and resuming Tours is done from the guiding device (the teacher's tablet) by simply selecting the option on-screen. As soon as the option is selected, all other viewers connected to the Tour will display a black screen and a "paused" message.

Teacher-Guided Benefit #5 - Guide a Tour with a router anywhere in the world

- The Google Expeditions Kit contains many VR viewers (headsets with phones) for students (10, 20, 30), a teacher tablet for guiding Tours, and a router. When provided power, the router can

connect the guiding device (the teacher tablet) to any android or iOS device connected to the router (including each of the phones from the Google Expeditions Kit). This allows the Tour guide (the teacher) to propagate a Tour to everyone on the private network provided by the router. Guiding a Tour does not require an internet connection, only that the guiding device used by the teacher has the Tour already downloaded and the teacher and student devices are connected to the same router. Please note that whether guiding others or self-guiding, the guide must download the Tour while connected to the internet to guide or view a Tour. Once the Tour is downloaded to a device, the Tour can be guided with the Google Expedition Kit mobile router (or viewed by any one person from that device to which the Tour was downloaded) anywhere in the world. This is especially useful for providing virtual experiences complementary to learning exercises while immersed in nature. Alternatively, connecting the router to the internet using an ethernet cable can be useful to allow students to search and view many different Tours individually and guide Tours with fellow classmates.

- Consider taking students to the field to view a particular example of a structural feature, sedimentary relationship, or fossil. A teacher could contextualize the field site by providing Tours. For example, consider a teacher uses a Tour to understand the modern analogue of ancient rock layers. Immersing students in a photosphere depicting the “Age of the dinosaurs” or the depositional environment like a meandering river and floodplain would help students before, during and after field studies. With the Google Expeditions Kit, educators can bring Virtual Tours wherever they take their students, which allows educators to help students make connections in space and time.

Teacher-Guided Benefit #6 - Many already existing tours

- Anyone can guide Tours that they created themselves or Tours that have already been created by other people. Google’s Expeditions app hosts almost 1000 professionally made Tours, all curated by Google. The master list of Tours can be found at <https://docs.google.com/spreadsheets/d/1uwWvAzAiQDUEKXkxvqF6rS84oae2AU7eD8bhxzJ9SdY/edit#gid=0> or by clicking [here](#). Simply find the name of a Tour you’re interested in, and search for that Tour’s name in the Expeditions app. Having access to already-created Tours saves time, not having to create them yourself. On the other hand, being able to create and guide your own Tours allows for a degree of personalisation and detail or approach not present in already-created Tours, but at the cost of much more time.

- There may be times when you wish to support course content using a Virtual Tour. For relatively simple, introductory, and/or general content, it may be easier to use already created Tours, which more frequently explore introductory/more general concepts. This can save instructors time. For supporting more specific, complex, and/or upper-year level courses, it may be challenging to find appropriate pre-made Tours, so instructors may find it more conducive to create their own Tours.

Part B: Unique Self-Guiding Benefits

Self-Guided Benefit #1 - Support Student-Centred Learning

- Viewing Tours individually allows the user (student) to navigate each POI, image, and scene at their preferred pace. Students can determine how long they need to spend on each scene to understand a certain concept, without feeling rushed or that they missed key information if the Tour is teacher-guided. Self-guiding Tours allows users not only see the text within POIs but also go back and forth between Scenes, POIs, and images. This supports many types of students that can progress at their own pace and take time to process information and concepts. For example, a student can return to a Scene showing the modern coastline and its sediment distribution to better understand ancient coastal deposits preserved in layers of rock shown in a subsequent Scene.
- Having the ability to self-guide a Tour means the Tour has been downloaded onto the viewer's device, allowing students to view and review the Tour whenever they'd like to, without needing an internet connection and viewing this Tour anywhere in the world. This promotes accessibility of the Tour content wherever the student would have a mobile device or computer. Please note that a Tour downloaded from the Expeditions app will only remain on the device for 30 days and the title of the Tour should be catalogued so that you can find the Tour in the future. So, self-guided Tours can be accessed and reviewed by students on the bus, on a field course, after class and in any location students have an iOS, Android, or Windows device.

Creating a Virtual Tour

Using a computer, navigate to <https://arvr.google.com/tourcreator/> or search for "Google Tour Creator". Get started and select the "+ New Tour" button. You'll be brought to the title card of your new Tour. This will create a Tour linked to whichever Google Account is signed in. Selecting the "Create" option, at the bottom right will prompt you to add your first Scene from Google Street View (you may

also upload your own 360° or 180° images by selecting the Upload tab). Search for a location see if there are any photospheres of it, by dragging the tiny Pegman around the area. Below is a list of some of the different components involved in Virtual Tours with some tips about how to get the most out of each one.

Title card: The information you include on the title card will appear underneath your Tour once selected on poly.google.com.

- When creating the scenes of your Tour, click your Tour title in the top left corner to return to the Title card.
- The description has a character limit of 2500 and should summarise the information in each of your Scenes.

Scenes: These are the backgrounds of your Tour and can be 360° photospheres from Google Street View or your own pictures (either 180° or 360° images).

- Whether you select the Street View or Upload option, try to use pictures that are informative and captivating to ensure your Scene keeps viewers immersed, whilst still being relevant to your overall message.
- If you choose to upload your own 180° image, it will be wrapped around your field of vision as if you're viewing it from within a cylinder.
- Consider using between 3 – 5 Scenes per Tour, in order to give viewers enough context on your topic, while not being extraneous. This is just a recommendation, so feel free to use your discretion.
- You can also add sound to each scene by selecting the ambient audio or scene narration icon below the credits section. Up to the first 30 minutes of the sound file will play.

Points of Interest (POIs): When selected by viewers, their attention will be drawn to the location in your Scene where you placed the POI.

- Each POI has a character limit of 300, so when explaining the point of interest, it's important to use simple, but informative language.
- Consider adding a .png, .jpg, or .jpeg file to your POI by selecting the "Add image overlay" option. When viewers select and are directed to that POI, the picture you've included will pop

up. This can be a great way to contextualise geographical location or other important visual information that can't be seen in the 360° photospheres.

- Think about using between 3 – 5 POIs per Scene in order to be detailed, but not unnecessarily so. The number of POIs you have may be more flexible, depending on the content and message of the Scene.
- Be sure to make use of the entire photosphere when placing POIs – they don't all have to be within the same field of view. A 360° image offers much more content than a regular picture and you can use this to immerse viewers more than you would be able to otherwise!

References: When using information from an outside source, it's important to provide credit to that source and avenue to seek more information.

- Google Tour Creator will just list all credits from each Scene as one long credit when previewing your Tour. Instead of using the Credits section in each Scene, consider adding your credits manually to the end of the overall Tour description, as you're able to organise them.
- You can also include an extra Scene and/or POI that contains an image of your references list.

How to Create Panoramic Backgrounds for Google Tour Creator Scenes

Below, you'll find instructions for creating panoramic backgrounds, which can be used as an alternative to 360° photospheres when creating Scenes with Google's Tour Creator. Panoramas (or 180° images) differ from 360° photospheres because of the way they're viewed. 360° photospheres are still pictures that are viewed in all directions as if rotating your perspective around the centre of a sphere. 180° images are panoramic images that are viewed as a continuous strip, as if rotating your perspective around the centre of a cylinder (the walls of the cylinder are the panoramic image and the top and bottom faces of the cylinder remain blank with a solid black background).

Instructions for Creating Panoramas

1. **Open your image editing software of choice.** You can use something as complex as Adobe Photoshop or something as simple as Microsoft PowerPoint, as long as you'll be able to save your panorama as a .png, .jpg or .jpeg file. These are the only image file types you can upload with Tour Creator.
2. **Create your panoramic background.** Consider making a background that is approximately 5 to 6 times as wide as it is tall (the larger dimensions you use, the better quality your background will be). For example, in PowerPoint, your slide size might be 100 cm by 20 cm. This will create a

blank white background of the dimensions you've selected. In an image editing software, it might be 3000 px by 600 px. When panoramic backgrounds are added as a Scene within your Virtual Tour, your two-dimensional panorama will be wrapped around you in 360° as if you're viewing it from the centre of a cylinder, rotating about a fixed location. Therefore, it's recommended you use a wider background, to accommodate for this effect. Now that you have the background of your panorama, you may want to add many individual images on top of the background.

3. **Locate and save some individual images you'd like to include on the background of your panorama.** These individual images will be layered overtop of the background you've already created after you've finished moving the individual images to a desired location on the background. First however, you need to find some images, of the highest quality you're able to, especially if you're using images with text on them (using images with text is optional, as you're able to add text directly over top of the panorama background in the image editing software).
4. **Import your individual images onto your panoramic background.** At this point, you should have the background of your panorama and your high-quality individual images ready to import. You can either import images from your computer or copy and paste high-quality images from the internet, and they will appear layered over your panorama background. You can then move the individual images around and resize them. In PowerPoint, this may be as simple as using the insert function and selecting the images you've saved from their folder. In a more complex image editor, this may involve importing or opening each image as a separate layer.
5. **Arrange your individual images on the panoramic background.** Keep in mind that the right edge of your panoramic background will connect seamlessly with the left edge of your panoramic background, so arrange your images accordingly. You can also add arrows, lines, or other symbols to denote the sequence or connection of the images you've layered over your background. Avoid adding explanatory text to the panorama background or to your imported images – this can be done when creating your Virtual Tour. When creating Scenes for your Virtual Tour, Tour Creator will allow you to place POIs (points of interest) over any part of the image (in this case, your panorama) that you use as the Scene background. You can add up to 300 characters of text to each POI, which will appear when that POI is selected during the viewing or guiding of your Virtual Tour. This avoids the need for extraneous amounts of text added to your panorama.

6. **Export your panoramic background with individual images on top.** In the image editing software of your choice (i.e. PowerPoint or Adobe Photoshop), save your image as a .png, .jpg, or .jpeg file. These are the only files that can be uploaded to create backgrounds for Scenes in Tours Creator.

Congratulations! You've created a simple panoramic background. When adding a new Scene to your Virtual Tour in Tour Creator, select the Upload tab, where you'll be able to upload your panoramic 180° image as the background of the Scene. This background will be wrapped around your view in 360° in the shape of a cylinder.

Additional Tips:

- **Choose .png images when layering images on your blank panoramic background.** You'll notice that some objects or diagrams have an unwanted solid or patterned background when you import them over your panoramic background. By finding or converting to .png images of objects or diagrams, the images you import and layer on top of your blank background won't have backgrounds themselves.
- **Remove the backgrounds of non .png images you import.** When importing images to layer over your plain panoramic background, any image that isn't a .png file will have its own background. Imagine you'd like to import a picture of a rock, but the rock picture has a solid black image background, which will contrast with your plain white panoramic background. By using an image editing program (such as Adobe Photoshop or GIMP), you can remove the black background around the rock using the Colour Select and Cut tools. You can then export the rock image from your image editing software and import it as a layer over your plain panoramic background as a .png, and it will have a transparent background instead of a solid colour background.
- **Adjust your panorama, based on how it looks in your Scene.** Achieving a desirable appearance for your newly created Scene is an iterative approach that requires uploading a background multiple times after small edits have been completed. Once you've uploaded your panorama as a Scene to your Virtual Tour, you may notice some formatting inconsistencies; your panorama may be distorted, your images/text may be sized incorrectly, etc. If you're dissatisfied with components of your panorama, it's important to revise these components (in whichever software you used to create the panorama), and re-upload it. When it comes to the size of the individual images layered over your panorama, consider making them roughly 20-25 percent as

tall as the panoramic background itself. Consider also using text between size 10 and 20 if you add text to your panorama.

- **Change the background colour of your panorama.** In step 2, you created a plain white panoramic background for displaying images. You may wish however, to change the colour of this background, to better suit the pictures you import and overlay onto it or the overall theme of your Tour. In PowerPoint, you can do this by selecting the Design tab and clicking the Format Background option. This will allow you to change the Solid fill colour of your blank background. You're also able to use pictures or patterns as the background of your panorama. Simply import an image of whatever picture or pattern you'd like to use, manually adjust it to the size of your background, right click it, and select the Send to Back option. This will ensure it remains underneath any smaller images you're overlaying onto the background. Keep in mind that the left side and the right side of your panoramic background will be seamlessly connected in your Virtual Tour and using pictures or patterns that aren't continuous will result in a distracting seam line. If you choose to make your panoramic background a picture or pattern, consider using something simple, to avoid being distraction those viewing your Tour.
- **Improve your editing skills.** If you aren't familiar with image editing, it can be advantageous to learn at least one software package. GIMP is one program that is a good free alternative to Adobe Photoshop. Some other free alternatives include Paint.net, Photoshop Express, and Pixlr.

Reviewing a Virtual Tour

An effective way to review and revise Virtual Tour text and information is by compiling that text and information in a template. Feel free to use the template below, which also contains areas to create Intended Learning Outcomes (ILOs) for each of your Scenes. ILO's should communicate what the viewer should be able to **know, do, and value** by the end of each Scene, and for your overall Tour. Be sure to check that each of your Scenes ILO's contribute to the overall ILO of your Tour. You can revise and edit (or update) your Tour at any time by going to <https://arvr.google.com/tourcreator/> and signing into the Google account you used to create the Virtual Tour.

Below is a checklist containing a brief summary of all the components that should be included in a Virtual Tour. Use this list to quickly ensure the Virtual Tour you're reviewing is complete. For more specific information about what to include within each component, please see the Creation Guide, in the Creation section above.

A Tour title, description, and cover photo relevant to the information within the Tour	
An appropriate number of titled Scenes that contribute to the overall message of the Tour	
A description for each Scene that contextualises the importance of the respective Scene	
An appropriate number of titled POIs within each Scene	
Descriptions for each POI that contextualise their relevance to the message of their Scene	
At least 1 Scene highlighting the location of the Virtual Tour in reference to UW	
2D image overlays contribute positively to, and make sense within, their Scenes respectively	
Correct spelling, grammar, and accurate information are used	
Information taken from other sources is referenced correctly, both in-text and in full	

Virtual Tour Content Review Template

While creating your Virtual Tour, be sure to complete this template, replacing the information highlighted in yellow for each section that corresponds to the information in your Virtual Tour. You may be inclined to complete this template first, and then add the information to your Virtual Tour, or vice versa. Reviewers should track all changes and add comments so that the author can review each suggested edit and either accept or decline these. Different perspectives can really help improve Tours bringing seemingly disparate ideas together (with limited characters) into a holistic Virtual Tour that benefits students.

This template is accessory to reviewing a Virtual Tour. Due to the many visual components of Virtual Tours (which can be difficult to include in this template), Tours should be viewed with their accompanying completed template during the self- or peer-review process.

Tour name: *Include the name of your Tour*

Tour Link: [*Include a link to your Tour on Poly.Google.com*](#)

Authors: *List the authors of your Tour*

Tour Learning Outcome: *Create a Learning Outcome for your Virtual Tour*

When creating a Learning Outcome for your Tour, consider the sum of information you'd like viewers to ascertain from your entire Tour. Consider creating Learning Outcomes for each of your Scenes first, from which you can create an overall Tour Learning Outcome. What are the most important things that viewers should learn from each Scene? What is the purpose (or Learning Outcome) of each Scene?

Tour Description: *include your Scene 1 description here*

x/2500 characters

SCENE 1: *Scene Name*

Scene 1 Learning Outcome: *Create a Learning Outcome for this Scene*

Scene 1 Description: *include your Scene 1 description here*

x/500 characters

Scene 1 Co-ordinates: *Include the co-ordinates of the location at which your photosphere was taken. To find these co-ordinates, when editing your Tour, select the photosphere preview on the right, above your Scene name. Click “change” and, in the Street View tab, select “View on Google Maps”. You’ll be directed to your photosphere’s location in Google Maps. To see exactly where your photosphere was taken, select the yellow pegman in the bottom right corner of the screen. This will show you all of the 360° pictures that exist in the area. Right click on the location of your photosphere, and select “What’s Here?” This will reveal the Decimal Degrees co-ordinates of your photosphere. Clicking on these will reveal the DMS co-ordinates (which will be indicated by N or S and E or W directions). Replace this text with the DMS co-ordinates of the 360° photosphere location in your 1st Scene.*

POI 1 Description - *Include the name of your 1st point of interest*: *include POI text*

x/300 Characters

POI 2 Description - *Include the name of your 2nd point of interest*: *include POI text*

x/300 Characters

POI 3 Description - *Include the name of your 3rd point of interest*: *include POI text*

x/300 Characters

POI 4 Description - *Include the name of your 4th point of interest*: *include POI text*

x/300 Characters

POI 5 Description - *Include the name of your 5th point of interest*: *include POI text*

x/300 Characters

SCENE 2: *Scene Name*

Scene 2 Learning Outcome: *Create a Learning Outcome for this Scene*

Scene 2 Description: *include your Scene 2 description here*

x/500 characters

Scene 2 Co-ordinates: * Replace this text with the DMS co-ordinates of the 360° photosphere location in your 2nd Scene.*

POI 1 Description - *Include the name of your 1st point of interest*: *include POI text*

x/300 Characters

POI 2 Description - *Include the name of your 2nd point of interest*: *include POI text*

x/300 Characters

POI 3 Description - *Include the name of your 3rd point of interest*: *include POI text*

x/300 Characters

POI 4 Description - *Include the name of your 4th point of interest*: *include POI text*

x/300 Characters

POI 5 Description - *Include the name of your 5th point of interest*: *include POI text*

x/300 Characters

SCENE 3: *Scene Name*

Scene 3 Learning Outcome: *Create a Learning Outcome for this Scene*

Scene 3 Description: *include your Scene 3 description here*

x/500 characters

Scene 3 Co-ordinates: * Replace this text with the DMS co-ordinates of the 360° photosphere location in your 3rd Scene.*

POI 1 Description - *Include the name of your 1st point of interest*: *include POI text*

x/300 Characters

POI 2 Description - *Include the name of your 2nd point of interest*: *include POI text*

x/300 Characters

POI 3 Description - *Include the name of your 3rd point of interest*: *include POI text*

x/300 Characters

POI 4 Description - *Include the name of your 4th point of interest*: *include POI text*

x/300 Characters

POI 5 Description - *Include the name of your 5th point of interest*: *include POI text*

x/300 Characters

SCENE 4: *Scene Name*

Scene 4 Learning Outcome: *Create a Learning Outcome for this Scene*

Scene 4 Description: *include your Scene 4 description here*

x/500 characters

Scene 4 Co-ordinates: * Replace this text with the DMS co-ordinates of the 360° photosphere location in your 4th Scene.*

POI 1 Description - *Include the name of your 1st point of interest*: *include POI text*

x/300 Characters

POI 2 Description - *Include the name of your 2nd point of interest*: *include POI text*

x/300 Characters

POI 3 Description - *Include the name of your 3rd point of interest*: *include POI text*

x/300 Characters

POI 4 Description - *Include the name of your 4th point of interest*: *include POI text*

x/300 Characters

POI 5 Description - *Include the name of your 5th point of interest*: *include POI text*

x/300 Characters

SCENE 5: *Scene Name*

Scene 5 Learning Outcome: *Create a Learning Outcome for this Scene*

Scene 5 Description: *include your Scene 5 description here*

x/500 characters

Scene 5 Co-ordinates: * Replace this text with the DMS co-ordinates of the 360° photosphere location in your 5th Scene.*

POI 1 Description - *Include the name of your 1st point of interest*: *include POI text*

x/300 Characters

POI 2 Description - *Include the name of your 2nd point of interest*: *include POI text*

x/300 Characters

POI 3 Description - *Include the name of your 3rd point of interest*: *include POI text*

x/300 Characters

POI 4 Description - *Include the name of your 4th point of interest*: *include POI text*

x/300 Characters

POI 5 Description - *Include the name of your 5th point of interest*: *include POI text*

x/300 Characters

Effects and Applications of the Photosphere Tour Guide

While this document features Virtual Tour software that is no longer supported, the creation of the document has provided the basis for other more transferable work. At its core, the Photosphere Tour Guide does three things: provides context to the educational use of Virtual Tours, describes the specific educational benefits that can be achieved using Google's Virtual Tour software, and instructs readers on how they can easily and freely get started creating Virtual Tours. This document was inspired by the creation and presentation of a poster titled *Learning about Ontario's Paleozoic geology with virtual reality Google Expedition Tours* at the Regional-scale groundwater geoscience in southern Ontario in early 2020. The poster can be found [here](#).

These principles were used initially to create some Virtual Tours during the spring term of 2020, one of which was implemented in the fall 2020 academic term. This was done as part of an 8-month student co-op term, the results of which were presented at the virtual GeoConvention 2020, in a summary video that can be found [here](#). One Virtual Tour was implemented as an assignment for students in an undergraduate geoscience course, Earth 121, along with a quiz. This first-time implementation of a Virtual Tour provided an opportunity to determine how effective Virtual Tours can be for facilitating student learning. This was done as part of an undergraduate thesis, which concluded that Virtual Tours could be used to have students develop critical geoscience knowledge. To read the thesis in full and view a poster summarising the thesis, please visit <https://uwspace.uwaterloo.ca/handle/10012/17065>.

A video summary of the poster can also be found here:

<https://www.youtube.com/watch?v=uZt2qWHOH1w>.

This document was also instrumental in improving the assignment of another course, Earth 235. Prior to the creation of this Photosphere Tour Guide in the fall term of 2019, Earth 235 students were responsible for using Google Tour Creator to create their own Virtual Tours. This assignment was adjusted in the fall term of 2020 to include a peer review component, designed with the principles of this document in mind, such as the checklist for reviewing a Virtual Tour and the Virtual Tour Content Review Template. The peer review instructions provided to students were as follows:

- Each student will review VR Tours created by fellow Earth 235 students
- Reviewers are assigned: 3 submissions each (anonymous reviewers)
- Reviews involve examining VR Tours and associated Word Documents

- Reviewers must edit the file name of the Word documents (adding their initials of their name at the beginning of the file name)
- Reviewer Grade of Draft Submission: (Complete grading form called "Student Review of Draft Submission" in PEAR). In other words, the Reviewer must evaluate the "Draft Submissions" using the rubric called "Student Review of Draft Submission" in PEAR.
- Reviewer Suggestions for Draft Submission: (Submit required file - "Peer Review of Tour" in Microsoft Word 2007+ file, that includes tracked changes in PEAR). In other words, the Reviewers must track changes in each Word document to keep edits and comments visible for the author to see both the original text and added reviewer edits/comments (helping to improve VR Tours).

Based on this adjustment to the 2019 version of the assignment, students in the fall 2020 term created Virtual Tours that were more informative and better structured, by utilising both the Virtual Tour Content Review Template and by giving and receiving feedback to and from their peers. This resulted in students completing the assignment in ways that more closely aligned with intended learning outcomes.

The Photosphere Tour Guide has also provided a foundation for a contract research assistant position which, due to the discontinuation of Google's Tour Creator software, necessitated the discovery of a new software which could facilitate similar learning outcomes. Further research was conducted regarding the use of Google Tour Creator, focussing specifically on how its many features contributed to student learning. It was important to determine why Google Tour Creator was so effective for creating Virtual Field Experiences in order to determine how to find a replacement. Google Tour Creator was concluded to be effective due to its support of the following five factors:

1. The sense of immersion able to be created within Virtual Tours
2. The engagement, structure, and exploration afforded by Virtual Tours
3. Virtual Tours can be simple to create, free, and pedagogically effective
4. Virtual Tours can help students prepare to conduct upcoming field work more efficiently
5. Locations all around the world can be included in Virtual Tours, regardless of their physical accessibility

For a more in-depth understanding of how Google Tour Creator contributes to each of these factors as well as the reasons these factors are beneficial for student learning, videos summarising each of these

factors can be found here:

<https://www.youtube.com/playlist?list=PLI3cne3hDjm5aH99grHaEo3wPffO0gDgo>.

While the Google software-specific instructions of this document can no longer be used to create Virtual Tours, the Photosphere Tour Guide has provided a crucial foundation for the exploration and implementation of Virtual Tours in the Department of Earth and Environmental Sciences at the University of Waterloo. This document has been used to modify/create undergraduate geoscience course content, scaffold BSc thesis findings on the effectiveness of Virtual Field Experiences in undergraduate geoscience education, and support the discovery of new, effective Virtual Tour platforms.