

The Giant Arch

Exhibit Content Focus:

This exhibit focuses on how to build an arch, a self supporting structure. Arches are most often used in architecture and bridge building. The wedge shaped pieces on either side of the center piece are called voussoirs, while the center piece is called the keystone. Each voussoir must be precisely cut so that it presses firmly against the surface of neighboring blocks and conducts loads uniformly. When designed correctly, an arch is already the right shape needed to support the entire load above with compression forces only.

The application of a compression force to an object causes it to become squashed or compacted. By using the arch configuration, significant spans can be achieved. This is because all the compressive forces hold it together in a state of equilibrium. An arch can also carry a much greater load than a horizontal beam can support. This carrying capacity stems from the fact that pressure downward on an arch has the effect of forcing the voussoirs together instead of apart. Some solid materials like stone and ceramics are able to withstand very large compressive forces with very little measurable deformation which make them a suitable building material for the construction of high walls and columns. The steepness of the arch is called curvature. The curvature of an arch determines the angle at which the arch's ends hit the ground.

To construct an arch shorter than head height, a frame is needed to follow the form of the underside of the arch. For arches taller than head height, scaffolding is needed to hold the parts in place until the arch is fully constructed. Due to poor planning or construction techniques, an arch can fall once the frame or scaffolding is removed. Modern arches of steel, concrete, or laminated wood are highly rigid and lightweight, so that the horizontal thrust against the supports is small; this thrust can be further reduced by stretching a tie between the ends of the arch.

Related Apps:

- **Name: Giant Timer**

- Icon:






- Description: A very large stopwatch and timer
 - Relation to Exhibit Content: This app is a great way to give a challenge to a group of visitors. Using the Giant Timer, time a group to see how long it takes them to put the giant arch together correctly. Once they have done it once, ask them how they might be able to do it faster? Discuss if they had any struggles with the process and then let them try again. If it is a large group, time the group as a whole, and then each time, take away one person to see how if they can build it as fast as the group. Or make it into a friendly competition and have pairs of visitors compete against each other to see who can complete the arch in the fastest time.
 - Helpful Hints: Make sure you are using the stopwatch mode.

- **Name: Camera**



- Icon:



The Giant Arch

- Description: The camera app can be used two ways: both still photos and video. A switch at the lower left of the screen toggles the function.
- Relation to Exhibit Content: First you can take still photos to capture a completed arch, one that has been done the correct way, or one that visitors tried to assemble an alternate way. Second, you can record visitors putting the arch together, then allow them to watch the video to see where they struggled, or just to see and discuss their process.
- Helpful Hints: When using video, check the camera roll and delete any old photos and videos from the iPad. Video utilizes a lot of hard drive space. The camera will exit if you are approaching the limit on the iPad.
- **Name: iMotion HD**
 - Icon: 
 - Description: iMotion HD can be used for two types of photography: stop motion animation and time lapse photography. After selecting New Movie, you can choose time lapse or manual (stop motion). Time lapse takes photos at intervals from .5 seconds to once per day. Manual allows you to take photos at any interval you choose. Example: as each block is placed into the arch.
 - Relation to Exhibit Content: You can document the building process using either function, but manual (stop motion) allows for the most flexibility when recording the group. Take pictures as the group builds the arch, one block at a time or at an interval of your choosing. When the build is complete you can watch the “video” to see where they struggled and also to discuss the building process.
- **Name: Bridges**
 - Icon: 
 - Description: This app shows a variety of different bridge designs, including arch bridges.
 - Relation to Exhibit Content: Arches are one of the first designs used to create load bearing bridges. The two arch examples in the app are the Jadukata Bridge, and the Ponte Vecchio Bridge. Select either one to show visitors to see if they can find the arch used in the bridge design.
 - Helpful Hints: The bridges are listed alphabetically. However if you select a bridge you want to come back to, select the star to save it in the favorites list.
- **Name: GoodReader**
 - Icon: 
 - Description: This app allows you to access many types of documents through the iPad. Word, Excel, PowerPoint, etc.

The Giant Arch

- Relation to Exhibit Content: Through GoodReader you can upload and access any files you want. We have Giant Arch QTC (questions to consider) and Giant Arch Challenges.
- Helpful Hints: GoodReader allows you to create folders. Creating folders for specific components or galleries allows you to find what you are looking for much more quickly.
- **Name: Simplepedia**
 - Icon: 
 - Description: This app is a link to all articles on Wikipedia. Search for Arch or Catenary to read more about forces on an arch, construction of an arch and also to see pictures of various types of arches and arch construction processes.
 - Relation to Exhibit Content: This allows you find more content about arches and use the pictures with visitors.
 - Helpful Hints: Tap the Offline Articles button to see if Arch and Catenary have been searched before. If they appear in the offline articles touch the term and it will load more quickly than typing in the words in the search box.
- **Name: Videos**
 - Icon: 
 - Description: This app is a repository for all of the videos that have been placed on the iPad. Tap on the app icon to see a series of thumbnail images for each of the videos. The Building Zone-Forces on Bridges video will show a short Wowie about the forces on an arch. If you do not have access to the video on your iPad, you can find it at: <http://www.cmhoustonblog.org/2010/02/10/arch-engineering/> or <http://youtu.be/W38N5ehhBYg>
 - Relation to Exhibit Content: This video focuses on how compression and tension keep the arch from the falling down.
 - Helpful Hints: Watch the video a few times before going out on the floor. It is hard to hear sound coming from the iPad, so you will want to explain to visitors what is happening in the video. Come up with your own script to give details about the arch and why it can stand without other support.

Questions and Challenges for the Giant Arch:

(Can also be found in GoodReader if uploaded to iPad)

Example Questions to Consider: Giant Arch

1. What happens if you change the order of the pieces?
2. What happens if you reduce the total number of pieces?
3. What happens if you change the starting point for one or both of the arch legs?

Example Challenges: Giant Arch

The Giant Arch

1. What is the fewest number of people you can use to successfully build the arch?
2. What is the fastest time your team can build the arch?
3. Can you successfully build the arch without the keystone? How?

Additional Information/Resources:

- There are several photos located on the iPad to illustrate different aspects of arches. There are diagrams of the different parts, arches used in bridges, aqueducts and free-standing arches: such as the Gateway Arch. The construction process of two modern arches can also be found – Hoover Dam By-Pass and Dallas Cowboys Stadium.