

3.3 GATES OF HORUS

Gates of Horus is an educational game based on a Virtual Egyptian Temple (Jacobson, 2005e, 2004a), which provides both the content and the structure for our learning experiments. The temple has no real-world analog, although it is constructed mostly from elements of the Temples of Horus at Edfu (Arnold, 1999) and at Medinet Habu (Chicago, 1930). Its purpose is to embody the key features of the typical New Kingdom period Egyptian temple in a way that an untrained audience can handle. The temple consists of four major areas, the exterior (Pylon), the Courtyard, the Hypostyle Hall, and the inner Sanctuary, arranged in that order and separated by gateways.

Compared to a real temple, the virtual Egyptian Temple model is simple, having only enough detail to represent the key features required (Figure 19). For example, there is only one of each of the four types of areas, while an actual temple might have had several Courtyards and Hypostyle Halls. Similarly, the hieroglyphics are larger than they would be in an actual temple to make them more legible. There is a copy of the high priest in each of the major areas, functioning as a pedagogical agent. In this way, it is similar to the Virtual Notre Dame Cathedral (DeLeon 1999). Nevertheless, the scale and proportions of the spaces are correct, hieroglyphics make the appropriate statements, murals and statuary are in their proper locations, and so on.



Figure 19. Temple of Horus and the high priest

In the game, the student-priest is navigating a view through which the screen is made to look like a window onto the virtual world. The student is able to use the cursor to click on individual features of the Temple, which prompts the priest in that particular area to explain that feature's meaning. To progress forward, the student must answer all of the priest's questions. The questions are based entirely on what the priest has to say about that area's activities. After answering these questions, the Gateway to the next area of the Temple opens which the student explores and learns about in the same way. The student wins the game when s/he answers all of the questions from the priest in the inner Sanctuary. Metaphorically, this makes the divine image of the God speak, and bring the blessings of heaven to the land of Egypt.

Gates of Horus uses CaveUT logging functions to record everything that happens in the game. We make use of this in our experiments (section 6.2, p200).

3.3.1 Interface

Gates of Horus is based on the two freeware packages, CaveUT and VRGL (Jacobson, 2005) and a commercial game, UT2004 (EpicGames, 2004). The student navigates and interacts using a mouse. In our experiments, students used a special type of cordless mouse, the Gyromouse (Figure 20, below) as a reasonably effective device for navigation and selection (Duncan, 2006; Herpers, 2005; Olwal, 2002; Patel, 2001; Hafner, 2000; Winograd, 2000). All of the test subjects played *Gates of Horus* using the Gyromouse, regardless of whether they were using a desktop computer or the immersive display.



Figure 20. The Gyromouse

To the operating system, the Gyromouse appears as a standard two-button-with-wheel mouse, but in practice it is somewhat difficult to use. By holding a trigger on the underside of the mouse, one could activate the ability to turn, which is then done by moving the mouse in the direction the student want to turn or look. The student can also move forwards and backwards by pressing the left and right mouse buttons. Finally, to exit navigation mode and to go into cursor mode the student presses the mouse wheel.

In cursor mode, the student can select an object by moving the cursor over the composite screen like a very large image map on a flat web page. However, the targeting is three-dimensional, allowing the student to select the same object from many directions. For example, Figure 21, below, shows a hawk statue in front of the temple with the targeting cursor over it. The cursor also indicates when it is over an active object by turning green (not shown). Down on the little mouse wheel changes the interface back to navigation mode.



Figure 21. Hawk statue and object selection cursor.

In the Desktop and Control conditions, each computer was equipped with a monitor, a keyboard (which went unused during game-play), the Gyromouse, and two headphones connected to the single sound port on the computer via a Y-splitter adaptor. During play, the student would hear the voice of the priest on one pair of headphones. During the training phase, a tester would wear the other headphones to hear the priest, also. In the Theater condition we used wireless headphones.

In the Theater condition, *Gates of Horus* uses CaveUT to display on the main screen of the Earth Theater, a multi-projector partial dome, shown here in Figure 22, Figure 23, Figure 24. The Gyromouse-based control of the cursor and general interaction with the game are exactly the same as with the desktop condition. However, using immersive display has a large practical effect in the way the student perceives the virtual space, navigates through it, and selects objects. For example, students with an immersive view often learn to (virtually) move less and physically look more, taking advantage of the wide view.



Figure 22. Moving through the Virtual Egyptian Temple

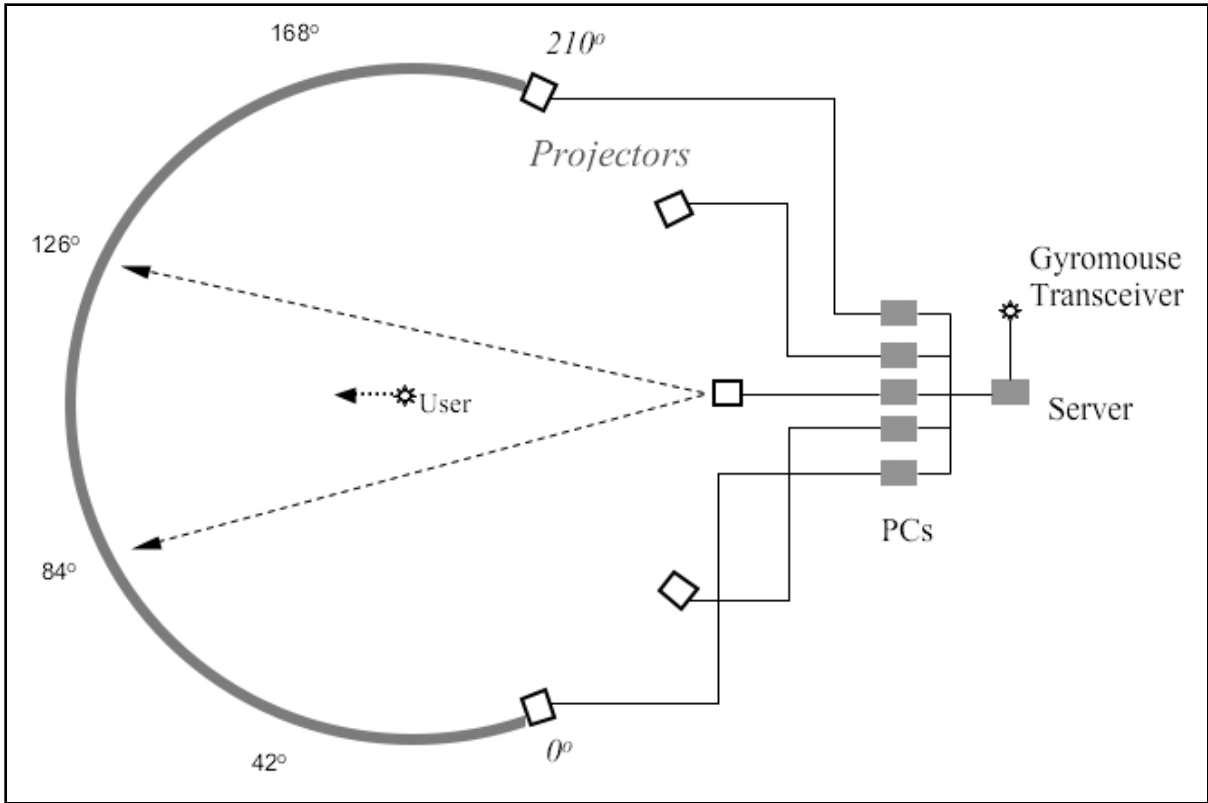


Figure 23. Overhead Diagram of the Earth Theater Main Screen

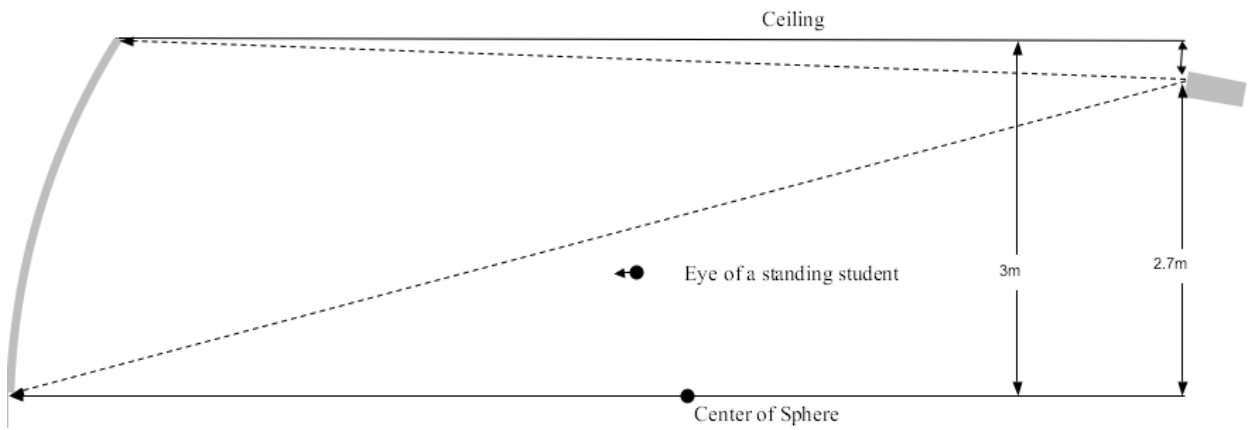


Figure 24. Side View Diagram of the Earth Theater

For the purpose of illustration, the person in Figure 22 is standing too close to the screen. In our experiment the student was located where Figure 23 and Figure 24 indicate, slightly forward of the center of the sphere defined by the curve of the main screen. We allowed the student to sit or stand, according to their wishes.

Interestingly, students who have played first person shooter games tend to waste the advantage of the immersive display by over-focusing on the center of the screen, navigating as they usually so in their desktop-centric games. Students, who have not played games of this type, tend to have a harder time learning to navigate, but develop better search strategies. Our (anecdotal) observation is that both types of students appear to do equally well.

3.3.2 Training Phase

The student begins the game facing the student side of the screen. The student will interact with the experimenter and with the software to learn how to play the game.

1. The training session begins with the student (virtually) facing the part of the temple shown in Figure 25, below. The experimenter demonstrates the proper use of the Gyromouse, and lets the student navigate around the exterior of the Temple, until s/he appears to be comfortable with it.
2. The experimenter then demonstrates object selection, again using the Gyromouse. The experimenter supervises the student as s/he selects random features of the temple, until the student appears to be proficient.
3. The experimenter asks the student to navigate back to where s/he began, to see the view in Figure 25, below.



Figure 25. Training Area

4. The experimenter directs to student to click on the priest, which triggers a voice recording, "Before you begin the game, we will show you how to play using this small example. You are looking at the Egyptian priest and side of the temple, which is behind him. On the wall, you can see that two human-like images are highlighted. Notice how they are facing each other and the things around them. Please click on each highlighted feature to find out what it is .
5. When the student clicks on the figure on the left, s/he hears a recording of the figure offering something good to the Ram-Headed god, Khnum . When s/he clicks the figure on the right, s/he hears a recording of the figure receiving a gift from the Ram-Headed god, Khnum .
6. After having clicked on both figures and heard the recordings, the student hears a recording saying, "Notice how the cursor changes color when it is over either one of the figures. Pay attention to the color of the cursor, because there are interesting things in the temple that you will want to click on, but they are not spotlighted. Next, you will have to answer a question. To answer 'yes' click the right mouse once. To answer 'no', click the right mouse button twice, quickly. This is sometimes called a 'double-click'. Please try it now."
7. From this point, on, each time the student single-clicks the priest, the recorded voice says, "Please try again. Click the right mouse button twice, as fast as you can."

8. When the student double-clicks, the priest said, "Good! Now make a 'yes' answer by clicking the mouse, once." Every time the student double-clicks, the priest says, "Please try again to make a 'yes' by clicking the right mouse button only once."
9. When the student produces a single-click, using the proper button, the priest says, "Good! Now, click on the priest, and answer his question with a 'yes' or a 'no'. When clicked upon, the priest asks: "In the mural in front of you, is Khnum reaching out for Pharaoh's present?"
10. Each time the student/student indicated, "Yes , the priest would reply, "Your answer is incorrect, please try again. Is Khnum reaching out for the present from Pharaoh??"
11. When the student answered n, the priest said: "Correct. You are now ready to play the game. Please go to the front of the temple."
12. The experimenter directs the student to move to the front of the temple and moves the view to approximate the scene in Figure 19.
13. The experimenter gives (Appendix D, p.355) to help the four student find the most difficult clues in each area. We had discovered the need for these during pilot testing.
14. The experimenter stays with the student, ready to answer questions, while the student works through the Pylon stage of the game. We collect and analyze data, while the student is working with the pylon, but we are careful about drawing any conclusions from it, because this is still a part of the training phase.
15. When the student has finished with the pylon, and the main gate of the temple opens, the tester leaves the student to complete the game.

3.3.3 Game Logic

The following is a description of the logic which support
 Because these are generic instructions on how to play the game, we use the present tense.

3.3.3.1 Definitions We use the following terms in all further discussion of the Temple and the experiment.

- 1. Area:** There are four *areas* associated with the temple, the Pylon, Courtyard, Hypostyle Hall and Sanctuary. The interaction logic for each area is the same, except where noted.
- 2. Priest:** Each Area also has a *priest* standing near the closed gate to the next area.
- 3. Goal:** Each Area has a *goal*, which is a concept or idea. The goal has two or more questions associated with it.
- 4. Clue:** A *clue* is one of the short voice recordings which explain something. For example, when the student clicks on the hawks on the ceiling, the recording it triggers is called the Ceiling clue. Each goal has two or more questions associated with it.
- 5. Feature:** Each clue is associated with a temple *feature*, which can be anything. Some features are spotlighted. When the cursor is over any active Feature, the cursor changes to t h e a c t i v e c o l o r .
- 6. Activate:** When the student clicks on a temple Feature, s/he *activates* the clue associated with it. Until that clue is Complete, it is activated.
- 7. Introduction:** Each Area has a clue called *Introduction*, and its Feature is a particular patch of ground. For the Pylon, it is the Area in front of the temple, large enough to find e a s i l y a n d w i t h s o m e e m p t y F o r t h e C o u r t y a r d i t e t w e e n is the Area just inside the door from the outside. For the Hypostyle Hall, it is the Area near the door to the Courtyard, and for the Shrine it is the Area near the door to the Hypostyle Hall. Of the last three, each one is positioned so that the student will (virtually) enter it the first time s/he enters the Area. The intro Area is indicated with a ring-of-smoke effect just over ground. In all other ways, each Introduction is functionally the same as all the other clues.
- 8.** Each clue has several *Questions* associated with it. The questions are always in yes/no form, and always asked by the priest in the room.

9. Each clue also has a *View* associated with it, which is the ideal (virtual) location and orientation for the student to see the corresponding feature of the temple.
10. When the student has correctly answered enough of the questions associated with a view we say that the clue is *Complete*. Similarly, a Goal is completed when all of its questions are answered correctly.
11. Until all of the clues have been Completed, there is always one and only one clue that is called the *Current Clue*. It is always (1) Activated (2) not Complete and (3) the clue most recently clicked. There could be two or more clues that the student has heard, but which are not complete. The Priest keeps track of which clues are currently Active and the student's most recent answer to each question.

3.3.3.2 Actions

Here, we characterize the basic rules of the game.

1. The student may trigger an Introduction audio recording, **only once**, by (virtually) walking onto the area associated with it. Entering the area again will not trigger the introduction recording. However, the student may trigger the introductory recording at any time by clicking on the floor just inside the door to the area. That part is indicated by the smoke ring effect.
2. Each time the student clicks on the priest agent, s/he will hear questions associated with features in the area or goal questions about the area as a whole. The student answers with a Yes or No, using the buttons on the mouse. If the student immediately clicks on the priest, again, the priest will repeat the question.
3. Once a student has answered a question correctly, the priest will never ask it again.
4. If a student has answered a question incorrectly, the priest will ask some other question associated with the same clue. Only if no other questions remain will the priest ask the incorrectly answered question immediately again.
5. If the student's second wrong answer for that clue is since the time that a new *gong played*, then the student's view will automatically play again and the student will hear the clue's recording.

6. The student may click on an active feature that clue is **not** Complete, it will become the *Current Clue*, regardless of whether one or more clues are currently active.
7. When the Current Clue is completed, a previous clue that the student has heard, but has not completed, will become the new Current Clue. If no clues are active, but there are still clues the student has not yet heard, the priest will instruct the student to go hunt for more clues.
8. When all clues in an area are complete, the priest will ask questions related to the goal. When the goal is complete, the priest will congratulate the user and the gate to the next area will open.
9. When the student successfully answers all speak, congratulating the student on winning the game.

3.3.4 Statements and Questions

This section gives the full text for each clue in the Temple, the questions associated with each clue, and the goal questions associated with each area. The name of each clue indicates the feature to which it is attached. Each clue is preceded by its name and a description of how to activate it. Each question is followed by its correct answer in parentheses. Because this is generic information about the game, we use present tense.

3.3.4.1 Pylon Here, we describe each clue associated with the pylon (front) of the Temple, and all the questions associated with each clue. In each description, the first sentence describes the action the user must take to *Activate* the *Clue*. The second sentence gives the text of the Clue as the student hears it. Each question is followed by its correct answer.



Figure 26. The Pylon

1. Intro: To hear this clue, the student enters a white circle on the (virtual) ground, which marks a touch-trigger volume in the front of the temple. "The very large front of the temple is called the 'Pylon'. It is gigantic, impressive, and colorfully decorated, but the colors have faded away over time. The massive east and west halves represent the mountains on either side of the Nile. The Pylon is a symbol of what Egypt could be." To hear the introduction, again, the student can either go back to the starting position (in the circle) or click the circle.

Q1. Is the whole temple as massive as the Pylon? (no)

Q2. Was there originally more color in the decorations on the Pylon? (yes)

Q3. Just from what you see of the Pylon, does the temple seem well ordered and designed? (yes)

2. **King:** Click on the very large scene spotlighted on the left part of the temple. "Pharaoh is depicted on a grand scale, shown defeating the enemies of Egypt. The god grants Pharaoh the power and authority, represented by a sword. The Egyptians believed that this was the way things were supposed to be."
 - Q1. In the battle scene, is Pharaoh winning? (yes)
 - Q2. In the battle scene, is the god also beating Egypt's enemies? (no)
 - Q3. Do the gods give Pharaoh the authority to defeat the enemies of Egypt? (yes)

3. **Hawk:** Click on either hawk statue flanking the Main entrance. "I am Horus, the god of Kingship. The hawk is my symbol and this is my temple. The image of Pharaoh beneath the hawk's breast shows that I protect him, for Pharaoh and the gods are united for the good of the world. I represent all gods, and Pharaoh is the link between the people and the gods."
 - Q1. Is there disunity between the gods and Pharaoh? (no)
 - Q2. Does the hawk show that this is the temple of Horus? (yes)
 - Q3. Is it important that the hawk statue protects a little king statue? (yes)

4. **Disk:** Click on the winged disk over the main gate. "The winged disk is a symbol of unity and protection, helping to guide you through the temple. It represents the divine life-force which flows from heaven and into all things. The disk is a symbol of the world according to the Egyptians, representing creation, life and especially protection. "
 - Q1. Does the winged disk represent unity? (yes)
 - Q2. Does the winged disk guide you through the temple? (yes)
 - Q3. Does the winged disk represent war? (no)

5. **Pylon Goal Questions:** The Priest asks these, when the student has answered all of the other questions about the Pylon.
 - Q1. Did the Egyptians think the world was orderly? (yes)
 - Q2. Does the scene where Pharaoh is beating the enemies of Egypt show what the Egyptians wanted? (yes)

If the student's answers to these questions are satisfactory, the gates to the Hypostyle Hall will open.

3.3.4.2 Courtyard Here, we describe each clue associated with the Courtyard of the Temple, in the same way we did for the Pylon.

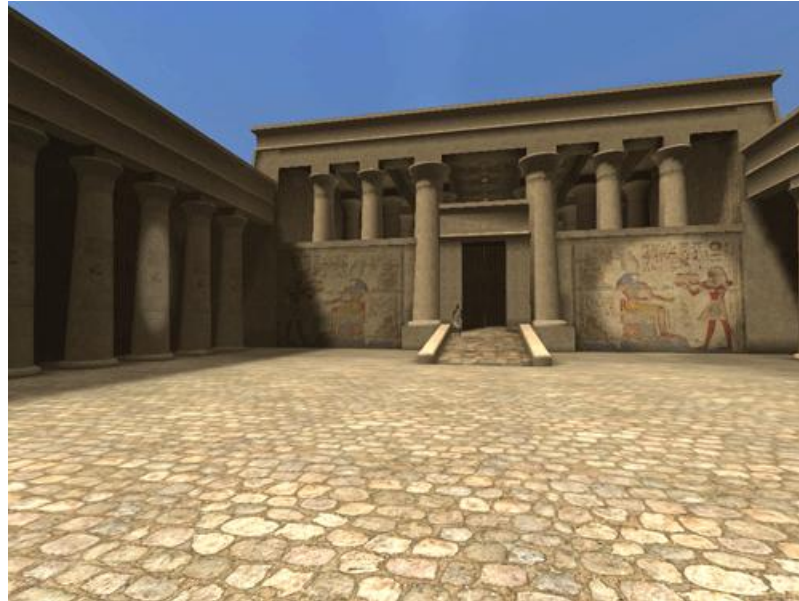


Figure 27. The Courtyard

1. Intro: Enter the Courtyard. "The Courtyard is an open and undivided space, made for large religious celebrations and rituals. Everyone comes to these events dressed in the same simple garments. They do this to show how all people are equal and humble before the gods."

Q1. Does Pharaoh come to the Courtyard, sometimes? (yes)

Q2. Can ordinary people go to the Courtyard? (yes)

2. Floor: Click on the floor volume. It is centered on the courtyard, filling in ~~g g e r~~ about two-thirds of the space. It stops short of the columns and the ramp into the Hypostyle Hall. To hear the introduction, again, go back under the courtyard gate to leave the trigger volume, or click on the area under the door. "The Courtyard was a wide open space, without subdivisions. It held large religious celebrations and rituals. Everyone dressed in simple garments to show that they are humble before the gods."

Q1. Is the Courtyard divided into different areas for different people? (no)

Q2. Do rich people wear fancy cloths during the celebrations here? (no)

3. **Sky:** Click the sky above the Courtyard. The open sky over the Courtyard reminds us of the connection between heaven and earth. All Egypt is united under the sun, which embodies the creator god, Amon.
 - Q1. Does the sun embody the god, Amon? (Yes)
 - Q2. Was there a purpose to having no roof over the Courtyard? (yes)
4. **Festival Scene:** Click on either wall, behind the columns on the long sides of the space. The trigger volumes should approximately run the length of each wall, except for a blank spot behind the spotlighted column. "The celebrations here are joyous events showing the peoples' gratitude to the gods. It is a sacred duty, a serious business, but also an enjoyable one. Everyone brings the best things they have to give, as further offerings of gratitude."
 - Q1. Do people come to the Courtyard to complain to the gods? (no)
 - Q2. Do the people give their worst things to the temple? (no)
5. **Offering Scene:** Click on the spotlighted offering scene to the right of the gateway to the Hypostyle Hall. "On behalf of all Egyptians, the King gives thanks by offering every good thing 'to the god, who is their creator. In return, he blesses the King, the land of Egypt and its entire people with life and prosperity forever."
 - Q1. Does Pharaoh represent the people's interest before the gods? (yes)
 - Q2. Do the gods give the King something in return for his offerings? (yes)
6. **Columns:** Click on the spotlighted column. "The king and god embrace, representing humanity and divinity coming together in a public way. The King represents all Egyptians, while Horus represents both the gods and the natural world."
 - Q1. Do the king and Horus spend all their time in the Courtyard? (no)
 - Q2. During the celebrations, were the god and Pharaoh symbolically there? (yes)
7. **Courtyard Goal Questions:** The Priest will ask these, when the student has answered all of the questions, above.
 - Q1. Did the people give thanks to the gods as a community? (yes)
 - Q2. Did the people bring gifts with them to the festival? (yes)

If the student's answers to these questions are satisfactory, the gates to the Hypostyle Hall will open.

3.3.4.3 Hypostyle Hall Here, we describe each clue associated with the Hypostyle Hall of the Temple, in the same way we did for the Pylon.



Figure 28. Hypostyle Hall

1. Intro: Enter the hall to trigger the recording. To hear the recording again, go back under gate from the Courtyard to leave the trigger volume, then enter it again, or click on the area under the gate. Unlike the Courtyard, the Hypostyle Hall was a quiet and private place. Only the literate people, the upper class, ever came here. They conducted small private ceremonies to honor their ancestors. This is another way for the people to connect with heaven.

Q1. Do people revere their ancestors here? (yes)

Q2. Can anyone come to the Hypostyle Hall? (no)

Q3. Do worshippers in the hall connect with heaven through their ancestors? (yes)

Q4. Is the Hypostyle Hall a public space, like the Courtyard? (no)

2. Lamps: Click any one of the lamps. The Egyptians remember making offerings and prayers to them. These offerings are placed before statues and images of their ancestors, which are kept in homes and workplaces. Those who make great gifts to

the temple may have family offering places inside the Hypostyle Hall, a place of great honor.

- Q1.** If you make a big donation to the temple, can you put a statue of your ancestors in the hall? (yes)
- Q2.** Could anyone have a statue or offering table in the Hypostyle Hall? (no)
- Q3.** Can a poor Egyptian still have an ancestor statue or offering table at home or at work? (yes)

3. Columns: Click the highlighted column. The Hypostyle Hall is filled with plant-form columns which represent the primeval marsh. This marsh surrounded the first mound of land, which rose from the waters at the beginning of time. It is built on a grand scale to let you know that you are in a sacred space.

- Q1.** Do the plant-form columns represent broccoli? (no)
- Q2.** Do the columns have a special meaning? (yes)
- Q3.** Do the columns represent the primeval marsh at the beginning of time? (yes)

4. Ceiling Hawks: Click on the center strip of the ceiling, the part with the hawks printed on it. The hawks on the ceiling are spirit guides between heaven and earth.

- Q1.** Do the spirit guides on the ceiling show the connection between heaven and Earth? (yes)
- Q2.** Do the birds on the ceiling lead you out of the temple? (no)

5. Hypostyle Hall Goal Questions: The Priest will ask these when he decides that the student has answered enough of the questions, above.

- Q1.** Is the Hypostyle Hall an intimate space? (yes)
- Q2.** Does the hall support a private connection to the divine? (yes)

If the student's answers to the Hypostyle Hall willions are open.

3.3.4.4 Sanctuary Here, we describe each clue associated with the Hypostyle Hall of the Temple, in the same way we did for the Pylon.



Figure 29: The Sanctuary

- 1. Intro:** Enter the Sanctuary to trigger the recording. To hear the recording again, the student can click in the floor underneath the doorway. The Sanctuary is the most central, the most important place in the temple. Its decorations are of the most intricate and excellent workmanship, all made of the best materials. The most important ceremony. No questions are associated with this statement.
- 2. Back Wall:** Click on the spotlighted Pharaoh. (Only the Pharaoh (and his stand) could conduct worship services here. Ordinary folk never saw the Sanctuary .
 - Q1.** Could an ordinary person worship here? (no)
 - Q2.** Did Pharaoh represent the community here? (yes)
 - Q3.** Is the Sanctuary the least important place in the temple? (no)

- 3. Floor:** Click on the spotlighted spot on the floor. The groundSanctuary is the the primordial mound, the very first place in both space and time. People in every town in Egypt think that the world began under their local
- Q1.** Did the local Egyptians believe that the world began on the ground where their temple is built? (yes)
- Q2.** When the world was created, was the ground under the Sanctuary created last? (no)
- Q3.** Did the local Egyptians think that time began where their temple is built? (yes)
- 4. Shrine:** Click on the top of the shrine. The Shrine was the gateway earth, from which the blessings of heaven would flow, but only if proper ceremonies were conducted correctly. It is the god who opens
- Q1.** Is it important for the Pharaoh or the High Priest to do the ceremonies correctly? (yes)
- Q2.** Do the blessings of heaven come out from the shrine? (yes)
- Q3.** If asked correctly, would the gods help the people? (yes)
- 5. Divine Image:** Click on the figurine in the shrine. Standing in the shrine of Horus represents all gods. At times, it is inhabited by the spirit of the god, who influences events for the benefit of the community. For example, if the gods were pleased, they might bring a good harvest to the land.
- Q1.** Is the statue of the god just a statue to the Egyptians? (no)
- 6. Sanctuary Goal Questions:** The Priest will ask these when he decides that the student has answered enough of the questions, above.
- Q1.** Does Pharaoh communicate with the gods here? (yes)
- Q2.** Is there anything more important than what happened in the Sanctuary? (no)
- Q3.** In this temple, does Horus represent all gods? (yes)

When the student has answered these questions satisfactorily, the following recording plays:

Congratulate You have unlocked the secrets of my temple. When you are King, you will come here to make the offerings, so that the gods will bless the people and land of Egypt, forever. This is your power, your right and your duty .

Figure 30 shows the trigger volumes in the Temple. to trigger a recording, the student either touches the area (steps into it), or clicks on it with the cursor.

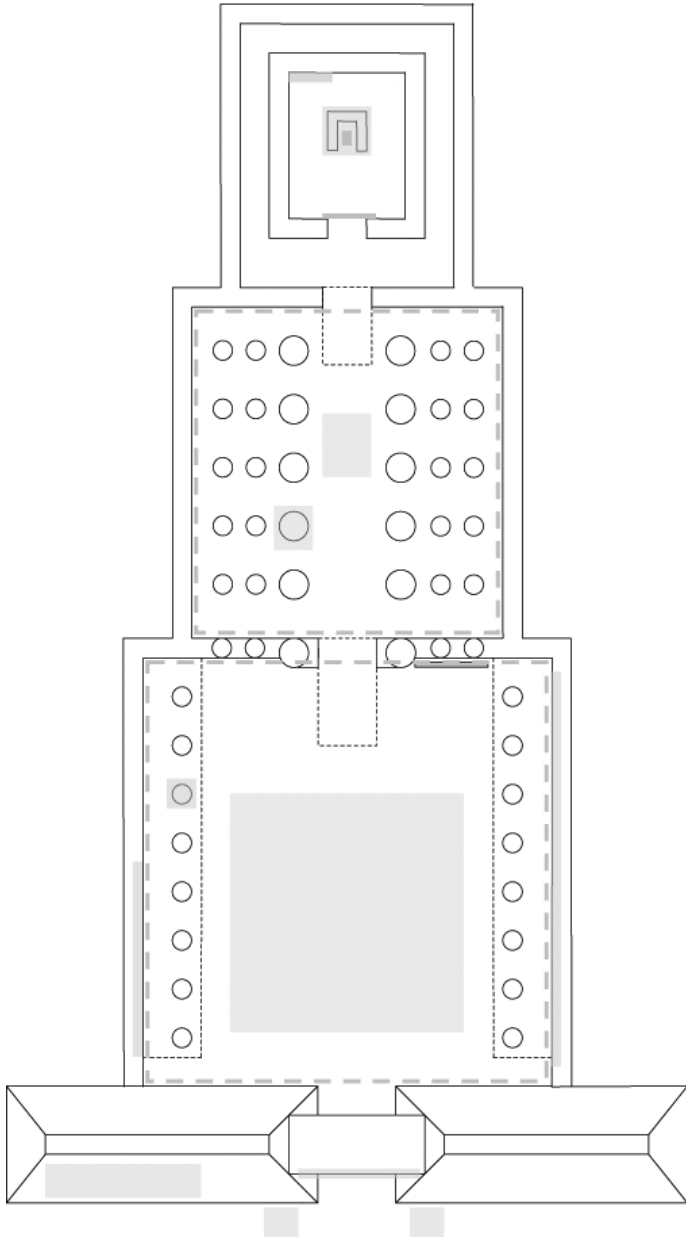


Figure 30. Gates of Horus Trigger Volumes in the Temple