The teachFASTly.com resources are not intended as a complete curriculum. The activities are designed to be woven into your existing teaching. This Quick Stop Lesson Plan is therefore not a single lesson plan, but rather a quick way of exploring the themes of an Activity Map. It includes one Discover activity, and two Delve activities. Together, these may take more than a class period, and you may want to add other activities between them. For more information, visit www.teachfastly.com.

Models, Humility, and Truth

Sometimes arguments about the relationship between faith and science fall into proclaiming the absolute truth of one side, and the deep unreliability of its opposite. Such dismissals in either direction can quickly end up misrepresenting how science, or theology, or both, work.

This Activity Map introduces students to the role of models in scientific and religious thinking, and engages them in exploring how commitment to truth might go alongside an awareness of the need for humility.

This Activity Map offers a selection of activities intended for both Bible and science classes, creating opportunities for collaboration across the curriculum for teachers, and more coherent learning for students. It aims to help students see the relationship between the Bible and science as calling for humble investigation and careful thought, not as just contending a few key positions. It tries to engage them in thinking carefully about truth and humility.

It is recommended that work on this topic be coordinated between science and Bible teachers.

This Quick Stop Lesson Plan on **Models, Humility, and Truth** contains the following activities and attachments from www.teachfastly.com, which are combined for your ease of use in a downloadable ZIP file:

DISCOVER Activity: Models in Science

Activity Attachment

- *Models in Science Slideshow*

DELVE 1 Activity: At the Well

Activity Attachments

- *At the Well Handout*
- *At the Well Slideshow*

DELVE 2 Activity: Candle

Activity Attachment

- *Candle Slideshow*

DISCOVER

Activity: Models in Science

Time: 20 minutes

In Brief
This short introductory activity engages students in reflection on how basic scientific models relate to reality. Students will look at slides of scientific models and discuss how they may have developed, how they may have changed over time, and their relevance to what they represent.

Goals
Students will understand how models are used in science to account for data for specific purposes.

Students will understand that scientific models have explanatory power and are subject to revision.

Thinking Ahead
Models utilize one part of our experience as a kind of scaffolding to help us understand another. They are a standard feature of our thinking in the fields of science and theology. In both, models help us gain a better grasp of the nature of reality, while reminding us that there are limits to our understanding, and that humility is appropriate.

We see the world through models. This means that we do see the world, and that we see it in an indirect way, that is mediated by models.

This activity introduces the idea of models in science. Modeling is only part of the nature of science; to explore the nature of theories and theory construction, you will need to draw from your regular curriculum.

Preparing the Activity

Needed:

- Presentation slides in the **Models in Science Slideshow**

Teaching the Activity
Show the first slide from the **Models in Science Slideshow**, which depicts two images of the night sky.

Ask students what they would see if they looked carefully at the night sky each night over a long period of time, either with the naked eye or with a simple telescope, and kept a record. Elicit possibilities that include changes in shape (phases of the moon), changes in position (movement of constellations), visible movement (meteors), and repetition of patterns over time.

Then ask students to try to imagine that they have never seen a movie that is set in space, have never seen a photograph taken in space, and have never heard of anyone flying up into space.

- What kinds of questions might they ask themselves as they watched the lights in the sky at night move?
- What would need to be explained?

Elicit that we might look for patterns in the movement, and wonder if we could use them to predict future cosmic events (such as eclipses). We might look for a way of explaining how all the moving pieces fit together. Ask students to discuss briefly with a partner how we might go about arriving at a theory of how all the data fit together.

Next, present the second slide, and ask students what they think it shows. Explain that it is an image of the solar system from the astronomy article in the first edition of *Encyclopedia Britannica* from 1771, showing the apparent movement of the Sun, Mercury, and Venus, relative to the earth. It offers a model that explains the movement of the objects in the night sky. Ask students to identify the key assumption on which it is built—that the earth is in the center. Point out the epicycles—the repeating loops. Explain that if the earth was placed in the center, then to account for the observed movements of the stars and planets, it was necessary to model them as moving in repeating loops. Emphasize that this model represents the movement as we see it from earth.

Now, show the third slide. Point out that we would need to explain why the planets seemed to move in such a curious pattern. Mention that Aristotle's physics assumed that objects in the sky should move in perfect circles, which would make the actually observed movements even more puzzling.

Ask students if they can figure out from the new diagram how movement in perfect circles could produce the loops in the previous diagram. Explain, as needed, the idea that the planet is moving in a small perfect circle, while the center of that circle is moving in a larger perfect circle around the earth. From the vantage point of earth, this would look like the loops in the previous picture. You can illustrate this in motion by showing one of the animations of Ptolemy's system available online, such as Ptolemaic Planetary Model (https://www.youtube.com/watch?v=wGjlT3XHb9A) or Ptolemy's Solar Hypotheses (https://www.youtube.com/watch?v=Plxed3JVOnI). Emphasize that this model is intended to represent the actual motion of the planets, not just their progress across the observed night sky.

Finally, show the heliocentric model on the fourth slide. Ask students why they think this model replaced the previous models. As students make suggestions, point out that the new model was not immediately more successful at predicting the movement of objects in the heavens—the old one worked quite well for that purpose. However, the new model was more elegant; as we began to develop better telescopes, collect more accurate observational data, and develop better mathematical models of the movement of planets, it gradually became apparent that it fit more of the data than the old model. It also fit better with other new developments, for instance, our understanding of gravity. Eventually, it proved more accurate and more useful in accounting for more data.

Remind students that all of these are models: constructed representations that allow us to picture some part of reality in order to continue to study it more accurately. All of them were useful for particular purposes, but they were also subject to change. Ask the class to reflect together on what this might imply for how we see scientific knowledge. Focus in particular on the questions:

- What do models help us do?
- If something is just a model or a theory, does that mean it is not scientific? Does it mean we cannot have any confidence in what it says? (Emphasize that models are a way of accounting for data.)
- How fixed are scientific facts? Is there always potential for a change in our model? What might bring change?
- How might humility fit into this picture? (Note the need to be open to change in our own assumed models of the world.)

DELVE 1

Activity: At the Well

Time: 35 Minutes

In Brief
This Bible class activity[1] engages students in examining how different mental models of the causes of people's behavior lead to different interpretations of John 4. This offers a way into learning about the role of mental models in interpretation, and how interpretation affects theology as well as science. Students will read a passage from John 4 and compare interpretations of it based upon different models.

Goals
Students will understand that mental models of how the world works affect our interpretation of Scripture.

Students will reflect on how mental models relate to humility and trust.

Thinking Ahead
Models utilize one part of our experience as a kind of scaffolding to help us understand another. They are a standard feature of our thinking in the fields of science and theology. Realizing that they play a role in both can help to defuse a sense of tension between the two. In both, models help us gain a better grasp of the nature of reality, while reminding us that there are limits to our understanding, and that humility is appropriate.

We see the world through models. This means that we do see the world, and that we see it in an indirect way, that is mediated by models.

This activity explores how the role of models affects our reading of Scripture. There are two risks here: one is that we will mistakenly exalt our own interpretations to the status of absolute truth and despise those who read differently, and the other is that we will lapse into an apathetic sense that the Bible can be made to say anything at all, and so we are not answerable to the text.

As you prepare this activity, think carefully about how to keep the emphasis on how the role of models in thinking calls for humility and offers us real access to understanding.

Preparing the Activity

Needed:

- Bibles or copies of the **At the Well Handout**
- Presentation slides in the **At the Well Slideshow**

[1]This activity draws heavily upon material from *Christians and Cultural Difference* by David I. Smith and Pennylyn Dykstra-Pruim, Calvin College Press, 2016. Used by permission.

Teaching the Activity

Tell students that they are going to look further into the ways that mental models play a role in how we make sense of what we think we know, and that they will do this through interpretation of a Bible passage.

Assign students to read John 4:4-26 from the New Testament, either from the Bible or from the provided **At the Well Handout**. Have students read through the passage silently; then have them read it aloud in pairs, so that they are familiar with the flow of the passage.

Next, ask students if they can identify any places in the conversation where either Jesus or the Samaritan woman seems to suddenly change the topic of conversation to something new. Give students a few moments to identify these in pairs and then take suggestions. Draw students' attention to verse 16 (when Jesus and the woman have been talking about water and drinking and Jesus suddenly says "Go call your husband") and verses 19-20 (they have been talking about her husbands and she suddenly starts talking about where to worship). Help students to see that these seem like surprising shifts—ask them to imagine a conversation that goes:

> "Are you thirsty? Would you like a coffee?"
>
> *"Sure, let's get a coffee."*
>
> "Go get your husband!"
>
> *"But he's at work."*
>
> "I know he is. He works long hours."
>
> *"Should I worship in a Protestant church or a Catholic one?"*

You could mention that John's Gospel uses such sudden shifts and apparent misunderstandings in other places (e.g., Jesus' conversation with Nicodemus). In order to understand this passage, we need to arrive at a model of the situation, and of the intended logic of the text, that lets us make sense of the data in front of us, the sequence of the topics. Ask students to discuss with their partners the following three questions:

1. Why does Jesus suddenly change the topic to husbands when she asks for living water?
2. Why does the woman suddenly change the topic to temples when Jesus mentions her past husbands?
3. What can you tell about the woman's character from the story? What kind of person is she?

When students have had time to discuss, show the first slide of the **At the Well Slideshow**. This slide contains a number of short phrases drawn from published Bible commentaries on John 4. Ask students whether this interpretation is similar to what they concluded. (It may or may not be.) Ask them why the last sentence would claim that it is "obvious" that Jesus wants to reform the woman's life—what in the text would support that conclusion? Do not, at this point, critique students' interpretations, and if they arrived at something different from the com-mentaries, that is fine.

Next, tell students they are going to step back from the story for a moment and think about some of the assumptions we use to make sense of what is happening.

Show the second slide of the **At the Well Slideshow**, an image of people helping push a car. Ask students to imagine they are walking along a street, and see someone whose car has broken down. They see several other people stop and help the driver by pushing the car to a safe place. Ask them to tell a partner how they would answer the question "Why do you think those people stopped to help?"

Show the third slide, which shows two different kinds of explanations, and ask students which explanation theirs most resembled. Show the explanatory text that points out that the first is an internal explanation (i.e., they helped because of some quality inside them; they were good people) and the second is a contextual explanation (i.e., they helped because something in the situation pushed them to help).

Explain to students that research in cross-cultural psychology suggests that:

- On average, Western people, who have grown up in a culture that stresses individual responsibility and self-reliance, instinctively lean towards internal explanations of others' behavior. They tend to assume that people behave as they do because they are moral or immoral.
- On average, Asian people, who have grown up in a culture that stresses communal belonging and interdependence, instinctively lean towards contextual explanations of others' behavior. They tend to assume that people behave as they do because of the constraints of their contexts.

These are just averages—there are individual variations in both cultures. This difference is referred to as a "causal attribution difference." Due to the mental models of behavior instilled by our cultures, we attribute causes to events a little differently.

Now show students Slide 4 (a repeat of Slide 1) and point out that these comments are from Western Bible commentators. Ask students to identify evidence of a preference for internal explanations.

Tell them that a recent American author wrote a book (*In the Land of Blue Burqas* by Kate McCord, Moody Publishers, 2012; see page 305) about spending time among poor women in Afghanistan, and describes how those women reacted to the story from John 4. It was immediately obvious to them what was going on in the story.

Use Slide 5 to show the main points[2]:

- The woman would not have been able to choose whom to marry or whether to marry.
- She has been used and abandoned by five men, and the one she is with now does not even have the decency to marry her.
- As a result, she is deeply shamed in her community, which is why she is at the well alone in the middle of the day, instead of with the other women.
- Because of her shame, she cannot go to the places of public worship.
- Jesus tells her that she can still worship God, that she does not have to be at one of the temples and God can meet her where she is. This is good news!

[2]Paraphrases for this slide drawn from *In the Land of Blue Burqas* by Kate McCord, Moody Publishers, 2012. Used by permission of Moody Publishers.

Remind students that they have been learning about the role of models in science and theology. Ask them to articulate what role mental models have played in interpreting this passage. Which of the interpretations shown on Slide 4 and Slide 5 are straightforward observations of what the text says, and which are *inferences* based on prior models of how the world works? A mental model of the causes of human behavior has led to two different interpretations seeming obvious to two different sets of readers.

Ask students if this means the text has no meaning or can mean anything at all. Surely not. If students want to pursue this line of thought, ask them if this interpretation could be justified from the text: Jesus mentions husbands because he wants to fight her husband and wonders how many men he will have to fight; she mentions temples because they have boxing rings in them, and "worship" really means "buy popcorn."

Though we use models to interpret, we are still accountable to the text. We come to the text with mental models of how the world works that affect how we interpret it, and then we test those models against the text and any other relevant information, such as historical research on ancient Samaritan culture. Sometimes we may have to keep more than one model in play until we have more information, but we are still ultimately answerable to the text.

Remind students that there are commonalities between the two readings of John 4. Jesus was offering mercy and good news and a fresh relationship with God, and the woman needed to be freed in order to receive it. Also emphasize that if we had no mental models at all, we would have no idea how to read the text—having a mental model gives us access to the story, even as we need to remain open to having our model corrected by further reading.

Finally, ask students to write a brief reflective journal on the following prompt:

- Why might there be a need for humility with regard to our interpretations of Scripture? Is this incompatible with understanding and trusting Scripture?

DELVE 2

Activity: Candle

Time: 25 Minutes

In Brief
This activity[1] engages students in interpreting a "discrepant event" and distinguishing their observations from their inferences. It helps students see how scientific models can be based on observation, yet still be tentative and open to revision. Students will witness the teacher lighting a "candle," and evaluate the differences between observations and inferences.

Goals
Students will be able to distinguish observations from inferences.

Students will examine how making inferences based on observations helps to show the ways that scientific knowledge models reality.

Thinking Ahead
As we have seen in the previous activities in this map, models are a standard feature of our thinking in the fields of science and theology. Models utilize one part of our experience as a kind of scaffolding to help us understand another.

Understanding the role of models in our thinking can help us consider the relationship of our knowledge claims to humility and trust. Models are just representations, and can be revised, so our claims to know should be framed in humility. We should not claim more for them than they warrant. Since our models are based on encounters with reality, we can trust them, at least provisionally, to help us see what is there. Acknowledging that they are provisional need not plunge us into despair about our ability to know truth.

We see the world through models. This means that we do see the world, and that we see it in an indirect way, that is mediated by models.

Preparing the Activity

Needed:

- A package of white cheese sticks (string cheese)
- A package of almond slivers (not slices)
- Multi-purpose lighter (Aim-n-flame) or matches
- A fire extinguisher or a cup of water
- Presentation slides in the **Candle Slideshow**

[1]This activity is adapted by its author from copyrighted material in Learning & Teaching Scientific Inquiry: Research and Applications by James Jadrich and Crystal Bruxvoort (NSTA Press, 2011). Used by permission.

Just before the lesson commences, prepare the "candle" by opening a cheese stick and inserting an almond sliver into the tip. Insert enough of the almond sliver so that a small portion of the sliver protrudes out of the cheese stick. This sliver acts as a "wick" in the false candle. You may want to light the "wick" for a brief time, as this makes it easier to ignite during the lesson itself. Prepping two different "candles" is helpful, in case one unexpectedly fails. The students should not see the "candle" until the lesson takes place, so hide it until after you have described to the class what you want them to do as part of the demonstration.

Teaching the Activity

Open the lesson by giving some basic directions to the class. Tell them that in just a moment, students will be shown a "phenomenon," and as soon as they can see it, they should share what they notice about the "phenomenon." Select a student to keep a record of observations shared by the class. You may want them to keep a record of their observations where all can see (e.g. a large whiteboard). The person recording observations should not make any interpretations of what is shared, but just capture what is volunteered by the class. Encourage the class to share observations as soon as they come to mind. A number of comments should be shared in a relatively short period of time.

When ready for the demonstration, go ahead and light one of the "candles."

As soon as the oil in the almond sliver starts to burn, hold the "candle" for all to see, and tell students to share their observations. They often share observations like "light," "burning," "smoke," "wax," "wax melting," and perhaps, "candle."

After several observations are shared (and right around the time the "candle" looks to be burning out), blow out the "candle," and ask a couple of follow-up questions:

- Predict what you think is going to happen over time. (Answers might include: "the candle is going to shrink" or "you're going to get wax on your hand.")
- When would you most likely use such a phenomenon?" (Answers might include: "when the power goes out" or "at night.")

The next step in the demonstration should be a dramatic one.

Ask students to put their eyes on you, and ask them if they have ever seen this phenomenon used in the following way: blow out the "candle," if it is still burning, and with theatrical flair take a big bite out of it!

Enjoy the audience's shocked reaction as you chew a couple of bites! Students immediately wonder what you just ate. You may have to tear apart the string cheese in order to convince the audience that you did not just eat a wax candle.

Next, move to a careful presentation of the distinctions between observations and inferences. An observation is often described as a careful description of an object or event based on information gained using a person's five senses, such as hearing, smelling, or touching. Properties you could observe include: height, weight, color, sound, shape, smell, and amount. Examples of observations (included for optional presentation on a slide in the **Candle slideshow**) include:

- The leaves on this tree are green in August.
- This apple is crunchy and sweet.
- Tonight's dinner smells like baked meat loaf.
- Crystal's hair is shorter than Annie's hair.
- The red car crossed the finish line before the blue car.

Notice how each statement above does not include attempts to explain why or how. For instance, consider a change to the first statement. What if the statement read something like, "The leaves on the tree are green in August because of the presence of a green pigment called chlorophyll in the chloroplasts of certain cells?"

When interpreting or drawing a conclusion based on information gained through a person's senses, the statement is an inference, rather than an observation.

Inference examples are included on the second slide in the **Candle Slideshow**.

- What was really *observed* in the edible candle demonstration?
- Where were we (likely unknowingly) *drawing inferences*?

Return to the recorder's list of student comments (an example is shown in Slide 3 of the **Candle Slideshow**). This list typically contains comments like:

- Smoking
- Fire
- Burning
- Wax dripping
- Wax melting
- White object
- Cylindrical
- Wick at the top
- Candle

Work through this list with students, discussing where inferences were made, rather than pure observations. For instance, "wax dripping" or "melting" are claims as to the identity of the object, and thus, are inferences based on the object appearing to be a candle. Similarly, "smoke" is really an inference and not a pure observation. An observation would be something like, "I observed fine, gray particles originating from the top of the white object moving steadily upward toward the ceiling." You could infer that this phenomenon is smoke, not steam.

To further practice the distinction between observations and inferences, use the included practice problems (Slide 4 of the **Candle Slideshow**). Help students see the difference between obersvation (e.g., "it is a blue object, there are black marks on the white surface") and inference (e.g., "it is a blueberry, there are letters").

Then ask students to write in in their own words how they would distinguish between an observation and an inference. Ask them to provide three different pairs of examples showing an observation (e.g., "the pointed object leaves an inky line when dragged along the white paper"), versus an inference (e.g., "the object is a felt-tip pen"). It may be helpful to have pairs of students look at each other's work to double-check the sets of examples.

In closing, use the questions on Slide 5 of the **Candle Slideshow** to discuss the following issues with students.

In everyday life, there doesn't seem to be a pressing need to distinguish between an observation and inference, but in science, this careful distinction is helpful. As evidenced in the "edible candle" demonstration, this is challenging to do. We thought we were making observations, but we were mostly making inferences. There is really no such thing as a pure observation. There always seems to be a little inference in all of our observations:

- Do we really see an object or is it an illusion?
- Is it really blue or are we just offering a culturally specific term for our sense of how the light strikes it?

This activity helps us understand why all scientific models (and theories) are best viewed as just that: models. They move from observation, to attempting to make sense of observation, by building models. Models are durable, but always pending, and best viewed as subject to revision.

Some might fear scientific models are useless, given any sort of tentativeness or lack of complete certainty. Others would claim that you could not treat scientific knowledge with integrity unless you accurately understand science as model making. Use the questions to help students see that admitting that inferences and models are tentative and open to revision does not mean giving up on truth, but respecting it. It is seeing that there is a reality to which our models are answerable, but that we should not claim too much for our models of it. Knowing the truth requires that we cultivate the humility needed to give up familiar half-truths.