

# Lessons from the classroom – Dr. Jamie Jensen (Church of Jesus Christ of Latter-day Saints) associate professor of biology Brigham Young University

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Jamie Jensen: 00:25 I am really excited to be here. I just want to first start out by thanking Dr. Bertka and her colleagues for inviting me here. I think that this topic is salient right now to the scientific enterprise and to society as a whole. I also want to say, as she said, I'm a faculty member at Brigham Young University. I'm also a faithful member of the Church of Jesus Christ of Latter-day Saints. I'm a Mormon and I was just at church this morning, actually. And so with that, I have found a way to reconcile my religious beliefs with the science that I study and I love. I'm excited to share with you how we help students do the same. All right. My objectives, when I go into a classroom, first is I want students to understand evolutionary theory, so that they can apply it to daily decisions in their lives. (01:16) Second, I want them to accept evolution so that they will apply it to decisions in their daily lives. And then third, I want to offer them a way to reconcile these two ways of knowing. I want to go back really quickly to the first two, the understand and accept. I often get asked in my research, why don't you care so much that they accept? Isn't it enough that they understand, and our students understand really well? I would offer my argument that, no, it's not enough that we just understand. Let me give you an example, just to sort of illustrate this. Preeclampsia, is a condition you probably all familiar with, it kills 75,000 women worldwide each year. It's a complex disease that medical researchers have been working on for a while. Well recently and evolutionary biologists noticed a connection between life history strategies and evolution and what the molecule might be that's causing preeclampsia. (02:09) He suggested this radical idea that the molecule causing it is actually made by the fetus. He went to the medical researchers and he said, "I think you should test this." Luckily we had a medical researcher who was willing to accept evolution as a valid theory and was willing to put in the time and the effort and the money to test this hypothesis. Lo and behold, he was right. The molecule that causes preeclampsia comes from the child and it is in line with human evolution. And so, if we look at the definitions, to understand is just to become aware of the mechanisms of evolution, but to accept is to decide that it is a valid explanation. And so that's what we're going for, is acceptance.

(02:52) All right. Do our students understand? Yup, they do. Okay. BYU students, BYU is a highly selective institution. Our students score in the 96 percentile on the biology major fields exam, specific to the population, genetics and evolution. We are in the 99th percentile. Our students are really good at telling us how evolution works. Right? But the big question is, do they accept? I'll show you a bunch of data about that in a minute. What I want to do is actually give you a big overall picture of several religious groups across the country about evolution and about my population specifically. And then we will talk about the different influential factors that have been posited for acceptance of evolution. We'll talk about each of those in detail.

(03:39) All right. The first thing I want to do is talk about this snapshot. I had a bunch of collaborators and we wanted to know what was the state of evolution acceptance across the country. We were actually trying to replicate the Pew data. Pew forum did a nationwide survey in 2008. They gave everyone the statement, "Evolution is the best explanation for life on earth." If you look on the left there, it shows we have 48% agreement nationwide with that statement. We're split 50, 50. And then they broke it up by different religious affiliations. I'm specifically looking at for religious affiliation. So Protestants, Catholics, Mormon, and Jewish individuals, and you can see that the highest accepting religious affiliation was Jewish, followed by Catholic, with Mormon sitting down there at the very bottom, right? With a 21% acceptance of that statement. (04:31) And so we saw this data and wanted to know a little bit more. We wanted to know what things we might be able to tease out as influential factors for this. We needed to be able to replicate this data and have access to those respondents, not these specific ones, but a group similar to it. And so that's what we did. We use the Qualtrics survey system and they have panels of respondents that are organized by all different kinds of demographic factors. And so we requested that our respondents come from Jewish population, Mormon population, Catholic population, and then amongst the Protestants, we specifically chose Southern Baptist, is one of the bigger groups of Protestants. (05:10) We asked them the same question, evolutions the best explanation for life on earth. I've got the Pew data on the right to remind you of what they found. This is what we found on the left. You can see that we're very similar. We have a pretty good sampling of what the Pew forum was sampling, as far as acceptance goes and the same trends are there. All right. With this data, though, we could add in a whole bunch of other survey questions and get more information out of these individuals. One of the things we wanted to know is, does knowledge of evolution correspond to

acceptance? Because this is one of the things that in the literature is very mixed. Some people find that it's a direct correlation. Some people find that there's no correlation or it's negative. And so we wanted to know, is there any correlation. Surprisingly, those who reject evolution the most, know the most. (05:58) That was kind of interesting to us. There doesn't seem to be a relationship between, at least in our sample, your knowledge of evolution and whether or not you accept the theory. By the way, we use the knowledge of evolution exam. It's a published inventory, deals with a bunch of different components of evolution. All right. That was interesting question. And then we thought, okay, well, we want to know if religiosity, so your dedication to your religion, does that affect your acceptance? And is it specific to each different religious affiliation? And so we use some published inventories of religiosity. We combine them together. I'll talk about them more in a second when I show you a diagram. But what we did is, we took average religiosity for each of the religious affiliations, and then we went one standard deviation or more above, and one standard deviation or more below and called them low religiosity or high religiosity. (06:51) This is just an interesting trend. There was a significant interaction, meaning that not all denominations feel out the same, specifically amongst the Jewish people, if you are low religiosity or average religiosity, you both group as high accepting, with high religiosity being the opposite. Whereas all the other religions were the opposite of that. Being average religiosity was the same as high religiosity, in your acceptance of evolution. This is not necessarily new. We've seen this before in the literature that your religiosity is certainly a predictor of your acceptance of evolutionary theory, but we were happy to see that it does still exist in the data we collected. What we wanted to do though, is a little bit more sophisticated of an analysis. I know this is sort of complicated stats, but we did some structural equation modeling. (07:41) Structural equation modeling is a way to, you basically create a model and then you confirm its validity using data. Does the data support this model? It's especially useful for latent variables. Things that you can't directly observe or measure, like height or weight. Okay? A lot of the intellectual or cognitive factors that we measure are latent variables. We used this technique, and this was our model that we came up with. We wanted to know if there were relationships between these variables. So the direction of the arrow indicates the direction of the relationship, this predicts this, and then the numbers on the lines and their asterisks indicate significance of the relationship. And so you can see here that the religiosity measures, let me explain those.

Religious practices, things like, how often do you go to church? How often do you read the scriptures? Religious influences, how much does your religion influenced your daily activities?08:35

What you wear, what you eat, that kind of thing. And then religious hope is, do you believe in the afterlife? Do you believe in rewards and punishments for good and bad behavior? That kind of thing. These are all, like I said, they came from different published inventories in the literature. When we put them together as a single religiosity measurement, we did a lot of statistical analyses on it, including structural equation modeling to make sure they were a good instrument for what we were looking at. This is what we see. The religiosity factors are significantly correlated with one another, which is not surprising. We see a significant positive correlation of your religiosity and your acceptance of creationist views. These are things like, the earth was created in seven, 24 hour periods, sort of the literal creationism. We also see that your acceptance of creationist views negatively predicts your acceptance of evolutionary theory, which again is something we've seen in the literature before. (09:28) That religion has a strong influence over your acceptance. The next question we wanted to ask is, are there specific components of evolutionary theory that some religious denominations struggle with over others? We broke up our evolutionary statements into four broad categories. Human evolution statements, natural selection, how do things evolve? Age of the earth, is the earth old? And then the other things fell into a general evolution category. You can see that the same trends exist that we saw in that original data, right? With Jewish people being most accepting, down to Southern Baptist and Mormons being least accepting. What we thought was interesting from this was two things. Number one, age of the earth does not appear to be that big of an issue anymore amongst the religions, at least that we looked at. Most are okay with the earth being old. And then not surprisingly human evolution is the most controversial of all of them. (10:30)

All right. Oops. Sorry about that. I just jumped back with my thumb. Just a moment. There we go. Okay. Going to the next one. All right. That was sort of our snapshot. Then we wanted to look at some of the things that influence acceptance, that we could get at. The first one is this scientific reasoning ability. Scientific reasoning ability has been posited as an influential factor in acceptance of evolution. Let me show you what I mean by that. It can be measured by Lawson's classroom test of scientific reasoning. I use this frequently with all of my students at BYU. It seems to be a very strong predictor of their performance in introductory biology. I'm not the only one that's found that, there's several published papers on that. It's

basically, this test is a content independent, you don't need to know any biology content, test of PJ's formal and post formal operational skills. (11:27) Things like proportional reasoning, probabilistic reasoning, controlling variables. And so, these are just some of the questions. This is the controlling variables questions, the proportional question. There's 24 questions on the test. I can look at a student's score at the beginning of the semester and just about predict what their final grade in my class will be. There's been a lot of speculation that perhaps your general overall science smarts would affect your acceptance of evolution. And this came out of the actual original designer of the test, Anton Lawson, who was actually my PhD major advisor. We are tight. Anyway, he did this study back in 1992. This is path analysis. It's very similar, sort of a specific case of structural equation modeling but not really as good at doing latent variables, but it's a good statistical technique. (12:16) What he was looking at, was students scientific reasoning ability, their pre-test and post-test knowledge of evolution and pre-test and post-test test acceptance of evolution, across an introductory biology course. In his paper, they suggested that there was an indirect relationship, positive relationship between your scientific reasoning ability and your post-test beliefs, going through your knowledge. Let me explain what that means, that what he was positing, is that, the higher your scientific reasoning skills are, the more likely you are to learn evolutionary theory, and therefore the more likely you are to accept it. But he would often say to me, in lots of heated discussions we had in his office, that you have to be smart to accept evolution, right? And so I thought, I want to test that. On our sample, we actually gave these respondents, the scientific reasoning test, and we ran a structural equation model on it, to see if there was any predictive ability between your scientific reasoning and your acceptance of evolution. (13:16) It turns out that there's not. In the data we collected, there's no relationship between your scientific reasoning ability and your religiosity or your scientific reasoning ability and the acceptance of either of these viewpoints. What that means, is that, you can have really great scientific reasoning skills and still outright reject evolution, or you can have really poor scientific reasoning skills and totally accepted as a valid theory, that there is no relationship, which I find encouraging. It goes against a sort of conception in the field among scientists, that if I can just get them to think better, they will accept evolution. I think it also that idea contributes to this sort of condescending approach that some scientists take in teaching about evolution, that you don't accept because you're dumb and I'm going to make you think better and I'm going to make you smarter and therefore

you'll accept. (14:06) We see that there's no relationship there between them. That was one where we said, okay, that's not it, there's gotta be something else that's getting in the way. Then we looked at age. Because we had this sample, the sample we requested from Qualtrics. We asked them to divide it up 50%. 50% college age, so 18 to 25, and 50%, 26 and better, non college age. We wanted to know if these acceptance patterns were the same in the two different age groups. We divided it by religious affiliation. I've put the Pew forum data up there again. Can we dim those lights? Is that possible? Those top ones, if not, it's fine. It's just hard to see the numbers on there. But there's your Pew forum data. And then these are the different religious affiliations and you can see that amongst the Southern Baptist and the Catholics, and we ran a high square to make sure they were statistically significantly different or the same. (14:57) Southern Baptist in Catholics, there is no difference between college age and non-college age. Thank you. That's better. Amongst the Jewish individuals, it was interesting that the younger generation is actually less accepting than the older generation. I'm not even going to try to interpret that, but that's what that is. But amongst my population where I can speak to it, it's the opposite. Amongst LDS youth across the country, 18 to 25 year olds are more than double in their acceptance rates of the 26 and older. We found that to be really interesting, that there seems to be a shift going on in the upcoming generation. (15:38) What about human evolution? This is the big stickler, right? In human evolution, this is the Gallup poll that was done in 2014. Basically, they gave respondents three options to choose from for the origin of human beings. The first one is, human beings have developed over millions of years from less advanced forms of life, but God guided this process. This is this evolutionary creation or theistic evolution. The second one is human beings have developed over millions of years from less advanced forms and God had no part in it. A naturalistic evolution. And then the third is, God created human beings pretty much in their present state, a very short time ago. A special creation. This is where the nation falls. 42% outright reject human evolution in any form, and then the others are sort of split between God guiding it, or God not guiding it. (16:28) We asked our Qualtrics respondents, this statement. Now it's not exactly the same statement. But we asked them, evolution provides the best explanation for the origin of modern day humans. We're seeing similar things. We've got a 56% agreement with that. It's a little higher than what we're seeing over here. And then the rest follow the same patterns that you see before. Jewish are most accepting, followed by Catholics, followed by Mormons and Southern Baptist, with

their acceptance of human evolution. Then we looked by age, to see if there's a different trend by age. You can see here, I put up the Gallup data. You can reference that. Amongst Southern Baptist and Catholics, the college age and non-college age are exactly the same. Okay? Amongst the Jewish individuals, we see the same thing, the older generation is more accepting of human evolution than the younger generation. And then again, within the Mormon population, it's exactly the opposite, but not statistically significant. (17:28) All right? You see that 18 to 25, they're at 38%, 26 and older at 28%, but the p-value there indicates that it didn't reach statistical significance. However, if you look at the national average, we are still lower than the national average. That means the human evolution is still a big sticking point amongst the LDS population. Then we wanted to know, is it different at BYU? I'll remind you, this is the Qualtrics data that we collected across the country. This is anybody who affiliated with the Mormon church across the country. We had access to BYU students. Why would we think it's any different at BYU? Well, BYU is, like I said, it's highly selective and it's a religious institution. It's run by the Church of Jesus Christ of Latter-day Saints. (18:16) 98% of our student population are Mormons. But it's highly selective. Incoming freshmen GPA is a 3.9. ACT is a 29. These are sort of top of their class in high school kids that come into the institution. And so we had this data actually from a previous study we were doing, and this is, it's a slightly different statement. I want to point out that a lot of the research has shown that subtle changes in the statement you present to students or anyone, can drastically change the results. I acknowledge that the statements aren't exactly the same. There could be some differences there. But we gave them the statement, organisms existing today are the result of the evolutionary processes that have occurred over millions of years. This comes from the MATE, which is the measure of the acceptance of evolution. (19:05) Anyway, what you see, is that by the end, this is at the end of an introductory biology class, 80%, almost 81% agreed with that statement, which is wildly different than the youth that we're seeing over here in the Qualtrics sample. That was interesting. Why are they accepting so much more? That's what got us into thinking about, all right, what is it that we're doing that's changing things? Now, human evolution is not as great of a story, but still looking fairly good. This is again a slightly different statement, but it was, modern humans are the product of evolutionary processes that have occurred over millions of years. We collected this from over a thousand undergraduates at the end of their biology 100 class. We see that they're split 50, 50, but this is statistically significantly higher than what we saw in the Qualtrics sample.

We are getting better acceptance of human evolution as well. (20:04) That's what we thought was puzzling. Wow, our students are showing these big differences. And so then with this, I have to tell you, so Dr. William Bradshaw, he's an amazing man, and he taught at BYU, back when I was an undergraduate. I think I even took a class from him. He had gathered data on the students and their acceptance rates, 30 years ago. He showed up in my office just a couple of years ago and he said, "Hey, I've got this data. Do you want to do something with it?" Of course I was salivating. "Yes, I do." I rerun the exact same study that he ran 30 years ago, today, to see if there was some shift in our youth. That's what I'm going to show you here. (20:44) The first part of it, I know there's a lot on this slide. Let me help you interpret this. We gave BYU students. This is our non-majors introductory biology class, bio 100, at the very beginning of the semester. They walk in our doors and they get this essay prompt, and they have to write a five paragraph essay on their thoughts about evolution, and they turn it in, it's anonymous and we don't read them until after. Dr. Bradshaw collected data from 1987 to 1996, on over 8,500 students. We started repeating it in 2014, we're up to 755 students that have taken it now. And then what we did is, we read all of the essays and we used what's called grounded theory with emergent themes. From a layperson's perspective, it's just let me read these essays and see if really cool themes stick out to me. (21:33) Then you run it through a bunch of raters and get inter-rater reliability. We did this iterative process till we were 99% agreement on what the major theme of each of these essays was. I've got this ordered from least accepting to most accepting along the X axis. It goes all the way from my fully accepted evolution. I'm okay with evolution, but humans are different, all the way down to, how dare you even speak of it, I'm offended. Okay? That's where it ranges, and you can see the yellow bars are from 20 to 30 years ago. The red bars are today. If we look at full acceptance, we're talking about just that last bar. If we do sort of a looser interpretation of evolution, so yes, I believe in evolution, but not humans or I believe in evolution, but I have a hard time with big speciation events. That's adaptation only. (22:20) If we look at those two categories, this is where we've come. Full acceptance and loose acceptance, 30 years ago to today. We've gone from 12.7% to 38.4% and 36 to 64.8%. This is just over a 30 year time period. We'll talk more about this. This is at the beginning of their introductory biology class, before we've done anything or had any instruction. I wanted to give you though an idea of what we were seeing. I went through the essays and I picked like the most common theme that I saw from each of these time periods. I'm going to



read it to you. You can read along. 1987, the first thoughts that this theory brings to my mind, provoke a feeling of disgust and disagreement. This belief upsets me a great deal because of the passage in Genesis that States that God made man in his own image. (23:06) And thus, we are not some creature empirically derived from simpler life forms through time. Evolution is nothing more to me than a thoughtless idea created to explain how man came to be. Evolution makes me frustrated and upset. It has no direct application to today's world. That's the general trend we were seeing. Today, this is the trend we're seeing. I recognize the evolution of species all around me. I can clearly see the resemblance between primates and humans. We are so alike. We look, think reason and even feel in similar ways. Evolution makes sense to me. I know that God is the creator. I know that the account of the creation is true. It does not make sense to me that humans are a coincidence that happened by some chance of evolution. My source for this belief is different than that for evolution. (23:45) Now, the trouble or the unknown comes when I try to combine both of these truths, archeological, geological, and any other logical evidence, one may find doesn't disprove the scriptural accounts, frankly, I've thought of how to combine them and how to make them work together and I've gotten almost nowhere or at least not anywhere that makes sense to me. (24:02) Okay. This is a general feeling we get from the students, is that they've seen the science. They've seen it in high school. They've seen it. They're like, this really makes sense. But my faith says this other thing, and therefore I'm not allowed to believe it and I don't know what to do. Okay? That's when we saw a lot. I want to show you and what we'll get to the end of what we do, but we had four hypotheses for why we're seeing the shift over 30 years. And since we have access to these students, we can just ask them. We wanted to look at four different things, and I'm going to show you data that we collected on these four different hypotheses for why we are seeing the shift in the acceptance rates. (24:38) The first was better high school preparation. Maybe they're just getting a better go at it in high school, and therefore they're more accepting when they come into our classroom. We asked them, did your high school teacher cover evolution? Very encouragingly, yes, they are covering evolution. Most of the students though thought it was a week coverage. I don't know what they're basing their weak versus strong on, but they thought it was sort of a weak coverage. They are getting coverage though. That's an overwhelming coverage. We asked them... That's a really bright green on that screen. (25:11) It's like, boom. We asked them, did your high school teacher have a bias? Did you feel it was

conflicting? 63% said it was totally neutral, which is great. We do have about 20%, that said I felt a religious conflict with learning about evolution. Then we ask them, what was their acceptance when they came out of high school. Now, some of them are thinking back, but most of them are freshmen. When they came out of high school was like two weeks ago. Right? We asked them, what's your acceptance? They're evenly split between neutrality or no conflict and then mild religious conflict. I don't know. That's the data we have to support the hypothesis. They're getting a better high school coverage of it, maybe, that's pretty much all I can say from that. (25:54)

Maybe they're getting better high school coverage. Our second hypothesis, is that, there's less negative messaging by church authorities. Let me be clear about the LDS religion. The LDS religion is doctrinally neutral towards evolution. It's not pro, it's not con, it has no statement on the theory of evolution, but culturally we have not always been very neutral. That's because, because we are neutral, the authorities are allowed to have opinions and authorities on both sides of the argument have expressed those opinions and that has influenced generations of Mormons. And so there's sort of a cultural legacy of resistance to evolution. But recently with our students in this last cohort, 92% say, no, I haven't heard any negative messaging at all, which is wonderful. (26:48) The other thing we asked him about is LDS seminary coverage. Seminary is religious education for high school students, so they can choose to go to one hour a day of LDS seminary. We asked them if it was taught in LDS seminary and overwhelmingly they said, no. And if it was taught, it was taught as being compatible, which is great. The church educational system is also shifting in its messaging about evolution. And then interestingly though, we actually do have official statements that back up what I just said about the neutrality. They have been compiled by Brigham Young University into an evolution packet that can be found all together in one spot. We asked students, have you heard of this? Do you know what the official statements of the church are? And overwhelming, no, they don't. They don't know what their own religion says, which is where we come in. Right? (27:36) And so our next hypothesis was, maybe their views towards science are changing, just in general their views towards science. I want to point out two things before I show you the data on this one. Number one, the church's official stance towards science has ever changed. Okay? Joseph Smith, 1843, he was the founding prophet of the Mormon church. He said, "One of the grand fundamental principles of Mormonism is to receive truth. Let it come from which it may." Right? 1910, "Our religion is not hostile to real science. That which is

demonstrated, we accept with joy." That's the first presidency, is the prophet and his two counselors. (28:16) And then one of our most recent prophets, president Gordon Hinckley, in 1999 said, "The 20th century has been the best of all centuries. The life expectancy of man has been extended by more than 25 years. The fruits of science had been manifest everywhere. This has been an age of enlightenment." The church itself has never, ever been anti-science, but you got some of those anti-science views sometimes from the students, especially 30 years ago in that cohort. I wanted to point that out. The other thing I want to point out is that we're dealing with millennials, and millennials, there seems to be a growing trend of sort of ditching religion altogether. Right? (28:54) And so this, Ross Pomeroy is a scientist and a columnist, and he writes about these things and he says, "Religion is declining in America. In 1998, 62% of Americans said they were moderately or very religious. In 2014, that numbers dropped 54%. According to a recent study irreligion is particularly pronounced amongst younger Americans. Nearly a third of millennials were secular, not merely in religious affiliation, but also in their belief in God, religiosity and religious service attendance. While a variety of factors are likely at play, I'd like to focus on what may be the most significant contributor, science. As scientific evidence questions the tenets of religion, so too, does it provide a worldview to follow, one that's infinitely more coherent." This is one of the trends we're seeing. Interestingly, we're also seeing an opposite trend where they're becoming so anti-science and religious, that they'd totally reject science. (29:43) We're kind of creating this dichotomy. We wondered about this too, is that, is this playing a role at BYU? We looked at our Qualtrics data. Since we had it, we divided it into the younger college aged generation and the non-college aged generation and we looked at their religiosity, to see if there were differences, are the younger generation less religious. We didn't see this difference. Now, keep in mind that these are all respondents who affiliate with a religion. We're a little bit biased in our sample. But amongst those who affiliate with a religion, there's not a difference in religiosity. I can tell you from my experience at BYU teaching these students, there's not a decline in religiosity. There's an honor code at our university. Everybody has to follow it, they seem to be very overtly religious. (30:27) We aren't seeing that. But looking at trends towards science, this is what we asked them. We asked them, should intelligent design be taught in the classroom? We have 40% almost that say, yes, it should. Now I think this is a manifestation of the fairness attitude that millennials generally have. If there is an idea out there, we should be giving everybody fair treatment of this idea.

And so we're not sure with that one. The second one we asked them is about climate change. Is it real? Is it human caused? We're 50, 50, or actually we're 50, and then 30 that say, I don't care. I don't know. Right? That was that one. Then we asked about vaccines, should you avoid vaccines because of autism and things like that? Overwhelmingly 74% say, no, of course you should vaccinate your child. (31:13) As far as views towards science is changing, I think their views towards science are context specific. Depends on what topic you're talking about. In some topics they're super scientific and in other topics they're super not. I think it's a really hard one to know. We did ask them know about the conflict between science and religion. We actually asked this question, I didn't, Dr. Bradshaw asked this question 30 years ago. We are seeing a significant shift in this, where the agreement with the statement that science and religion conflict, has gone way down today. Then also that scientists can't be religious. That's also gone way down. Not as much as we'd like. This was interesting. I saw this and I was like, wow, 30% of my students think that I can't be religious, disturbing. Anyway, that's that. Maybe the views toward science are shifting or at least the views towards the conflict are shifting. (32:08) All right. The BYU effect. I want to show you and tell you about what we do at BYU and why we think we're seeing the trends that we're seeing. But first, before I do that, I just want to let you know that this is happening other than BYU, right? This is Sara Brownell's work. She's one of my associates at Arizona State University. She is doing, is at a public state institution where she's just letting students take a moment to reconcile religion and science, and they're seeing a dramatic shift in the perceived conflict that students have. This is really encouraging to me that it's being done outside of a religious institution, because at the religious institution, we have a little bit more flexibility in what we can talk about in the classroom, but they're doing the same types of things and they're getting some good results. (32:55) This just came out 2017. All right. We have this idea that what we're doing in the classroom is actually doing something. We decided to test it and sort of a preliminary test to see if we are seeing differences with what we do. I'll tell you about the intervention in a second, but I do want to show you the data. We took bio 100 classes that had the intervention and we compared them to a bio 100 class without the intervention. They both got taught evolution, and we wanted to know if we get changes in acceptance. We get a significantly greater change and acceptance if we do our intervention with students. Okay? This was the data that we published back in 2015, these essays are our other set of data. We have essays to show, are we seeing a change? (33:37) The

essay that I give to the students at the beginning of semester, we give it to them again at the end. We say, okay, now that you've had a section of bio 100, a whole semester of it, tell us what you think, have your views changed? Have they stayed the same? If so, why? These are our post essays. Again, this is showing the change across a semester. I put the pre-test data up there, so you can remember what we were seeing before. I've ordered them from least accepting or least change to most accepting of evolutionary theory. We did the same thing, grounded theory with emergent themes and categorized our essays. This last one here, I wanted to point out, this theme only came up in the recent data. This is the idea that students kept saying, well, I believed it before, but now I have evidence to back up what I thought before. (34:25) That was really encouraging. You can see that if we group, these last three are total, full acceptance of evolutionary theory. If we include the, yes, I'm good with it, but not humans, then we've got a more elusive acceptance. If I show you the numbers, I've done the math for you, right? Full acceptance, we get by the end of the semester, almost a 62% acceptance rate, full acceptance humans and animals. That was a terrible thing to say, humans and animals, humans and non-humans, animals, okay? And then loose acceptance, if you allow humans to be different than the rest of animals, then we get up to 83% acceptance, which explains that 80% acceptance we were seeing on the other data I showed you. What we're doing in the classroom is having a huge impact on their ability to recognize evolutions as a valid theory. (35:18) The question is, what are we doing in the classroom? Let me show you. How do we teach evolution? I like to call it, offering them a road to reconciliation. Okay? I want them to feel they can have both. Right? And so one of the things we emphasize, first, let me tell you, we actually spend, we take class period. It's a one 50 minute class period, before we start our evolution unit. We sit down with the students in a non-confrontational and very friendly environment and we say, hey, look, I know there's conflict for you in this. Let's talk about it. Okay? One of the things that I emphasize, is that, science and religion are complimentary. They are answering two different sets of questions, right? Science is interested in how it happened and when it happened, what are the mechanisms and when did this occur? (36:06) Whereas religion is answering who and why, what's the purpose, right? The conflict comes in when each answers tries to answer the other's questions. And so if we can keep those complimentary ways of getting at the truth, then it's okay that both are there. You can think of them as puzzle pieces that fit together. Sometimes they don't totally fit together the way you've got them and you need to look for

more puzzle pieces, instead of throwing them out, right? You can look for more puzzle pieces to fit them together. Then we sit there and we talk about, we give them the science. That's one of the things that we're very strong on, we teach the facts. This is actually a display that sits out in the hallway at BYU of hominid fossils. (36:48) This is John Hawks, he's Homo naledi. If you've heard of the new discovery. I had the opportunity to go and spend a few days with him and talk about Homo naledi, which was so amazing. We share all this with students, we don't chintz on the facts. They learn all about evolution, but we also tell them what the church says, so that they're aware of their religion stance towards evolution. I've just gathered a few of the snapshots, the full thing is available at that website at the bottom. If you want to know what the official statements are. "Whether the mortal bodies of man evolved in natural processes to present perfection, through the direction of power of God, whether they were born here in mortality, as other mortals have been, our questions not fully answered in the revealed word of God." That was in 1910. In 1959, "The church has issued no official statement on the subject to the theory of evolution." (37:36) That was by the prophet. So it's an official declaration of the church. In 2016. This just came out in a church publication last year. "The church has no official position on the theory of evolution. Organic evolution or changes to species inherited traits over time, is a matter for scientific study. Nothing has been revealed concerning evolution." We hope students feel comfortable with the fact that it's okay to learn about this. Your religion is not anti, in fact, it's neutral towards evolution. Then the last thing I'd like to show, I'm going to share it with you. This is Smoothini The Ghetto Houdini, he was on Britain's got talent. I'll show you a little clip.

Howie Mandel:	38:13	Okay. Let's see you do what you do.
Smoothini:	38:17	Am I allowed to go close to you guys?
Howie Mandel:	38:19	You can. Yes.
Smoothini:	38:20	All right. Thank you very much.
Howie Mandel:	38:21	You're welcome.
Smoothini:	38:22	Now the thing about bar magic, as opposed to regular magic, is the fact that I don't use big props. I don't, I can't afford them. That's all I have. To dazzle the world. Now, the thing about magic that happens close to your face, is that, it has to be

performed exquisitely. I can't pronounce that word correctly, but, ex use me.

Howie Mandel: 38:47 He just popped the cards.

Smoothini: 38:49 But honestly, I just do not like card tricks, because-

Howie Mandel: 39:00 That's amazing. But [crosstalk 00:39:03] coming from.

Smoothini: 39:03 I have beautiful six year old son, and I want to do something to you, Ms. Mel. That my little boy likes. Can I see you hand. The other side. Thank you. Perfect. I'm going to take this ball, put it right about here. I want you to hold that ball real tight for me. Thank you. Without bothering that ball, we're going to go abracadabra. Open up your hand.

Ms. Mel: 39:27 Shut up.

Smoothini: 39:33 Let me mentally assault you too, on the other hand. Because I am ghetto.

Howie Mandel: 39:44 Wow, he's good.

Ms. Mel: 39:47 Yeah. He's good.

Nick Cannon: 39:57 Pretty full.

Audience member: 39:58 Oh my goodness.

Smoothini: 40:05 Thank you. Not my name though. That is the name.

Howie Mandel: 40:14 Wow.

Ms. Mel: 40:23 Wowza.

Smoothini: 40:23 Thank you.

Jamie Jensen: 40:27 Okay. I show my students this clip and I tell them that when I first watched this, my mind was blown, and I was watching this and the only logical conclusion I could come to, was that he's magical. He has magical abilities. Then I was thinking about it and I thought, you know what's even cooler? He's not, and there's a way that he did that, and there's a way that I can find out how he did that, which is so much cooler to me. I tell the students the same thing I think of creation and the biodiversity we have on earth and humans the same way. Is it possible that God poofed them all into existence by magic? Well, that would

be cool if he had magic. But what's even cooler, is that, he probably didn't, and that there's a way that he did it and even cooler that I can find out, which makes biology the study of magic. That is it with [inaudible 00:41:22].

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