

# I Won't Teach Evolution; *It's Against my Religion.*

And Now for the Rest of the Story ...

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“I won't teach evolution, I don't believe in it; besides it is only a theory, and it is against my religion.” Do straightforward refutations of the foundation of biology and the accompanying rationale like this one explain all of the factors related to some biology teachers' refusal to teach evolution? Apparently not, for research presented here suggests that many teachers do not teach evolution because of their strong religious convictions. However, these teachers' strong religious convictions are directly correlated to their lack of understanding of the nature of science, as well as their lack of understanding of evolutionary theory. The remainder of this article will detail critical background information, research methodology, data analysis, and conclusions related to the following research questions:

**Research Question 1.** Are there significant correlations between teachers who claim that they reject evolution based upon their religious beliefs and the same teachers' understanding of the nature of science and their understanding of the theory of evolution?

**Research Question 2.** Do teachers with a strong understanding of the theory of evolution and the nature of science accept evolution even if they hold strong religious beliefs?

## Background Information

Evolutionary theory is considered the cornerstone of modern biology by most biologists. There is little

argument among biologists that evolution has and is happening (American Association for the Advancement of Science, 1989; National Academy of Sciences, 1999; National Association of Biology Teachers, 1995; National Research Council, 1985; Moore, 2000; Nelson & Skehan, 2000; Rutledge & Warden, 1999). In the words of prominent geneticist Theodosius Dobzhansky, “Nothing makes sense in biology except in the light of Evolution” (Dobzhansky, 1973). However, the gap between the scientific community, biology teachers, and the layperson's understanding and acceptance of the theory of evolution is large. According to a 1997 Gallop poll, nearly 40% of Americans think it would be appropriate to teach creationism rather than evolution in public schools (Moore, 2000). Nationwide, only 57% of biology teachers consider evolution to be a unifying theme in biology (Moore, 2000). This gap in acceptance of the theory of evolution between biologists, laypersons, and some biology teachers has been attributed to many factors. Two factors are the lack of understanding of the basic nature of science and the lack of understanding of the theory of evolution. This lack of understanding is characterized by quotes from lay people and biology teachers with phrases like: “Evolution is far from being proven;” “Teach evolution as a theory, not a fact;” and “Evolution is just a theory” (Bybee, 2001). These statements reveal that while science understands that a theory, like evolution, is a well-substantiated explanation of some aspect of the natural world, the public understands a scientific theory to mean a guess, a hypothesis, or lack of understanding.

In a study of a population of non-biology majors in college, the lack of understanding of both the nature of science and the theory of evolution correlated with a low acceptance rate of the theory of evolution (Bishop

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& Anderson, 1990). Lack of understanding of the theory of evolution and the nature of science seem to play a role in biology teachers' acceptance of the theory of evolution as well. After using a tool known as the "Measure of Acceptance of the Theory of Evolution Instrument" in concert with other survey techniques, Rutledge and Warden (1999) correlated both lack of understanding of the theory of evolution and lack of understanding of the nature of science with low acceptance of the theory of evolution in Indiana high school teachers. The correlation coefficients were statistically significant with values of  $r=0.7$  and  $r=0.71$ , respectively (Rutledge & Warden, 2000).

A third factor that appears to relate to acceptance of evolutionary theory is professed religious convictions that lead individuals to reject the theory of evolution. Bishop and Anderson (1990) suggested that professed religious convictions might play a more significant role in a person's acceptance of evolutionary theory than either his/her understanding of the nature of science or understanding of the theory of evolution. Bishop and Anderson (1990) retested non-biology majors as to his/her acceptance of the theory of evolution after receiving instruction in both the nature of science and the theory of evolution. The subjects received instruction as part of their non-major biology course, and their posttest responses revealed no significant change in their acceptance of the theory of evolution.

Biology majors seem to exhibit similar patterns to those described in the previous paragraph. In one study of undergraduate biology students, there was a strong degree of correlation between their rejection of evolutionary theory and their professed religious convictions (Downie & Barron, 2000). These undergraduate biology majors would presumably possess a stronger understanding of the nature of science and the theory of evolution. Therefore, Downie and Barron's research further bolsters the idea that religious conviction may play a pivotal role in a person's acceptance of the theory of evolution.

The correlation between professed religious conviction and lack of acceptance of evolutionary theory seems to hold true for biology teachers as well. Aguillard (1999) and Osif (1997) conducted research in Louisiana, Ohio, and Pennsylvania and found that biology teachers who rejected the theory of evolution often endorsed the teaching of creationism. Additionally, the biology teachers who rejected evolution often professed their rejection based upon religious convictions.

The literature suggests that there are significant correlations between acceptance of the theory of evolution and three factors. These factors are a person's understanding of the basic nature of science, his/her understanding of the theory of evolution itself, and his/her professed religious convictions. However, there appears to be limited research in the literature as to the interplay of these three factors and an individual biology teacher's acceptance or rejection and presentation of evolutionary theory. The following methodology describes research designed to address this gap.

## Methodology

High Schools in Oregon are separated into four class sizes based on enrollment by the Oregon State Athletic Association (OSAA, 2002). Twenty public high schools were selected at random from each class size for inclusion in this study. After selecting the 80 schools, each school's department chair was contacted to assist and cooperate in conducting a survey of Oregon biology teachers' understanding of the nature of science, theory of evolution, religious convictions, and presentation of the theory of evolution in their biology courses.

Seventy-nine of the 80 schools agreed to participate in the survey. The school declining did so due to the death of a faculty member that resulted in a change of job description for the lone science teacher. The participating schools were mailed up to three 90-question surveys to be completed by biology teachers. The surveys were color-coded with the green survey to be completed by the biology teacher with the most experience teaching biology, the yellow survey by the biology teacher with the least experience teaching biology, and the pink survey to be completed by the biology teacher with closest-to-the average number of years of biology teaching experience. Smaller schools, with fewer than three teachers, were mailed the appropriate number of surveys for their situation.

After selecting the member schools and mailing out the packets as described above, a follow-up letter was sent one week after the initial mailing to act as both a reminder, a thank you, and to ensure that the surveys had arrived at each site. After four weeks, department heads of schools that had not returned their surveys were contacted via phone, fax, email, or letter to encourage them to complete the surveys. Surveys not returned within the six-week time period were recorded as non-responses. Response rates for the survey are detailed in Table 1.

**Table 1.**  
Survey return rate of Oregon school by school size.

School size	Percentage of surveys returned
4A	75%
3A	64%
2A	55%
1A	60%
Total	66%

## Instrumentation

Six weeks after the conclusion of the initial mailings, the returned surveys were analyzed for correlations between biology teachers' understanding of the nature of science, understanding of the theory of evolution, acceptance of the theory of evolution, degree of religious conviction, and presentation of the theory of evolution in their biology courses. The 90-question survey represented a compilation of previous survey questions used by Rutledge and Warden (2000), as well as Osif (1997), and new material added specifically for this study. The first three sections of the survey were presented in near identical form to the Rutledge and Warden survey and used Likert scaling and multiple choice questions to assess biology teachers' acceptance of evolution, understanding of evolution, and understanding of the nature of science (Rutledge & Warden, 2000). The fourth section used 15 questions and a Likert scaling to quantify teachers' religious convictions. Twelve of these questions were presented in near identical form to the survey used by Osif (1997) in her study of Pennsylvania high school teachers. These 12 questions were originally part of a survey titled the "Christian Orthodox Scale" created at Wilfrid Laurier University in the Department of Psychology at Waterloo, Ontario, Canada. Three additional questions were added to the Osif survey to further assess a teacher's religious convictions. The fifth section of the survey consisted of four questions that used a Likert scaling to assess a teacher's presentation of evolution in his/her classroom. These questions were designed specifically for this survey. Finally, survey respondents were asked an open-ended question to help determine their religious affiliations. A complete copy of the 90-question survey and a detailed scoring guide can be downloaded at: [http://tranid.tripod.com/evolution\\_survey.htm](http://tranid.tripod.com/evolution_survey.htm).

## Limitations

Among other topics, this research investigated how teachers' religious convictions affect their presentation of the theory of evolution in their biology classes. The survey instrument focused primarily on measuring Christian religious convictions. This is a clear limitation of the study in that those teachers with religious views other than Christianity may score a low composite score on the section designed to measure religious convictions, indicating that they do not have strong religious convictions, when in fact they may hold strong religious convictions (just not strong Christian religious convictions). However, it appears that this limitation did not play a significant roll, due to the answers recorded by respondents to the open-ended question regarding their religious beliefs.

## Results

### Teacher Acceptance & Understanding of Evolutionary Theory

Analysis of the biology teachers' responses to the subscale designed to measure teacher acceptance of evolution demonstrated that Oregon biology teachers have a high level of acceptance of evolutionary theory. This subscale used a Likert scaling of responses; possible scores ranged from 20 to 100. The teachers' average score was 85.9 (Table 2).

Analysis of Item nos. 21-41 on the surveys revealed that Oregon biology teachers also have a high level of understanding of the theory of evolution. The range of scores was 0 to 21. The average score was 17.51 out of 21 or 83.4 % (Table 2).

**Table 2.**

**Teacher acceptance & understanding of evolutionary theory as measured by Survey Item nos. 1-41.**

Possible range of scores: Item nos. 1-20= 20-100 Item nos. 21-41= 0-21	Teacher acceptance of evolution: Survey Item nos. 1-20 n = 82	Teacher understanding of evolution: Survey Item nos. 21-41 n = 80
Average score	85.9	17.51
Standard deviation	17.48	2.53
Confidence limits	1.30	.19
Actual max score	100	21
Actual min score	30	10

Note: Alpha level on confidence limits measured at .05.

### Teachers' Understanding of the Nature of Science & Their Religious Convictions

Analysis of Item nos. 42-58 on the surveys revealed that Oregon biology teachers have a moderate to high level of understanding of the nature of science. Possible scores ranged from 17 to 85 and the average score was 66.08 (Table 3).

**Table 3.****Teachers' understanding of the nature of science & their religious convictions: Survey Item nos. 42-74.**

Possible range of scores: Item nos. 42-58= 17-85 Item nos. 59-74= 16-80	Teacher understanding of the nature of science: Survey Item nos. 42-58 n = 80	Teacher religious convictions: Item nos. 59-72 & 74 n = 80
Average score	66.08	45.01
Standard deviation	7.85	14.75
Confidence limits	.59	1.11
Actual max score	85	75
Actual min score	38	15

Note: Alpha level on confidence limits measured at .05.

Items 59-72 and Item 74 asked teachers a variety of questions that were combined to yield a composite score designated as their religious convictions. Analysis of these items revealed that Oregon biology teachers could be described as average with regard to their religious convictions. They are neither religiously dogmatic nor dogmatically atheistic. Possible scores ranged from 15 to 75, and the teachers' average score was 45.01 (Table 3).

Further analysis of Item no. 89 underscores the average nature of Oregon biology teachers' religious convictions. Item no. 89 stated, "Specify your primary religious affiliation, be as specific as possible; i.e. Mormon, Southern Baptist, Atheist, etc." Forty-eight of the respondents answered the question while 35 left it blank. Of the 48 respondents, six described themselves as agnos-

tic, five as atheist, two as "none," one as "spiritual but not religious," one as "not necessary," and one as Unitarian/Buddhist. The remaining respondents constituted 18 different groups that could broadly be called Christians. Of the Christian groups, eight referred to themselves as simply "Christian," six as "non-denominational Christian," five as "Presbyterian," and four as "Methodist." The remaining 14 groups of Christians had memberships of one or two. It is

difficult to characterize the 35 non-responses; they may represent people who were not religious at all, people who did not wish to share their religious affiliations, or people who were religious but held no specific religious affiliation. These non-responses further illustrate that no particular religious affiliation is prevalent among Oregon biology teachers, and that there is not a common set of religious convictions.

### Teacher Presentation of the Theory of Evolution

Item nos. 75, 77, 78, and 81 posed a variety of questions that were combined to yield a composite score designated as teachers' presentation of the theory of evolution in their classrooms. Analysis of these items demonstrates that Oregon biology teachers' presentation of evolution in their classrooms could be characterized as a "major" role in their biology courses, whereas their presentation of creationism represents a "minor" role in their classrooms. Possible scores ranged from 4 to 20, and the average score was 15.83 (Table 4). A score of 4 indicated that a teacher placed evolution in a minor role in his/her classroom and that he/she gave equal time to creationism, whereas a score of 10 correlated to a teacher placing major emphasis on evolutionary theory and presenting no creationism (Table 4).

**Table 4.****Teachers' presentation of the theory of evolution in their classrooms.**

Possible range of scores = 4-20	Teacher presentation of the theory of evolution: Survey Item nos. 75, 77, 78, & 81 n = 80
Average score	15.83
Standard deviation	3.08
Confidence limits	.23
Actual max score	20
Actual min score	8

Note: Alpha level on confidence limits measured at .05.

## Inter-Correlational Analysis of Teacher Presentation of Evolution & Other Subscales

Table 5 presents the many statistically significant correlations discovered with regard to teacher presentation of evolution. These correlations are discussed and presented graphically in the following paragraphs.

The most significant correlation was between teacher acceptance of evolution and religious convictions. The correlation coefficient of  $r = -0.80$ , presented graphically in Figure 1, demonstrates that teachers with strong religious convictions accept the theory of evolution less often than their less religiously-convicted peers.

The second strongest correlation found in this study was between teachers' presentation of evolutionary theory in their classrooms and their acceptance of evolutionary theory. The correlation coefficient of  $r = 0.72$ , presented graphically in Figure 2, demonstrates that teachers who do not accept evolutionary theory do not present it in their classrooms.

Teachers' presentations of evolutionary theory are also directly correlated to teachers' understanding of the theory of evolution as well as teachers' understanding of the nature of science. The correlation coefficients for these two factors ( $r = 0.50$  and  $r = 0.59$  respectively,) are presented graphically in Figures 3 and 4. If a teacher does not understand the theory of evolution, he or she is less likely to present it in their class. Furthermore, if they do not understand the nature of science, they are less likely to present the theory of evolution.

A strong correlation was discovered with regard to teachers' presentations of evolution in their classrooms and teachers' religious convictions. This markedly negative correlation scored a correlation coefficient of  $r = -0.65$  and is presented graphically in Figure 5. Teachers who possess strong religious convictions are much less likely to present evolution in their classrooms than their less religiously-convicted peers.

**Table 5.**

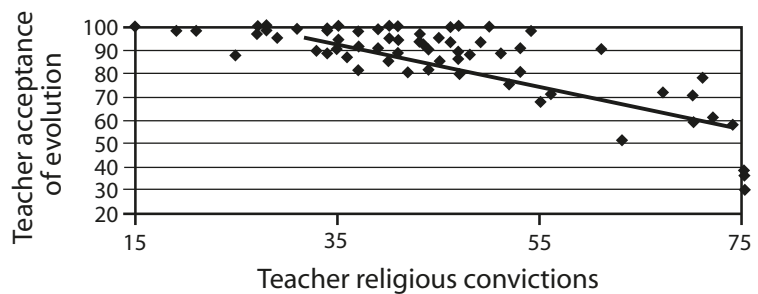
**Inter-correlation between teacher presentation of evolutionary theory & other subscales.**

SUBSCALE	1	2	3	4	5
1. Presentation of evolutionary theory	—	.72	.50	.59	-.65
2. Acceptance of evolutionary theory		—	.70	.65	-.80
3. Understanding of evolutionary theory			—	.55	-.65
4. Understanding of the nature of science				—	-.58
5. Religious convictions					—

Correlations statistically significant at alpha .05 with 80 degrees of freedom if above .217.

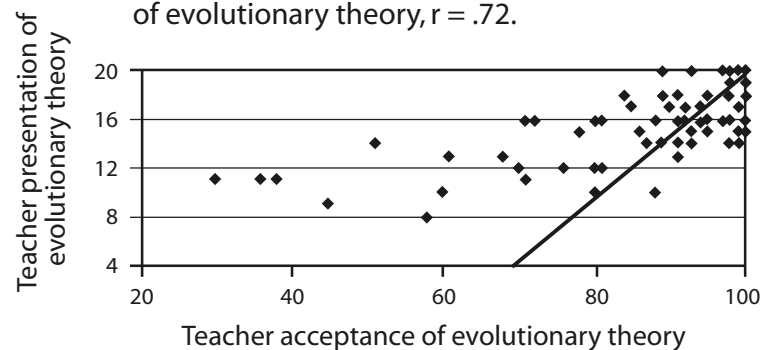
**Figure 1.**

Correlation of teacher acceptance of evolution with teacher religious convictions,  $r = .80$ .



**Figure 2.**

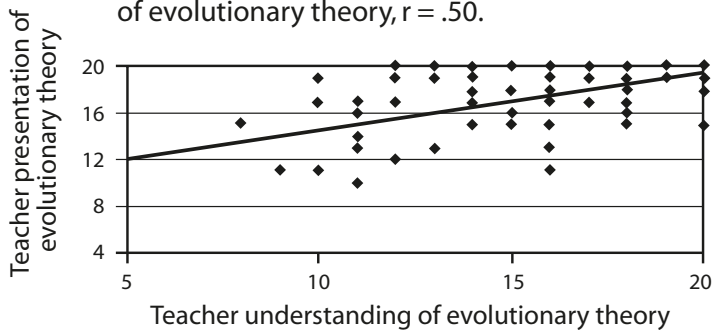
Correlation of teacher presentation of evolutionary theory with teacher acceptance of evolutionary theory,  $r = .72$ .



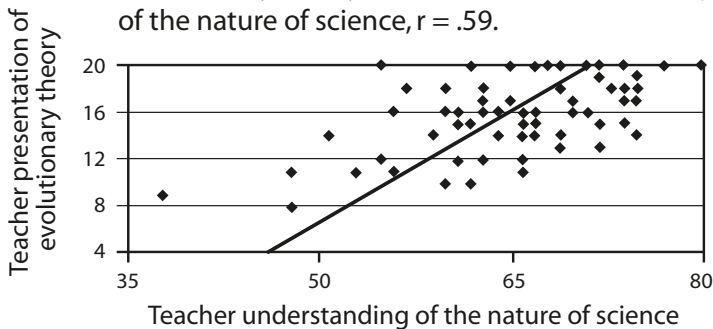
The data presented in Figures 1-5 show that the stronger a teacher's religious convictions, the less likely he/she is to present evolution. The data also demonstrate that if teachers have a strong understanding of the



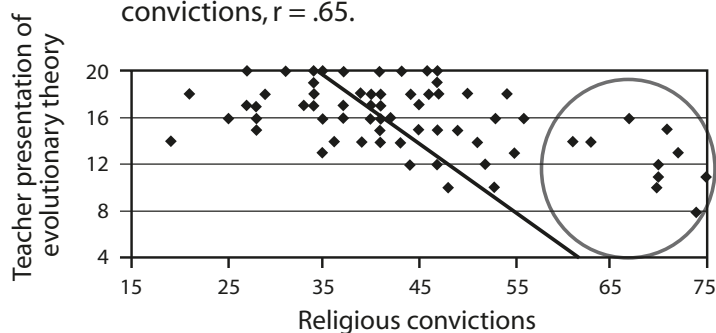
**Figure 3.**  
Correlation of teacher presentation of evolutionary theory with teacher understanding of evolutionary theory,  $r = .50$ .



**Figure 4.**  
Correlation of teacher presentation of evolutionary theory with teacher understanding of the nature of science,  $r = .59$ .



**Figure 5.**  
Correlation of teacher presentation of evolutionary theory with teacher religious convictions,  $r = .65$ .



nature of science and the theory of evolution, they will be more likely to present evolution. However, these correlations have been noted previously by Rutledge and Warden (2000), Aguillard (1999), and Osif (1997), and they do not really answer the core question behind this research. Recall that the first question of this article

attempted to determine if there were significant correlations between teachers who reject evolution on religious grounds and those same teachers' understanding of the nature of science and the theory of evolution. Figures 6 and 7 begin to address these questions.

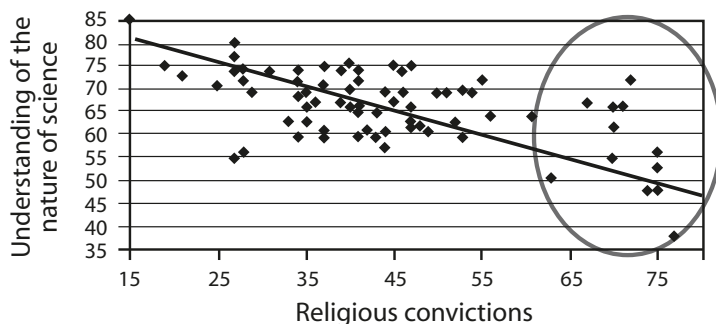
Figures 6 and 7 graphically present the correlations between teachers' religious convictions and their understanding of the nature of science, as well as their understanding of the theory of evolution. These negative correlations ( $r = -0.58$  and  $r = -0.65$  respectively,) indicate that, in general, the stronger a teacher's religious convictions, the less he/she understands both the nature of science and the theory of evolution.

On the surface, Figures 5-7, seem to paint a clear picture; religious biology teachers in Oregon do not present evolution and they do not understand the nature of science or the theory of evolution. However, does this mean that all teachers with religious convictions do not present evolution and do not understand both science and evolution? Perhaps not; the correlations in Figures 5-7 may have been skewed by teachers with strong or extreme religious convictions. Notice that in Figures 5-7, a group of outliers has been highlighted with a red circle. These outliers represent a group of 13 teachers who have strong or extreme religious convictions.

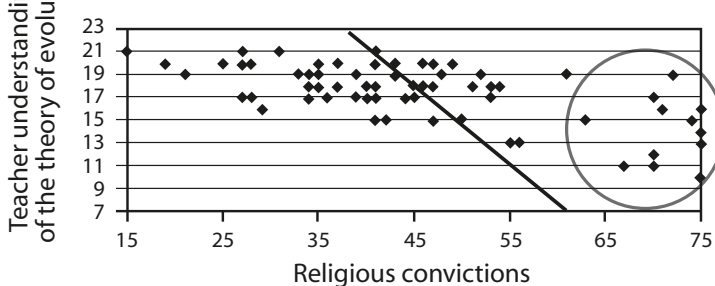
For the purpose of this research, teachers who scored more than two standard deviations above the mean on the religious convictions portion of the survey were characterized as having extreme religious convictions. Five teachers fit this profile. Teachers who scored between one and two standard deviations above the mean were characterized as having strong religious convictions; there were eight teachers who fit this profile.

Table 6 illustrates how biology teachers with extreme and strong religious convictions scored on all parts of the survey relative to all survey respondents. Teachers with extreme religious convictions scored nearly three standard-deviations below the mean on their acceptance of evolutionary theory, and more than two standard-deviations below the mean on their understanding of evolution and their understanding of the nature of science. Teachers with extreme religious convictions scored 1.7 standard-deviations below the mean with regard to their presentation of evolutionary theory.

**Figure 6.**  
Correlation of teacher religious convictions with understanding of the nature of science,  $r = .58$ .



**Figure 7.**  
Correlation of teacher religious convictions with their understanding of evolution,  $r = .65$ .



The scores of strongly religious teachers mirrored the pattern found in the scores of extremely religious teachers. Table 6 further illustrates how strongly religious teachers scored on all parts of the survey relative to all survey respondents. Teachers with strong religious convictions scored more than one standard-deviation below the mean on their acceptance of evolution, their understanding of evolution, and their presentation of evolutionary theory. Relative to the teachers with extreme religious convictions, teachers with strong religious convictions seem to have a better understanding of the nature of science. However, they still scored 0.7 standard-deviations below the group mean on their understanding of the nature of science, so they by no means have a firm understanding of the nature of science.

It is unsettling that there is a minor portion of the population of biology teachers who reject evolution based upon religious beliefs, yet at the same time has both a poor understanding of evolutionary theory and the nature of science. However, this group of teachers is small and does not represent the average Oregon biology teacher.

Data generated from these extremely and strongly religiously-convicted teachers should not be misconstrued as evidence that all teachers with religious beliefs possess an abnormally weak understanding of the theory of evolution or the nature of science. In fact, it appears that many religious teachers have a firm understanding of both evolution and the nature of science. The data generated by these less religiously-convicted teachers represent an answer to this article's second research question: Do teachers with a strong understanding of the theory of evolution and the nature of science accept evolution even if they hold strong religious beliefs?

Teachers with moderate religious convictions were described as teachers who scored between zero and one standard-deviation above the mean of the entire group on the religious convictions portion of the survey. There were 23 teachers who were moderately religious, and their scores on the understanding of the nature of science, understanding of the theory of evolution, and acceptance of the theory of evolution were not significantly different than the average scores of the entire group (Table 7). So, at least 23 teachers who thought of themselves as religious possessed understandings of the nature of science and the theory of evolution commensurate with the group mean (Table 7).

Teachers who have a strong understanding of the nature of science and the theory of evolution accept evolution, even if they are religious. In other words, you can be religious and accept evolution.

## Conclusions

Biology teachers in Oregon, for the most part, have a firm understanding of the nature of science and the theory of evolution. These understandings translate into a significant presentation of the theory of evolution in their classrooms. Many of Oregon's biology teachers are also religious and their religious convictions do not seem to prevent them from presenting evolution.

However, based on the data collected in this research, 16% of Oregon biology teachers do not present evolution, do not understand science, do not understand evolution, and have either strong or extreme religious convictions. These teachers may state that they reject evolution based upon their religious convictions, but their rejection of the evolutionary theory appears to also be related to their lack of understanding of the theory itself and their lack of understanding of the nature of science.

**Table 6.****Comparison of extremely & strongly religious teachers with all survey respondents.**

Possible range of scores Item nos. 1-20= 20-100 Item nos. 21-41= 0-21 Item nos. 42-58= 17-85 Item nos. = 75, 77, 78, & 81	Mean scores of all survey respondents n = 82	Mean scores of extremely religious teachers n = 5	Extremely religious scores as number of standard deviations below the mean	Mean scores of strongly religious teachers n = 8	Strongly reli- gious scores as number of standard deviations below the mean
Acceptance of evolutionary theory: Item nos. 1-20	85.9	35.8	- 2.87	65.13	- 1.19
Understanding of evolutionary theory: Item nos. 21-41	17.59	12.8	- 2.03	14.5	- 1.31
Understanding of the nature of science Item nos. 42-58	66.2	50.2	- 2.13	60.88	- .71
Presentation of evolutionary theory Item nos. = 75, 77, 78, & 81	15.83	10.6	- 1.7	12.38	- 1.12

Extremely religious teachers scored 2 standard deviations above the mean on Item nos. 59-72 & 74. Strongly religious teachers scored between one and two standard deviations above the mean on Item nos. 59-72 & 74.

**Table 7.****Comparison of moderately religious teachers with all survey respondents.**

Possible range of scores Item nos. 1-20= 20-100 Item nos. 21-41= 0-21 Item nos. 42-58= 17-85 Item nos. = 75, 77, 78, & 81	Mean scores of all survey respondents n = 82	Mean scores of moderate- ly religious teachers n = 23	Moderately religious scores as number of standard deviations dif- ferent than the mean
Acceptance of evolutionary theory: Item nos. 1-20	85.9	88.95	- .17
Understanding of evolutionary theory: Item nos. 21-41	17.59	17.9	.13
Understanding of the nature of science: Item nos. 42-58	66.2	66.55	.05
Presentation of evolutionary theory: Item nos. = 75, 77, 78, & 81	15.83	15.55	- .09

Moderate religious teachers scored between the mean and one standard deviation above the mean on Item nos. 59-74.

There are many ramifications of this group's non-acceptance of evolutionary theory; the most obvious of which is that they do not present the foundation of modern biology. However, if they did present evolution, their presentation most probably would be fraught with inaccuracies, including the presentation of creationists' arguments as valid scientific principals due in large part to their poor understanding of the theory of evolution (Table 6). Finally, their tenuous understanding of the nature of science itself most probably will be evidenced in their students' receiving a less-than-accurate education into the inner workings of science (Table 6). Students may very well walk away from their classroom not understanding the self-imposed limitations of science to investigate only natural phenomena. Or, that only



empirically-repeatable evidence can be accepted in science. Or, the students may walk away from the classrooms of 16% of the biology teachers in Oregon not understanding that science is not a belief system. They may not understand that science cannot accept things on faith.

These 16% of biology teachers and the general relationships between teachers' religious convictions, their presentation of the theory of evolution, their understanding of the theory of evolution, and their understanding of the nature of science represent a challenge that public schools in Oregon need to address if they hope to provide strong legitimate science education. The most obvious way to address these challenges is to hire only biology teachers with a strong understanding of science and evolution. Perhaps if we screened biology teacher candidates more thoroughly as to their understanding of science and evolution, we would not hear people claiming that they do not teach evolution because it is against their religion.

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