Evolution vs. Creationism in the Classroom: The Lasting Effects of Science Education*

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Abstract

Anti-scientific attitudes can impose substantial costs on societies. Can schools be an important agent in mitigating the propagation of such attitudes? This paper investigates the effect of the content of science education on anti-scientific attitudes, knowledge, and choices. The analysis exploits staggered reforms reducing or expanding the coverage of evolution theory in US state science education standards. I compare adjacent cohorts in models with state and cohort fixed effects and conduct fine-grained placebo tests to rule out scientific, religious and political confounders. There are three main results. First, expanded evolution coverage increases students' knowledge about evolution. Second, the reforms translate into evolution approval in adulthood, but do not crowd out religiosity or affect political attitudes. Third, the reforms affect high-stakes life decisions, namely the probability to work in life sciences.

JEL-Codes: Z12; I28; J24; P16

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1 INTRODUCTION

Anti-scientific attitudes can impose substantial costs on public health, the environment, and the economy. Misinformation about the danger of Covid-19 and a lack of trust in scientists and has undermined compliance with social distancing measures and vaccination recommendations, prolonging the pandemic (Bursztyn et al., 2020; Algan et al., 2021; Brzezinski et al., 2021; Jin et al., 2021). Climate change denial has reduced the support for policies cutting greenhouse gas emissions, contributing to its environmental and economic damage (Akter et al., 2012; Linden et al., 2015). The rejection of evolution theory has been used to justify white supremacy and racism in the US (Marks, 2012), and has contributed to anti-scientific agricultural policies and resulting food shortages in the Soviet Union (Graham, 2016).[1] While the societal costs of anti-scientific attitudes are well understood, evidence on its determinants is surprisingly scant despite its relevance for effective policy responses.

This paper isolates the content of high school science education as one determinant of anti-scientific attitudes that is directly subject to the policy maker.[2] To study whether the content of science education has lasting effects on individuals beyond attitudinal outcomes, the paper also analyzes how it affects scientific knowledge and life decisions. Specifically, I estimate the causal effect of students' exposure to the teaching of evolution theory in science education on (i) their knowledge about evolution at the end of schooling, (ii) their attitudes on evolution in adulthood, and (iii) the probability that they work in life sciences.

The focus of this paper is on evolution theory because of its fundamental role in

[1]The pseudoscientific theories of Trofim Lysenko, then-president of the Academy of Agricultural Sciences of the USSR and leading agricultural advisor to Joseph Stalin, have been made responsible for prolonging Soviet foot shortages in the 1930s ("Lysenkoism") (Joravsky, 1962).

[2]In general, attitudes are shaped by a multitude of factors many of which are rather shielded in the private domain. A large literature on the formation of attitudes and beliefs has emphasized the impact of inter-generational transmission in families (Bisin and Verdier, 2001; Guiso et al., 2008; Tabellini, 2008). Other determinants include peers and social networks (Sacerdote, 2001; Bailey et al., 2020), the media (Martin et al., 2017), political systems (Alesina and Fuchs-Schündeln, 2007), and macroeconomic conditions (Giuliano and Spilimbergo, 2014).

science, and its controversy in the population and the education system. Evolution can scientifically explain the existence of all species including our own. The American Association for the Advancement of Science (2021) states that “the foundation of all life sciences is biological evolution”. 98 percent of its members express support for the statement that humans have evolved over time (Pew Research Center, 2015). In contrast, evolution is a highly charged topic in the US population with only 65 percent agreeing that humans have evolved over time. This controversy has been reflected in heated debates and legal battles from before World War I to the present day on whether evolution is supposed to be taught in schools.[3] Teachers and school districts have been convicted for not following the educations standards’ stance on evolution. Even today, there is substantial variation across US states and years in the way how evolution is covered in education standards.

To isolate exogenous variation in students’ exposure to the teaching of evolution, this paper exploits staggered state-level reforms of the coverage of evolution in US State Science Education Standards (Science Standards). In the study period from 2000 until 2009, 22 states expanded the coverage of evolution in their education standard, and 15 states reduced it. I argue that the political and institutional processes leading to these reforms, in particular the predetermined timing of gubernatorial elections and the tenure of members of State Boards of Education, create idiosyncrasies in the determination of the precise reform years. This setting allows for the estimation of causal effects in two-way fixed effects models with state and cohort fixed effects, overcoming the identification problem that the content of science education is generally correlated with scientific, religious and political attitudes of the students’ environment which independently affect student outcomes.

Beyond the theoretical argument that the reform timing is determined by institutional idiosyncrasies, my empirical setup takes explicitly care of a range of endogeneity concerns by comparing adjacent cohorts around sharp reforms of the State

[3] For example, the New York Times published a report on recent controversies with the headline “Questioning Evolution: The Push to Change Science Class” (Haberman, 2017).

Standards. Specifically, the performed two-way fixed effects estimations can rule out as confounding factors (i) state-specific differences (such as education levels), (ii) cohort-specific differences (such as national changes in attitudes across time), (iii) time-varying state-specific shocks that affect adjacent cohorts similarly (such as natural disasters or state-level political or religious shocks that do not differentially affect children of different cohorts), and (iv) time-varying state-specific shocks that affect adjacent cohorts differentially, but smoothly (such as state-specific trends in science skepticism), in a robustness test that includes state-specific time trends. To conduct the set of analyses, I link state-level data on the evolution coverage in Science Standards with three individual-level datasets.

First, this paper shows that the evolution coverage in Science Standards affects what students learn about evolution in school. Specifically, I use the National Assessment for Educational Progress (NAEP) to demonstrate that students being exposed to a more comprehensive evolution coverage in high school are more likely to answer knowledge questions on evolution correctly by the end of high school. This finding exemplifies how the content of education standards can foster scientific knowledge, an outcome of direct economic importance given its effects on earnings and economic growth in the long run (Lucas, 1988; Barro, 2001; Hanushek and Woessmann, 2008, 2012).

Second, this paper demonstrates that the evaluated reforms have lasting effects on attitudes. To that end, I make use of the General Social Survey (GSS) to show that evolution teaching affects the probability to approve of the concept of evolution in adulthood. Being exposed in high school to a comprehensive evolution coverage in the education standard as opposed to no evolution coverage increases evolution approval in adulthood by 57 percent of the sample mean. This analysis underscores that reform effects persist long after students have left high school. This result exemplifies how science education can promote scientific attitudes, which can be directly relevant for improving public health, the environment, and the economy (Brzezinski et al., 2021; Martinez-Bravo and Stegmann, 2021).

Third, this paper shows that the evaluated reforms affect high-stakes choices, namely occupational choice. I hypothesize that learning about evolution, the fundamental theory of life sciences, affects the probability to work in life sciences in adulthood. Using the American Community Survey (ACS), I demonstrate that being exposed in high school to a comprehensive evolution coverage in the education standard as opposed to no evolution coverage increases the probability to work in life sciences in adulthood by 23 percent of the sample mean. This effect is mostly coming from the subgroup of biology, the subject in which evolution is typically being taught. This finding exemplifies how science education can attract future STEM workers, which does not only raise wages at the individual level (Hastings et al., 2013; Kirkeboen et al., 2016; Deming and Noray, 2020), but also has wider economic consequences through fostering innovation, technological change, labor productivity and economic growth (Griliches, 1992; Jones, 1995; Kerr and Lincoln, 2010; Peri et al., 2015).

A particularly useful feature of focusing on one topic such as evolution is the possibility to construct fine-grained placebo tests. Testing whether reforms affect non-evolution outcomes constitutes falsification tests. Specifically, I show null effects for (i) non-evolution scientific knowledge by the end of high school, (ii) non-evolution scientific, religious, and political attitudes in adulthood, and (iii) the probabilities to work in non-scientific occupational fields. These results provide empirical support for the interpretation that it is indeed institutional idiosyncrasies which determine the exact reform timing and not scientific, religious, and political trends or shocks. I further demonstrate that the reform effect on evolution knowledge is specific to students in public schools, while there is no effect for a placebo sample of private school students for whom Science Standards have never been binding. I also present event-study graphs which show no pre-trends. They also demonstrate that reform effects occur soon after reform adoption and are more pronounced for the group of states which reduce their evolution teachings relative to those which expand their teachings. Another robustness check replicates the main results on a subsample using only states with closely elected governors ruling at the time of the reform. In addition, the results are immune to potential biases in staggered two-way fixed effects designs from time-varying treatment effects (Callaway and Sant'Anna, 2021).

This paper contributes to the literature on the political economy of schooling (Lott, 1999; Cantoni and Yuchtman, 2013). I provide the first quasi-experimental evidence that attitudinal changes induced by reforms of the content of education translate into high-stakes choices of individuals. Cantoni et al. (2017) exploit a Chinese textbook reform to show that the content of education affects students' political and economic attitudes. Other seminal papers study the effects of the content of education on cultural identity (Clots-Figueras and Masella, 2013), civic values (Bandiera et al., 2019), and religiosity (Bazzi et al., 2020). While these papers show effects on attitudes, I go beyond that and demonstrate that high-stakes occupational choice is also affected.

At the same time, this finding enhances our understanding of how to increase the share of STEM graduates, which is a widely shared policy goal in many societies.[4] We know that occupational sorting is influenced by demand side factors such as expected earnings and non-pecuniary job benefits (Wiswall and Zafar, 2018; Arcidiacono et al., 2020), perceived ability (Stinebrickner and Stinebrickner, 2014; Arcidiacono et al., 2016a), and heterogeneous tastes (Wiswall and Zafar, 2015). Supply side factors such as grading policies (Butcher et al., 2014), admissions systems (Bordon and Fu, 2015), affirmative action policies (Arcidiacono et al., 2016b), or the provision of role models (Jackson et al., 2020) can also play a role (for an overview, see also (Altonji et al., 2016)). We demonstrate that the content of science education in high school can be an effective policy tool to attract STEM graduates.

This paper also speaks to the emerging literature on the determinants of religiosity (Iannaccone, 1998; Iyer, 2016; McCleary and Barro, 2019). Finding null effects on religious outcomes demonstrates that neither believing in nor belonging to religions is reduced by

[4]In the US, increasing the number of STEM graduates is a central policy goal of the Federal Government's strategic plan for STEM education 2018-2023 (National Science and Technology Council, 2018). Similarly, the EU aims to increase the number of STEM graduates as one of its twelve policy goals of the European Skills Agenda 2020-2025 (European Commission, 2020).

expanding the scientific content of science education. This is true despite the fact that being raised as Evangelical is the largest negative predictor of evolution approval in this study. While a number of studies have found a positive relationship between education and religiosity (McCleary and Barro, 2006; Glaeser and Sacerdote, 2008; Meyersson, 2014), other research suggests that education can decrease religiosity (Hungerman, 2014; Becker et al., 2017). In the specific setting of evolution teaching in the US, religiosity is not crowded out.

Lastly, this paper contributes to the literature on the effects of the content of education on students' knowledge. While the effects of topic-specific instruction time (Cortes and Goodman, 2014), minimum high school course requirements (Goodman, 2019), advanced placement courses (Conger et al., 2021), vocational school curricula (Schultheiss and Backes-Gellner, 2021), and the interaction of curricula and internet penetration (Sen and Tucker, 2022) are well understood, this paper can show that the content of education standards affects the knowledge of students on the topic in question in the intended direction.[5] Even more, the effects of the content of education standards last into adulthood.

The paper proceeds as follows. Section 2 outlines the historical and institutional background of the teaching of evolution. Section 3 provides information on the data measuring the coverage of evolution in Science Standards and the microeconometric datasets. Section 4 describes the identification strategy. Section 5 presents the results. Section 6 discusses robustness tests. Section 7 concludes.

2 INSTITUTIONAL BACKGROUND

2.1 The Battle for Teaching Evolution in US Public Schools

The teaching of evolution in public schools has been a contested issue for at least a century in the US. Although the scientific community reached a consensus on the validity of

[5] Arold and Shakeel (2021) show that the adoption of centralized education standards in the US in math and ELA had *unintended* effects on students' *overall* science achievement.

evolution relatively soon after Charles Darwin's publication of "On the Origin of Species" (Darwin, 1859),[6] the public did not share the consensus. This was and still is reflected in the educational system. For the decades before World War I, Beale (1941) describes that teachers wanting to teach evolution in an average American school had difficulties to do so. Only one quarter of the biology textbooks published between 1900 and 1919 contained information about evolution (Skoog, 2005). No book covered human evolution. In the 1920s, about one third of biology textbooks covered human evolution, documenting an early phase of a gradual and non-linear development throughout the 20^{th} century towards more evolution coverage in US high school biology textbooks.

However, the 1920s also marked the start for a series of legal disputes about the teaching of evolution in US schools throughout the 20^{th} century. At least 20 states considered bills to ban the coverage of evolution in public schools in the 1920s (Numbers, 1982). Among other states, such a bill became law in Tennessee, known as the Butler Act, which resulted in the famous Scopes trial in 1925. John T. Scopes, a biology teacher from Tennessee, was convicted in Tennessee v. Scopes for having taught evolution in the classroom. Although the Tennessee Supreme Court overturned the decision on a technicality, it decided that the law banning evolution from schools was not unconstitutional (Larson, 1999).

In the second half of the 20^{th} century, legislative and adjudicative decisions became more favorable towards the coverage of evolution in public schools (Moore et al., 2003b). In 1967, the Butler's Act was repealed by the Tennessee legislature. One year later, the Supreme Court of the US ruled that a law banning the teaching of evolution in schools in Arkansas was unconstitutional in Epperson v. Arkansas. As a reaction, creationists lobbied for laws requiring that equal time must be spent on teaching evolution and creation. In 1987, this was ruled unconstitutional by the US Supreme Court in Edwards

[6] Thomas Henry Huxley (1880, p.1) stated that "there is no field of biological inquiry in which the influence of the 'Origin of Species' is not traceable [...] and the general doctrine of evolution [...] may conduct its conquest of the whole realm of Nature". Ernst Mayr (1991, p.25), a leading evolutionary biologists of the 20^{th} century, wrote that "within fifteen years of the publication of the Origin hardly a qualified biologist was left who had not become an evolutionist".

v. Aguillard. In sum, the legal decisions of the 20^{th} century have paved the way for evolution to be taught in public schools. In the 21^{st} century, creationism and intelligent design are not permitted to be taught in US public schools anymore. Still, there remains substantial variation in evolution teaching across states and years, as the subsequent analysis of the evolution coverage in Science Standards demonstrates.

2.2 US State Science Standards

US State Science Standards serve as state-wide school curriculum frameworks in science. Historically, the content of US education has been determined at the local level. However, concerns about achievement declines of US students in the 1960s and 1970s and resulting economic costs (Hanushek, 1986; Bishop, 1989) gave rise for calls to establish rigorous and comparable education standards. In 1983, the report "A Nation at Risk" (National Commission on Excellence in Education, 1983) proposed the introduction of centralized education standards.[7] Several organizations have proposed guidelines for centralized educational standards for the different school subjects. Regarding science, the American Association for the Advancement of Science developed the Science Standard guidelines "Science for All Americans" (1990) and "Benchmarks for Science Literacy" (1994), and the National Research Council published the "National Science Education Standards" (1996). By 2000, all states except for Iowa had adopted Science Standards (Lerner, 2000a).

Science Standards define the scientific knowledge and skills students are supposed to master in a given grade in public schools. The scientific teaching a student is ultimately exposed to in class does not solely depend on the Science Standard of her state, but also on local school curricula, the selection of textbooks, the knowledge, ability and ideology of teachers, testing formats, and other factors. However, Science Standards form the basis

[7]Theoretically, centralized education standards can be more rigorous as they overcome a free-riding problem induced by the mobility of high school graduates across school districts and their pooling in the local labor markets (Costrell, 1994, 1997). At the same time, centralization can also reduce the incentive to develop rigorous and innovative education standards by abolishing competition between school districts (Tiebout, 1956; Oates, 1999).

of many of these factors and thereby, indirectly, affect the science teaching in schools. For instance, they affect how local curricula and lesson plans of teachers are written (Lerner, 2000b). Furthermore, science textbooks are arranged to match the content laid out in Science Standards, particularly reflecting the standards from larger states. In addition, statewide standardized exams often directly test the content set out in the Science Standards. Lerner (2000b, p.ix) summarizes that "the knowledge and skills set forth in state standards are supposed to form the core of "standard based" education reform. They are meant to serve as the frame to which everything else is attached, the desired outcome that drives countless other decisions about how best to attain it."

With regards to evolution, 88 percent of a nationally representative sample of US public high school biology teachers state that they focus heavily on what students need to know to meet Science Standards when teaching evolution (Figure A.1). Furthermore, I show suggestive evidence that teachers who are exposed to a more comprehensive coverage of evolution in the Science Standards spend more time on teaching evolution (see Appendix A.1 and Table A.1 therein).

2.3 Reform Examples from Florida and Texas

Reforms of the evolution coverage in Science Standards form the basis of the two-way fixed effects design performed in this paper. The following two reform examples illustrate how such reforms come into existence. While Florida expanded the evolution coverage in 2008, Texas reduced it in 2009. The Science Standard in power in Florida before 2008 did not mention the word "evolution", and its discussion of evolutionary processes (under a different wording) were minimal.[8] In February 2008, the Florida Board of Education voted 4:3 in favor of a new Science Standard that included evolution comprehensively. This close majority emerged after years of debating and drafting the Standard. In fact, the Standard was re-drafted yet another time just hours before the final vote. Replacing the term "evolution" by "the scientific theory of evolution" secured the majority ultimately.

[8] Lerner (2000b, p.14) describes the Science Standard as "Extensive standards that skim lightly over biological and geological evolution without ever mentioning the word. Not satisfactory."

The new Standard captured biological, geological, cosmological and even human evolution comprehensively (Mead and Mates, 2009).

In contrast to Florida, Texas reduced the evolution coverage in 2009. The evolution coverage in the Science Standard in place in 2000 was described as "brief but satisfactory" (Lerner, 2000b, p.15). It contained all areas of evolution except for human evolution. In 2003, Don McLeroy, the then-chairman of the Texas Board of Education, pushed for a much more limited evolution coverage. He stated that he personally does not believe in Darwin's evolution theory and in the earth being older than a couple of thousand years which was in part reflected in the Science Standard proposal. In 2003, his reform proposal found no majority in the Board of Education, and years of debate followed. In 2009, he proposed another Science Standard which required that "strengths and weaknesses" of evolution should be taught. This was regarded by some as an attempt to open up room for the teaching of creationism at the teachers' discretion, without mentioning creationism explicitly in the Science Standard. It was voted down 8-7. A second version required students to study the "sufficiency or insufficiency" of key principles of evolution. It was also voted down 8-7. A third attempt which contained creationist jargon more subtly was ultimately approved by 13-2 votes. This new Science Standard left out some areas of the teaching of evolution and added "pieces of creationist jargon" (Mead and Mates, 2009, p.366). For example, the phrase that "the estimated age of the universe was 14 billion years" was removed. Notably, the reforms in Florida and Texas did not follow a partisan change as all governors in Florida and Texas in the 21^{st} century have been Republican. Both reform examples shed light on the political process behind such reforms, and show that they are not simply a consequence of a change of government.

2.4 The Adoption Process of Reforms of Science Standards

Understanding the political process leading to reforms of the evolution coverage in Science Standards is of particular interest for assessing whether they create exogenous variation in students' exposure to the teaching of evolution. In this section, I argue that the fact that such reforms happen *at some point* is not as-good-as-random, but that the *specific timing* of such reforms is as-good-as-random given substantial institutional idiosyncrasies.

Reforms of Science Standards are decided on by majority vote of the members of the State Boards of Education. The selection process of the members of the State Boards of Education differs across states. In some states, the members are appointed by the governor, sometimes with the advice and consent of the senate (for example in California and Florida). In other states, the State Boards of Education members are elected by the public, typically in a staggered election across districts (for example in the District of Columbia and Texas). Some states combine the two selection mechanisms by appointing some members and electing others (for example Louisiana and Ohio). Student representatives or external experts are also appointed or elected in some states (for example in Alaska and Massachusetts).

Before the members of the State Board of Education vote on a reform of Science Standards, the standards are typically drafted by advisory committees. The composition of these advisory committees depends, again, on the state. In general, advisory committees consist of a panel of teachers and other stakeholders including, at least occasionally, scientists. In addition to the input of the advisory board, most State Boards of Education hold hearings or testimonies of stakeholders such as parents, scientists, religious representatives, among others. At this point, it typically becomes visible which interest groups lobby in favor or against the proposed reform. For example, the National Center for Science Education has lobbied for a more comprehensive coverage of evolution in multiple cases, while the Discovery Institute has spoken out against it. The probability of anti-evolution organizations being active in a state depends, among others, on the state's conservative Protestant adherence rate (Johnson et al., 2016). After the period of public comment, the State Boards of Education has the final vote.

On the one hand, the political process described above implies that these reforms happen at some point in a given state is not random. Instead, they reflect changing political views, either expressed by the election of a governor who subsequently appoints members of the State Boards of Education, or by direct election of the members of the State Boards of Education.

On the other hand, the exact reform year in a given state can be regarded as-good-as random. If the approval towards evolution or science in general changes in the population in a certain year, it will take a somewhat arbitrary number of years until this results in a reform of Science Standards because of institutional idiosyncrasies. In states where members of the Board of Education are appointed by the governor, the year of a reform crucially depends on the election year of governors, which is determined by the legislation period lasting four years in general. In states where members of the Board of Education are directly elected, the reform year depends on the elections, which typically take place in different districts in different years in a staggered manner. Further state-specific idiosyncrasies are induced by the fact that the tenure of members of the Boards of Education differs across states, which can last up to nine years like in West Virginia. Even after a new majority in the Board of Education is in power, the drafting, hearing, and voting on new standards causes further delay, as this can take months or years. In some cases, there are also spillovers in the sense that Science Standards reforms of one state affect the teaching in other states. This occurs, for example, because textbooks used in smaller states may follow Science Standards reforms of larger states. In sum, the number of years between a scientific, religious, or political shock and a reform of the evolution coverage in Science Standards can be very large. However, it can also be small if election dates and the tenure expiration of the marginal board member happen shortly after a given shock. Hence, the precise timing of such reforms is arguably exogenous. In the empirical analysis, placebo tests showing null effects on non-evolution scientific, religious and political outcomes test this narrative empirically. The same is true for regressions conditioning on the party of the governor.

2.5 The Implementation of Reforms of Science Standards

After new Science Standards are adopted, their implementation in the classroom tends to be rather swift. In general, widely publicized lawsuits convicting school districts for not implementing the teaching of evolution as outlined in Science Standards contribute to a fast implementation of such reforms.[9] In Florida in 2008, for example, school districts were supposed to adjust their lessons by including evolution comprehensively as outlined in the newly adopted Science Standard within one year. Furthermore, evolution was required to become part of standardized testing in Florida from 2012 onwards. In the 2009 Texas reform, the evolution coverage of the new Science Standard had to be in textbooks from 2011 onwards.

3 DATA

3.1 Coding of Reforms of Science Standards

To measure the coverage of evolution in a Science Standard, I make use of the "evolution score" provided by Lerner (2000a) and Mead and Mates (2009). The evolution score is a composite index based on an evaluation of whether the word "evolution" appears in a Science Standard, of the respective coverages of biological, human, geological, and cosmological evolution, and of the connection of the different aspects of evolution. In addition, the absence of creationist jargon and creationist disclaimers in textbooks is taken into account. The evolution score is defined between 0 and 1, with 0.01 increments. An evolution score of 0 indicates no or a non-scientific/creationist coverage of evolution, and a score of 1 a very comprehensive coverage of evolution. Notably, the creationist

[9] For example, a lawsuit that received national attention was Kitzmiller v. Dover Area School District in 2005. The Dover Area School District had required biology teachers to teach intelligent design (a form of creationism attributing the creation of the world to an intelligent designer) as an alternative to evolution. This requirement contradicted the content of the Science Standard in power at the time, and was ruled unconstitutional in Kitzmiller v. Dover Area School District. Specifically, the verdict barred the Dover Area School District from requiring teachers to "denigrate or disparage the scientific theory of evolution, and from requiring teachers to refer to a religious, alternative theory known as intelligent design." (Kitzmiller v. Dover Area School District, 400 F. Supp. 2d 707 (M.D. Pa. 2005)).

jargon in all Standards evaluated in this paper is never openly religious, which would be unconstitutional. However, there is large variation in the emphasis of (alleged) weaknesses and critique of evolution theory, opening or closing space for teachers who wish to teach creationist content.[10]

The evolution score is available for all states for the years 2000 and 2009, provided by Lerner (2000a) and Mead and Mates (2009), respectively. They also provide information on the year of reform of the evolution score for each state between 2000 and 2009 (if there was any reform). If more than one reform happened between 2000 and 2009 in a given state, there is information on the last reform.[11] The evolution score serves as treatment variable in all analyses presented in this paper. When merging it with individual-level datasets, each individual is defined to be exposed to the evolution score from 2000 if she entered high school before the reform year in her state, and to be exposed to the evolution score from 2009 if she entered high school in the year of the reform in her state or later. The high school entry year is the relevant year, as most of the teaching on evolution takes place at the beginning of high school.[12]

To illustrate the identifying variation, Figure 1 depicts the state-level evolution score *difference* between 2000 and 2009.[13] The evolution score increased in 22 states (implying a positive evolution score difference) and decreased in 15 states (implying a negative

[10]In 2000, Kansas received an out-of-range score of -0.18, as "it is a special case, unique in the extremity of its exclusion of evolution from statewide science standards" (Lerner, 2000b, p.16). For example, it did not cover Darwin, biological evolution and any reference to the age of the earth. In this paper, I change this evolution score from -0.18 to 0 for ease of interpretability of regression results. All results using the original score of -0.18 for Kansas instead of 0 do not differ meaningfully (results available upon request). Iowa had no Science Standards in 2000 which is coded as missing. The District of Columbia is treated as a state throughout this paper. The evolution score was originally defined between 0 and 100, but I re-scale it by dividing it by 100, again for ease of interpretability. More information about the details of the scoring scheme are provided in Lerner (2000b, pp.10-17).

[11]This implies that reforms before the respective last reform are not taken into account in the analyses. In theory, ignoring these prior reforms merely cause attenuation bias as long as these prior reforms are uncorrelated with the timing of the last reform in a given state. To test for this explicitly, I perform a robustness check restricting the sample to students from states for which careful examination of academic articles, legal documents, and state education websites indicates that they had only one reform between 2000 and 2009, see Section 6.4 and Table A.2 for more details.

[12]The standard high school curriculum typically features biology (the subject in which evolution is being taught) in the first year of high school.

[13]Figure A.2 also depicts the evolution score levels in 2000 and 2009.

evolution score difference) between 2000 and 2009. In the remaining 13 states, it remained unchanged. The states with the largest evolution score increases are Kansas, Mississippi, and Florida. The largest evolution score decreases are found in Connecticut, Louisiana, and Texas. By construction, the changes depend in part on the baseline level, in the sense that Science Standards which cover evolution very comprehensively in 2000 cannot expand the coverage by much until 2009, and vice versa. However, by identifying from changes within states I control for fixed differences between states. Overall, the evolution score changes are fairly well dispersed across the US, with each census region having at least one state in which the evolution coverage became more comprehensive, less comprehensive, and remained unchanged, respectively.

3.2 Micro Data

The following subsection describes the three micro-level datasets used in this paper. These repeated cross-sectional datasets are standardized and hence comparable across US states and cohorts, which makes them suitable for analyses with state and cohort fixed effects.

In all three datasets, I keep students in the sample who have no missings for basic controls variables and who enter high school after 1990 and before 2010 in my preferred sample cut. Hereby, I balance temporal proximity to the reform years with having sufficient years to estimate pre-trends and fixed effects credibly (and with statistical power in general). This approach also ensures not to identify from the adoption of the Next Generation Science Standards which started in 2013. The results of this paper do not hinge on this specific sample cut, as shown in robustness tests in Section 6.4.

3.2.1 NAEP: Evolution Knowledge in School

To estimate the effect of students' exposure to the teaching of evolution in high school on their knowledge about evolution by the end of high school, I link the evolution score with the restricted-use individual-level National Assessment of Educational Progress (NAEP). NAEP is a standardized student achievement test, measuring the knowledge of

US students in various subjects since 1990. For this study, I use the NAEP test for science in grade 12 as it contains questions on evolution. Students are coded as exposed to the Science Standard in place in the year and state of their high school entry, assuming that they entered high school three years before taking the test in grade 12 in the same state.

The main outcome variable "evolution knowledge" is defined as the share of questions on evolution answered correctly. The nine categories of scientific knowledge on topics other than evolution are defined analogously. They serve as placebo outcomes in subsequent analyses and include topics such as "reproduction", "climate" or the "universe". In addition, the NAEP student surveys provide rich student-level control variables. They include, among others, variables measuring the socioeconomic status such as subsidized lunch status, parental education and home possessions.

The main sample only contains public school students, as Science Standards have never been binding for private schools. However, the latter serve as a placebo sample in robustness checks. The main sample consists of more than 15,000 public school students who were asked at least one question on evolution. The descriptive statistics show that the average evolution score equals 0.65, implying that students in the sample were on average exposed to a "satisfactory" evolution coverage.[14] The mean of the main outcome variable "evolution knowledge" equals 0.32. The fact that not even one third of the questions on evolution are being answered correctly on average underscores the difficulty of the questions. Appendix A.2.1 provides detailed tables of the descriptive statistics and raw correlations. It also presents sample questions, explains how the science questions are grouped into topical categories, and how missing observations are dealt with.

3.2.2 GSS: Evolution Approval in Adulthood

To estimate the effect of students' exposure to the teaching of evolution in high school on their approval of evolution in adulthood, I link the evolution score with the restricted-

[14] Lerner (2000b) classifies evolution scores between 0.60 and 0.79 as "satisfactory".

use individual-level General Social Survey (GSS). The GSS is a biennial cross-sectional survey which monitors societal change by interviewing a nationally representative sample of adults in the US since 1972. Since 2006, respondents are asked about their approval of evolution. The GSS also provides the state of residence at age 16 and the birth year. I assume that respondents entered high school in this state at age 14 and merge the evolution score for this state-year combination accordingly. Hence, I can link the approval of evolution of individuals in adulthood to the evolution coverage of the Science Standard they were exposed to as students, even if they migrated to other states after finishing school.

The main outcome variable "evolution approval" is based on the question "Human beings, as we know them today, developed from earlier species of animals. Is that true or false?".[15] The corresponding indicator variable is set to one if the answer "true" was given, and set to zero if any other answer option was reported such as "false", "don't know", or "no answer". The GSS also asks a broad range of questions on scientific topics other than evolution, and on religious, political and partisan attitudes. Other variables capturing different dimensions of the childhood environment are employed as control variables, including the religion a respondent was raised in.

The GSS is sampled from the entire US adult population regardless of type of school attendance. It does not allow to differentiate between public and private school attendance as the NAEP. Instead, one can estimate effects net of endogenous sorting across school types, including homeschooling. The estimation sample of individuals who were asked the question on evolution approval contains more than 1,800 individuals. The descriptive statistics show that 58 percent of the sample approve of evolution which is largely representative for evolution approval in the US population at the time (Pew Research Center, 2009). More details on descriptive statistics, raw correlations and data background is provided in Appendix A.2.2.

[15] The words "human beings" are replaced by the word "elephants" for 10 percent of the questions on evolution approval in the sample. Table A.8 shows that the results are robust to dropping these 10 percent from the sample.

3.2.3 ACS: Occupational Choice

To estimate the effect of students' exposure to the teaching of evolution in high school on their probability to work in life sciences in adulthood, I link the evolution score with the individual-level IPUMS American Community Survey (ACS) (Ruggles et al., 2020). The ACS is a large-scale demographic survey which draws from a national random sample of the US population. Responding and providing correct information is required by US law. The ACS contains detailed information on the occupational field of the respondents. It also elicits the state and year of birth. I assume that students enter high school in this state at age 14 and merge the evolution score for this state-year combination accordingly.

Given that evolution is the fundamental theory of life sciences, the occupational field of primary interest in this study is life sciences. The main outcome variable "working in life sciences" is coded as an indicator variable equal to one if the respondent works in life sciences, and equal to zero otherwise. All other occupational fields are coded analogously. The ACS also allows to divide occupational fields into more fine-grained occupational subfields. The occupational field "life sciences" can be divided into the subfields "biology", "agriculture and food", "conservation and forestry" and "medical and other" for the purpose of subgroup analyses. Beyond sciences, I also analyze other occupational fields such as management, engineering and education. In total, there are 25 non-scientific occupational fields including one category for unemployed/not in the labor market which serve as placebo outcomes in robustness checks.

Like in the GSS, the ACS is sampled from the entire US population also including individuals who went to private school and homeschoolers. The estimation sample of individuals who are older than 18 years (i.e. who typically completed secondary education) consists of more than 6 million individuals. Further information, including descriptive statistics, is provided in Appendix A.2.3.

4 IDENTIFICATION STRATEGY

All three analyses presented in this paper are based on the following two-way fixed effects (TWFE) model. The TWFE model exploits the different timing of reforms of the evolution coverage in Science Standards across states, and the fact that some of the reforms extended the coverage of evolution, while others reduced it, and a third group of states did not reform the evolution coverage. It compares outcomes of cohorts who went to high school in states where the evolution coverage was reformed with previous cohorts from the same states before the reforms, relative to how the outcomes of these cohorts changed in states who did not reform at the time, after accounting for fixed differences between states and birth cohorts. The baseline parametric TWFE model is specified as follows:

$$Y_{istu} = \beta \cdot Evolution\_Score_{st} + \gamma \cdot \mathbf{X_i} + \delta_s + \lambda_t + \theta_u + \epsilon_{istu} \quad (1)$$

where Y_{istu} is the outcome of interest of individual i, who entered high school in state s and year t, and completed the test or survey in year u. The treatment variable $Evolution\_Score_{st}$ measures the intensity of the evolution coverage in the Science Standard in state s and year t. β is the parameter of interest capturing the effect on the outcome of being exposed to a very comprehensive coverage of evolution ($Evolution\_Score_{st}$=1) as opposed to being exposed to no or a non-scientific/creationist coverage of evolution ($Evolution\_Score_{st}$=0). The vector $\mathbf{X_i}$ contains the individual-level control variables. State fixed effects δ_s, birth cohort/high school entry cohort fixed effects λ_t, test/survey year fixed effects θ_u, and an error term complete the model. The standard errors are clustered at the state level which is conservative in this setting and accounts for the potential correlation of error terms across cohorts within states (Abadie et al., 2017; Athey and Imbens, 2021).

The baseline model addresses a range of concerns on the ability to estimate causal effects of the evolution coverage in Science Standards. One might be concerned that state-level differences in scientific, religious or political attitudes are correlated with the evolution coverage in Science Standards and affect scientific knowledge, attitudes as well as occupational choice. The state fixed effects absorb all differences in outcomes that are constant between states. In addition, one might be worried that national trends, such as attitudinal trends on scientific, religious or political topics, might erroneously appear as reform effects. To tackle this concern, the cohort fixed effects eliminate all national differences between cohorts.

A remaining concern are time-varying state-specific trends or shocks. For example, state-specific trends in human capital levels, or regional religiosity shocks induced by, say, church scandals may affect attitudes towards evolution differentially in different states. However, such factors only threaten the ability to estimate causal effects if they affect different high school entry cohorts differently. Many state-specific factors may be time-varying, but still affect adjacent cohorts similarly. This is the case, for example, if a church scandal occurring in a given year and state evokes similar reactions in adjacent cohorts. However, my empirical setup exploits cross-cohort variation within a narrow time window around the reforms, and identifies from reforms of the evolution coverage in State Standards that affect adjacent cohorts differently. Although reforms of Science Standards are generally applicable to all cohorts from the year of adoption onwards, the change in evolution coverage does typically only affect the high school entry cohort (and younger cohorts in the following years when they enter high school). This is true as the high school entry year is the year in which evolution is typically being taught.[16] The state fixed effects capture such time-varying state-specific factors that affect students of different cohorts equally.

Moreover, I address concerns about time-varying state-specific trends or shocks that affect adjacent cohorts differently, but smoothly, by conducting robustness checks with state-specific time trends. For example, the trust in science among students could develop

[16]To the extent that evolution is also being taught in higher grade levels, the difference in exposure to the teaching of evolution between pre- and post-reform cohorts is overstated in my coding. Hence, I interpret the results as lower-bound estimates as parts of the cohorts coded as exposed to the pre-reform State Standard may be partially treated by post-reform State Standards.

differently in the different states, but change smoothly across cohorts. The presented specification with linear and quadratic state-specific time trends is particularly demanding in terms of statistical power, as reform effects are only detectable as "jumps" from the cross-cohort trend. Showing that (at least the point estimates of) the main results hold in this specification reaffirms a causal interpretation of the presented findings.

In addition, the individual-level control variables take out observable differences between individuals that vary non-smoothly across states and cohorts. For example, controlling for the religion an individual was raised in ensures that outcomes across individuals are compared while holding constant their religion of upbringing.

Based on these insights, the TWFE model yields a causal effect if the identifying assumptions on parallel trends and the homogeneity of treatment effects hold. They requires that in the absence of Science Standard reforms, the change in outcomes in reforming states would have been the same as in non-reforming states. This is plausible given the institutional idiosyncrasies determining the exact reform timing, as discussed in Section 2. The following series of identification checks assesses its plausibility more formally.

I begin with conducting non-parametric event-study specifications, in which the reform of the evolution coverage in Science Standards in a given state and year is referred to as the "event". In contrast to the baseline TWFE model, the event-study model can examine non-linear pre-reform trends in outcome variables. For example, evolution approval trending in the direction of estimated reform effects prior to the reform could indicate a bias from underlying trends in the data. Another advantage of the event-study models is that the timing of reform effects can be assessed by disentangling effects which occur directly at the time of the reforms from those which phase-in gradually after the reform. Specifically, I estimate the effect of the evolution coverage in Science Standards in year t_s on outcomes of students entering high school k years before and after the evolution coverage reform, as captured by the parameter vector β_k.

$$Y_{istu} = \sum_{k=-4}^{4} 1(t_{is} = t_s + k)\beta_k + \gamma \cdot X_i + \delta_s + \lambda_t + \theta_u + \epsilon_{istu} \quad (2)$$

Effects are estimated relative to the year of reform k=0.[17] The event-study estimations yield changes in outcomes induced by the *average* reform. This requires to run the event-study models separately for the subsets of states that expand and reduce the evolution coverage, respectively, because joint event-study models would cancel out effects from opposing reforms. Within each subset of states, the regression coefficients can be interpreted as changes in outcomes induced by the average reform in that subset (i.e. averaged over different evolution coverage changes within a subset).

As outlined above, a remaining concern to validity of the parametric and non-parametric analyses are time-varying state-specific shocks that affect adjacent cohorts differently, non-smoothly, and are not absorbed by the individual-level control variables. A series of placebo tests addresses this concern. In the first analysis, I test whether the coverage of evolution affects evolution knowledge (main outcome), but not knowledge on scientific topics other than evolution (placebo outcomes). In the second analysis, I test whether the coverage of evolution affects evolution approval in adulthood (main outcome), but not other scientific, religious or political attitudes (placebo outcomes). In the third analysis, I test whether the coverage of evolution affects the probability to work in life sciences (and in particular biology), but not the probabilities to work in non-scientific occupational fields. Null effects on placebo outcomes suggest that no previously uncontrolled scientific, religious or political shocks coincide with the timing of the reforms. They also demonstrate that the effects reported in this paper are narrowly tied to the topic of evolution, providing empirical support to the claim that the exact timing of reforms is driven by institutional idiosyncrasies instead of political

[17] In all event-study graphs, two years are grouped together to one bin to smooth the number of observations across bins as not all microdata are not collected in every year (see section 3) The bins at the beginning (end) of the domain additionally include the years prior to (following) the domain's starting (ending) year.

changes. At the same time, they show that these outcomes themselves are not affected by the reforms.

Another placebo test makes use of a placebo sample of private school students for whom education standards have never been binding. One can test whether the reform effect on evolution knowledge is specific to public school students (main sample), but not detectable for private school students (placebo sample).

5 RESULTS

This section shows in three steps that the evolution coverage in Science Standards affects the knowledge about evolution of students, the attitude on evolution in adulthood, and the probability to work in life sciences.

5.1 Evolution Knowledge in School

The first analysis demonstrates that the evaluated reforms affect what students learn about evolution in school. To that end, I regress the share of questions on evolution answered correctly in the 12^{th} grade NAEP science test on the evolution coverage in Science Standards and different sets of control variables. Column (1) of Table 1 displays the raw correlation without any control variables. The positive raw correlation could imply that being exposed to a comprehensive coverage of evolution increases students' knowledge about evolution (reform effect). However, it could also reflect that comparatively high average levels of evolution knowledge raise the probability that states adopt a Science Standard that covers evolution more comprehensively, for example because students might be less willing to accept creationist teaching (reverse causality). The positive raw correlation could also be driven by third variables such as parental education affecting both the probability that states adopt comprehensive Science Standards and the probability that students have knowledge about evolution (omitted variable bias).

To isolate the effect of the coverage of evolution in the Science Standard on evolution knowledge, I add different sets of control variables in columns (2)-(4). When adding student-level control variables in colum (2), or state and cohort fixed effects in column (3), or both the student controls and the fixed effects in column (4), the positive correlation persists and becomes even larger compared to the raw correlation. The full model in column (4) is the preferred specification as it exploits the reforms of Science Standards as a source of arguably exogenous variation by controlling for time-invariant differences between states, national differences between cohorts, time-varying state-specific shocks that affect adjacent cohorts similarly, as well as student level characteristics. It corresponds to the TWFE approach as specified in equation 1.

Regarding the main variable of interest, I find that being exposed to an evolution score of one, i.e. to a very comprehensive coverage of evolution, as opposed to an evolution score of zero, i.e. to no or a non-scientific/creationist coverage of evolution, increases the share of questions on evolution answered correctly by 5.8 percentage points. This effect is statistically significant at the 1 percent level. Given that students answer on average 32 percent of the questions on evolution correctly, the reported effect equals 18 percent of the sample mean.

Next, I hypothesize that the reform effect on evolution knowledge is disproportionately large for underprivileged students as they might rely more on schools to compensate for the lack of science exposure they receive from their parents and private environments. To begin, I note that variables typically associated with lack of privilege such as being Black (relative to being White) tend to predict knowledge about evolution negatively, see Table 1. Conversely, variables typically reflecting privilege such as having a computer at home tend to predict knowledge about evolution positively.

I perform subgroup analyses by student characteristics to assess whether reform effects are largest for underprivileged groups. Figure 2 shows that the effect of the evolution coverage on evolution knowledge is larger for Blacks than for any other racial/ethnic group. With regards to socioeconomic characteristics, results show that students without a computer at home and students receiving subsidized lunch benefit disproportionately from a comprehensive evolution teaching. In fact, the point estimate of 12.7 percentage points for students without a computer at home is the largest effect in this subgroup analysis. This finding seems plausible as having no computer at home does not only indicate a low socio-economic status, but also directly impedes access to online information sources through the internet. Apparently, students rely mostly on what is taught at school if access to independent information sources is restricted. I conclude from the findings of this subgroup analysis that a scientific content of education, materializing in this study in the form of a comprehensive evolution teaching, can act as a substitute for privilege in the production of student knowledge, materializing in this study in the form of evolution knowledge.

5.2 Evolution Approval in Adulthood

The second analysis shows that the teaching of evolution has lasting consequences on attitudes in adulthood, shedding light on the persistence of effects of scientific educational content. At the same time, it examines whether the effect on evolution knowledge translates into neutral settings in adulthood in which the scientifically correct answer is not encouraged. It could well be that students who are exposed to evolution content are able and willing to answer science exam questions correctly to gain points in an exam as the NAEP, but that they are not convinced of the correctness of evolution theory.

Table 2 presents the GSS results from regressions of evolution approval in adulthood on the evolution score in high school, conditional on different sets of control variables. The raw correlation in column (1) is positive and significant. When subsequently adding student-level controls and fixed effects, the effect becomes even larger. The estimate in the full model presented in column (4) shows that individuals who were exposed to an evolution score of one, as opposed to an evolution score of zero, are 33.3 percentage points more likely to approve of evolution in adulthood. This effect is highly significant and amounts to 57 percent of the sample mean, making it larger than the corresponding effect on evolution knowledge reported in section 5.1.

To benchmark the effect size relative to other determinants of attitudes, I calculate persuasion rates (DellaVigna and Gentzkow, 2010). The persuasion rate induced by a reform changing the evolution score from zero to one is defined as the average treatment effect on evolution approval divided by the share of students who do not approve of evolution in the entire sample.[18] The corresponding persuasion rate equals 79 percent. This is larger than the persuasion rates Cantoni et al. (2017) report for a Chinese school textbook reform on a range of outcomes.[19] It is also on the upper end of the persuasion rate distribution of media which includes rates from 3-8 percent (DellaVigna and Kaplan, 2007) to 65 percent (Enikolopov et al., 2011) for different media, settings and outcomes.

Regarding subgroups, the religion an individual was raised in gives rise to a particularly interesting heterogeneity analysis, given the large differences in attitudes on evolution and creationism between religious groups. I first document that having been raised as Evangelical is a large negative predictor of evolution approval in adulthood as compared to the other religious groups, see Table 2. Specifically, individuals raised as Evangelicals are 29 percentage points less likely to approve of evolution in adulthood compared to individuals being raised non-religiously, conditional on the other regressors. The predictive power for individuals raised as Mainline Protestants is substantially weaker. For Catholics, it is indistinguishable from those raised as non-religious.

The subgroup analysis depicted in Figure 3 shows that the reform effects are larger for individuals raised as Mainline Protestants relative to those from any other religious upbringing. Conversely, students are less susceptible to the effects of evolution teaching if they were raised in a religion with strong anti-evolution views on average like Evangelicals,

[18] Another definition of the persuasion rate would require to divide the treatment effect of the average reform by the share of individuals who do not approve of evolution and who studied before the education standards were reformed. However, compositional differences by states and cohorts between individuals who studied before and after the reforms would bias results. Similarly, calculating the persuasion rate based on predicting treated and untreated students' beliefs and subtracting the treatment effect from the treated students' beliefs as in Cantoni et al. (2017) is not feasible as most students are treated to some extent even before the reforms which then go in different directions with different intensities.

[19] They find the largest persuasion rates for the outcomes "Not investing in a bond" (50 percent persuasion rate) and "Trusting the local government" (47 percent persuasion rate).

or with strong pro-evolution views on average like those raised as non-religious. Mainline Protestants, with moderate evolution views on average, seem to be most open to change their attitude on evolution depending on the school curricula. Furthermore, the results show particularly strong reform effects for individuals that grew up in urban areas instead of rural areas. Moreover, the reform effects are largest for Blacks relative to all other racial/ethnic groups, which confirms the conclusions from the previous subsection.

5.3 Occupational Choice

The third analysis reveals that the teaching of evolution translates into real-world high-stakes outcomes beyond attitudinal outcomes. Specifically, I focus on occupational choice as one high-stakes life decision in which an individuals' attitudes, values and beliefs may be revealed. I hypothesize that exposure to evolution theory (and hence to the fundamental scientific theory about the existence of life) affects the probability that individuals choose to work in life sciences.

Using the ACS, this analysis shows that being exposed to a more comprehensive teaching of evolution in school increases the probability to work in life sciences in adulthood, as presented in Table 3. The point estimate is significant and stable across specifications. The full model presented in column (4) shows that individuals who were exposed to an evolution score of one, as opposed to an evolution score of zero, are 0.035 percentage points more likely to work in life sciences as adults. This effect is significant at the 5 percent level but small in absolute terms due to the fact that few people work in life sciences in relation to the total US labor force. However, if expressed relative to the sample mean, the effect amounts to 23 percent.

The corresponding subgroup results by individual-level characteristics are in line with those from the previous subsections. Table A.3 shows that the effect on the probability to work in life sciences is larger for females than for males, and for Blacks than for other racial/ethnic groups, if expressed relative to the respective subsample mean (although only the former is significantly different). The ACS does not provide more individual-level covariates, but one can conduct insightful subgroup analyses by the outcome variable, namely by the four subfields of life sciences. Figure 4 depicts a positive and highly significant effect of the reform on the probability to work in biology. It is large in relative size, amounting to more than 39 percent of the sample mean. For all other subfields of life sciences, the estimates show reform effects that are much smaller in size and not statistically different from zero. This subgroup pattern underpins that it is indeed the evolution teaching which drives reform effects, given the fundamental relevance of evolution for biology,[20] and given that evolution is being taught in biology.

6 ROBUSTNESS

The presented TWFE estimations can be interpreted causally if the identifying assumptions on parallel trends and the homogeneity of treatment effects hold, as described in section 4. To assess the validity of these assumptions, the following subsections show non-parametric event-study graphs, placebo tests, robustness on time-varying treatment effects, and a battery of further specification checks including specifications with state-specific trends.

6.1 Event-Study Graphs

Non-parametric event-study graphs can assess pre-trends and the timing of reform effects. I conduct event-study models separately for the subsets of states that reduce and expand the evolution coverage, respectively, as joint event-study models would cancel out effects from opposing reforms. For the subset of states that reduce (expand) the evolution coverage, we hypothesize to find decreases (increases) in pro-evolution knowledge, attitudes and choices.

Figure 5 displays event-study graphs for the subset of states where the reform reduces

[20] This is illustrated by the well-known assertion by Dobzhansky (2013) that "nothing in biology makes sense except in the light of evolution".

the evolution coverage in Science Standards. They are depicted one below the other for the three main outcomes evolution knowledge by the end of high school, evolution approval in adulthood, and the probability to work in life sciences. For all three outcomes, there is no indication of differential pre-trends between reforming and non-reforming states, lending empirical support to the parallel trends assumption. Furthermore, it holds for all three outcomes that reform effects set in directly after reform adoption. For example, students entering high school one or two years after their state reduced the evolution coverage in the Science Standard display a reduction of 8 percentage point in the share of questions on evolution answered correctly in grade 12 relative to their counterparts who entered high school in the year of the reform or the year before. For the subset of states where the reform expands the evolution coverage in Science Standards, both the rejection of pre-trends and the existence of reform effects are far less clear (see Figure A.3). Although reform effects tend to go in the expected direction, the causal interpretation of the results presented in this paper is based on the subset of states that reduce the evolution coverage.

6.2 Placebo Tests

A remaining threat to internal validity are state-specific shocks, events, or trends that affect adjacent cohorts differently and coincided with reforms of the evolution coverage in Science Standards and affect the respective outcomes. The following placebo tests are designed to assess this treat. I show below that neither changes in knowledge on non-evolution scientific topics at the end of high school, nor changes in non-evolution scientific, religious and political attitudes in adulthood, nor changes in the probabilities to work in non-scientific occupations appear as reform effects. These findings support (i) that reform coefficients do not reflect underlying shocks or trends and (ii) that the reforms themselves do not affect these outcomes. The fact that the reform effects are neatly tied to the topic of evolution in all three independent datasets and outcomes therein supports a causal interpretation of the results of this paper. In sum, the placebo tests provide empirical support for the theoretical assessment that the exact reform timing is determined by institutional idiosyncrasies and not by scientific, religious or political confounders.

Evolution Knowledge in School: As is visible in Table 4, there is no effect of the evolution coverage in Science Standards on student knowledge in any of the non-evolution scientific topics such as reproduction or climate. Column (11) also presents a regression in which the outcome variable is the average of the nine shares of questions answered correctly on non-evolution scientific topics. The corresponding point estimate is insignificant and close to zero.

To rule out that shocks or events specific to evolution but not related to the Science Standards drive the main effect, I perform the main analysis on a placebo sample of students from private schools for whom the reforms were never compulsory. As shown in Table 5, the point estimate measuring the effect of the evolution coverage on evolution knowledge of private school students is very close to zero (although imprecisely estimated and therefore not significantly different from the point estimate of public school students). I conclude from this result that it is unlikely that there are shocks or events related to evolution coincident with the reform of evolution coverage in Science Standards, at least as long as they affect both public and private school students. This result also suggests that there are no spillovers from public school curricula to private school curricula. In addition, the main effect holds on a joint sample of both public and private school students addressing the concern that spurious selection of students or school curricula into (or out of) private schools coincidental to the reform drives the results.

Evolution Approval in Adulthood: Table 6 demonstrates that the evolution coverage does not affect non-evolution scientific outcomes in adulthood on topics such as radioactivity or antibiotics. This is true for each of the nine non-evolution scientific outcomes, and for the average of all nine outcomes. This finding can be interpreted as the adulthood equivalent of the placebo tests on non-evolution scientific outcomes measured at the end of high school shown above.

Table 7 shows that the evolution coverage has no effect on religious outcomes in adulthood. Religious outcomes include variables capturing (i) religious beliefs such as belief in God, (ii) religious belonging such as religious affiliation or churchgoing, and (iii) general religiosity.[21] There is no effect that is statistically different from zero on any religious outcome.

Table 8 demonstrates null effects of the reform on political outcomes. These outcomes comprise general political attitudes such as thinking of oneself as a Republican (as opposed to Democrat, Independent, or something else), political attitudes on specific topics typically regarded as controversial or partisan such as same-sex marriage, and preferences for governmental spending increases in areas such as alternative energy sources. There is no effect that is statistically different from zero on any political outcome.

Had there been, say, a negative coefficient on religiosity or political conservatism, it would be hard to disentangle whether this result was driven by confounding shocks or by the reforms. However, a null finding implies that neither confounding shocks nor reform effects are at work, because they plausibly operate in the same direction and do not offset each other. For example, it would be implausible to assume that negative confounders, say, state-specific church scandals coincident with the reforms, reduce the coverage of evolution in Science Standards causing a negative effect on religiosity, while at the same time offsetting this negative effect by increasing religiosity through other channels.

Occupational Choice: Before turning to the placebo analysis on the probabilities to work in non-scientific occupations, I begin with contrasting the reform effect on life sciences with effects on other scientific occupational subfields. Table 9 only shows significant reform effects on natural sciences (life sciences and physical sciences, with the effect on life sciences being marginally larger if measured relative to its sample mean), but not on non-natural sciences (science technicians and social sciences). When looking at the overall reform effect on the probability to work in any scientific field, I find a positive and significant effect.

[21] The distinction between believing and belonging follows Barro and McCleary (2003) and McCleary and Barro (2019) who find in cross-country analyses that believing stimulates economic growth, while belonging tends to reduce economic growth at given levels of religious beliefs.

Placebo tests in which the other 25 non-scientific occupational fields serve as outcome variables allow for testing of whether reform effects are specific to working in scientific occupational fields. As presented in Table 10, the coverage of evolution has no significant effect on working in any non-scientific occupational field. There is also no effect on being unemployed or not being part of the labor market, implying that the reform does not cause selection into employment and the labor market.

6.3 Time-Varying Treatment Effects

Even in the absence of confounding trends or shocks, consistent estimation of reform effects requires homogeneity in treatment effects (Chaisemartin and D'Haultfœuille, 2020; Sun and Abraham, 2020; Baker et al., 2021; Borusyak et al., 2021; Callaway and Sant'Anna, 2021; Goodman-Bacon, 2021; Roth and Sant'Anna, 2021). The treatment effect from the baseline TWFE model is a weighted average of all possible 2x2 difference-in-differences comparisons between treated and untreated groups as well as groups treated at different points in time (Goodman-Bacon, 2021). In settings with staggered treatment timing like in this study, time-varying treatment effects can bias results away from the true effect if already-treated students act as controls for later-treated students (negative weighting).

This concern can be addressed in a robustness check in which those 2x2 difference-in-differences comparisons in which already-treated students act as controls are excluded from the sample. Specifically, I implement the estimator by Callaway and Sant'Anna (2021) (CS estimator) which is designed to run with repeated cross-sectional data. Like with the event-study graphs, the CS estimator has to run separately for subsets of states that expand and reduce the evolution coverage, respectively, because joint CS estimations would cancel out effects from opposing reforms. Within each subset of states, the reform coefficients can be interpreted as changes in outcomes induced by the average reform in that subset (i.e. averaged over different evolution coverage changes within a subset).

Table A.4 presents the CS estimator of the effect of the evolution coverage on evolution knowledge by the end of high school. For the subset of states reducing the evolution coverage, the estimate shows a reform effect of 5.6 percentage points. It is highly significant and very similar to the overall TWFE effect of 5.8 percentage points. For the subset of states expanding the evolution coverage, the CS estimator is only about half the size, and not significant. The CS estimator on evolution approval in adulthood is reported in Table A.5. The CS estimator for the first subset of states amounting to 27.4 percentage points is relatively close to the 33.3 percentage points from the main TWFE model, although it does not met conventional levels of statistical significance. For the second subset of states, the effect is somewhat smaller in size and significance. Regarding the probability to work in life sciences, the CS estimator for the first subset of states is even marginally larger than the overall TWFE effect and comparable in terms of significance, see Table A.6. The CS estimator for the second subset of states is still positive but insignificant and close to zero.

These findings underscore the conclusion from the event-study models that the causal interpretation of the findings presented in this paper rests on the sample of states reducing the evolution coverage. However, the results from the group of states expanding the evolution coverage go in the expected direction too.

6.4 Further Robustness Checks

This subsection covers a battery of further robustness checks. The first test replicates the main analysis on a subset of reforms which themselves can arguably be regarded as-good-as-random (and not only their specific timing). This subset contains reforms in states in which the governor decides about the members of the State Board of Education, and in which the governor ruling at the time of the reform adoption won the previous election by a small margin. In these states, the outcome of the election and hence the political direction of the Boards of Education and their reforms is somewhat arbitrary. Although the set of states with close pre-reform gubernatorial elections reduces the sample size by about two thirds, the reform effects on evolution knowledge are robust (see column (1) of Table A.7). The same is true for analogous analyses on evolution approval in adulthood (see column (1) of Table A.8) and on the probability to work in life sciences (with the latter being estimated less precisely, see column (1) of Table A.9). These findings lend empirical support to a causal interpretation of the presented estimation results, even if it was not true that institutional idiosyncrasies were quasi-randomizing the reform timing.

Another, more direct, way to control for political changes is the inclusion of state-by-year controls for the political affiliation of the governor ruling in the state and year of the respective individuals' high school entry. As reported in column (2) of Tables A.7, A.8, and A.9, respectively, this test yields robust results throughout the three analyses both in terms of size and significance.

Adding state-specific time trends as control variables to the baseline TWFE model constitutes another way to assess robustness. These trends explicitly account for time-varying state-specific shocks that affect adjacent cohorts differentially, but smoothly. As is visible in column (3) of the three Tables listed above, the levels of significance tend to decrease in this demanding specification, while the point estimates largely hold and partly become even larger.

Another robustness check reduces the sample to states which had only one reform event between 2000 and 2009 based on careful examination of academic articles, legal documents, and state education websites. As shown in column (4) of the three Tables listed above, the results are largely robust and partly even more pronounced.

In addition, the results hold if the observation period of the main sample is defined differently. As reported in columns (5) and (6) of the Tables listed above, the results are robustness to sample definitions with fewer pre-reform cohorts, with the earliest cohorts entering high school in 1995 and 2000, respectively. Moreover, the results do not hinge on the precise coding of the outcome variables (for this test, the column numbers depends on the analysis, see footnotes of the three Tables listed above for more information). For example, the results are robust to coding those individuals who do not know how to answer the question on evolution approval as a missing observation instead of non-approving. There are also corresponding results for the analysis on evolution knowledge, but not for the probability to work in life sciences as the latter has no such outcome category. The remaining columns of the three Tables listed above show that all results are robust to conducting logit and probit specifications, and to dropping missing observations of control variables instead of imputing them.

Lastly, the interpretation of the results does not change when transforming the treatment variable to indicator variables. Specifically, the first (second) indicator variable is set to one if the evolution score is larger than 0.1 (0.2), and zero otherwise. The seven other indicator variables are coded accordingly. This coding eliminates a substantial amount of treatment variation, but allows to assess which domain of the evolution score distribution is particularly important for the production of evolution knowledge, evolution approval, and the probability to work in life sciences. Tables A.10, A.11, and A.12 show that most domains of the evolution score distribution are important for the production of outcomes with the exception of the highest value.

7 CONCLUSION

This paper shows that the content of science education has lasting effects on students by affecting their knowledge, attitudes and choices. To demonstrate this, the paper focuses on the teaching of evolution theory in the US. Exploiting institutional idiosyncrasies in the timing of reforms of the evolution coverage in US State Science Education Standards, I first document that the teaching of evolution causally affect student's knowledge about evolution at the end of high school. Second, I show that the teaching of evolution shapes the attitudes on evolution of exposed students in adulthood, while non-evolution scientific, religious and political attitudes remain unaffected. The null finding on religious outcomes speaks against concerns in the policy debate at the time that expanding the teaching of evolution may reduce students' religious convictions. Third, I demonstrate that the teaching of evolution impacts high-stakes life decisions as exemplified by occupational choice. All three sets of results are of direct economic importance given the effects on individual and societal outcomes of scientific knowledge

(Hanushek and Woessmann, 2008), scientific attitudes (Brzezinski et al., 2021), and of working in STEM occupations (Peri et al., 2015). Consensus on topics such as evolution could also reduce societal polarization and its associated costs (Alesina et al., 2020). In sum, I conclude from the three sets of findings presented in this paper that science education has lasting effects on students.

To illustrate the effect sizes, I calculate changes in outcomes that one would expect to observe if all states adopted Science Standards with a highly comprehensive evolution coverage relative to the average coverage in the sample. Linear extrapolation of the presented estimation results suggests that the evolution approval in the US population would increase by 20 percent of the sample mean in such a scenario. Analogously, the number of adults working in life sciences would increase by 8 percent of the sample mean, and in the subfield of biology by 13 percent of the sample mean.

This paper shows that the content of education standards is relevant for individuals in the short- and long-run. This conclusion challenges the notion that education standards have no meaningful impact on students which is prevalent in the academic and political debate. It has been argued that there is little room for education standards to affect teaching in reality due to the dominating role of other factors such as the teachers' own ideology for curriculum design in school (Moore et al., 2003a; Loveless, 2021). Still, legal pressures on school districts to follow education standards, the reflection of the content of education standards in textbooks, as well as the gradual expansion of standardized testing covering the content of education standards have arguably incentivized teachers to follow education standards. The analyses presented in this paper empirically demonstrate that they indeed affect what students learn.

More broadly, this paper shows that the content of school curricula and instruction lastingly shapes students. This is true even for a topic like evolution that is highly charged in political and societal debates. Despite its fundamental relevance for and overwhelming acceptance in science, people have strong partisan views on it. These views are likely determined by a multitude of factors. Still, what schools teach has long-run effects on individuals' fundamental views and translates into high-stakes choices.

Beyond the evolution content of US State Science Education Standards evaluated in this paper, the findings presented here might imply that other US education policies increasing the time teachers spend on teaching evolution could have created analogous effects.[22] Examples of such policies include the adoption of the Next Generation Science Standards, and improvements in pre-service teacher education (Plutzer et al., 2020).

Beyond the US, the question of whether evolution should be taught in school is controversial in many other countries too.[23] If such countries expanded their evolution teaching, one might observe analogous effects on the scientific knowledge, attitudes, and related life decisions of their citizens.

Beyond the topic of evolution, the findings of this paper might also be relevant more broadly for further topics of science teaching, such as vaccinations, climate change or the trust in science in general. It is up to future research to show that explicitly.

[22]Between 2007 and 2019, the average number of hours a high school biology teachers in U.S. public schools spends on teaching human evolution almost doubled from 4.1 to 7.7 class hours (Plutzer et al., 2020).

[23]This can be illustrated by the headlines "Turkey's new school year: Jihad in, evolution out" by the BBC (Altunas, 2017), "Israeli schools largely avoid teaching evolution" by the Times of Israel (Staff, 2018), and "Indian education minister dismisses theory of evolution" by the Guardian (Safi, 2018).

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MAIN TABLES AND FIGURES

Table 1 – Effect of evolution coverage in Science Standards on evolution knowledge in school

	Evolution Knowledge			
	(1)	(2)	(3)	(4)
Evolution Score	0.036*	0.039***	0.069*	0.058**
	(0.018)	(0.011)	(0.028)	(0.019)
Female		-0.003		-0.004
		(0.008)		(0.008)
Race/Ethnicity: Black		-0.084***		-0.082***
		(0.007)		(0.007)
Race/Ethnicity: Hispanic		-0.051***		-0.048***
		(0.009)		(0.009)
Subsidized Lunch		-0.012		-0.011
		(0.006)		(0.006)
Parental Education: Graduated High School		-0.009		-0.010
		(0.011)		(0.012)
Parental Education: Some education after High School		0.002		0.002
		(0.011)		(0.011)
Parental Education: Graduated College		0.023*		0.021
		(0.010)		(0.011)
Computer at Home		0.011		0.022**
		(0.007)		(0.007)
State FEs	NO	NO	YES	YES
Birth Year FEs	NO	NO	YES	YES
Other Controls	NO	YES	NO	YES
Mean of Dep. Var.	0.32	0.32	0.32	0.32
Std. Dev. of Dep. Var.	0.42	0.42	0.42	0.42
Adj. R-squared	0.001	0.043	0.015	0.049
Observations	15,530	15,520	15,530	15,520

Note: Dependent variable: Share of questions about evolution answered correctly. Other Controls: Indicator variables for asian (race/ethnicity) other (race/ethnicity), English language learner status, disability status, parental education, home possessions (books), and test year fixed effects. Standard errors clustered at the state level in parenthesis. Single, double, and triple asterisks indicate statistical significance at the 5%, 1%, and 0.1% levels, respectively. Data source: U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996-2009 Science Assessments for Grade 12

Table 2 – Effect of evolution coverage in Science Standards on evolution approval in adulthood

	Evolution Approval			
	(1)	(2)	(3)	(4)
Evolution Score	0.108**	0.089**	0.205	0.333**
	(0.040)	(0.033)	(0.115)	(0.107)
Female		-0.053*		-0.050*
		(0.022)		(0.022)
Race/Ethnicity: Black		-0.158***		-0.149***
		(0.038)		(0.040)
Race/Ethnicity: Hispanic		-0.100*		-0.091
		(0.044)		(0.056)
Raised in Rural Area		-0.014		-0.003
		(0.024)		(0.025)
Raised as Protestant: Mainline		-0.141***		-0.121**
		(0.035)		(0.035)
Raised as Protestant: Evangelical		-0.302***		-0.290***
		(0.046)		(0.047)
Raised as Catholic		0.018		0.019
		(0.037)		(0.040)
State FEs	NO	NO	YES	YES
Birth Year FE	NO	NO	YES	YES
Other Controls	NO	YES	NO	YES
Mean of Dep. Var.	0.58	0.58	0.58	0.58
Std. Dev. of Dep. Var.	0.49	0.49	0.49	0.49
Adj. R-squared	0.005	0.088	0.038	0.107
Observations	1,812	1,801	1,812	1,801

Note: Dependent variable: Approval to Evolution ("Human beings, as we know them today, developed from earlier species of animals - Is that true or false?", Indicator variable, 1=true, 0=false; don't know). Other Controls: Indicator variables for white (race/ethnicity; omitted category) other (race/ethnicity), parents born abroad, parental education, having lived with parents in adolescence, religion raised in (Indicator variables for mainline protestantism, evangelical protestantism, catholicism (all reported here), no religion (omitted category), judaism, buddhism, hinduism, other eastern, islam, orthodox-christian, christian, native american, inter-nondenominational, other religion), and survey year fixed effects. Standard errors clustered at the state level in parenthesis. Single, double, and triple asterisks indicate statistical significance at the 5%, 1%, and 0.1% levels, respectively. Data source: General Social Survey.

Table 3 – Effect of evolution coverage in Science Standards on probability to work in life sciences

	Life Sciences			
	(1)	(2)	(3)	(4)
Evolution Score	0.039*	0.035*	0.035*	0.035*
	(0.018)	(0.013)	(0.014)	(0.014)
Female		0.014*		0.013*
		(0.006)		(0.006)
Race/Ethnicity: Black		-0.127***		-0.115***
		(0.007)		(0.006)
Race/Ethnicity: Hispanic		-0.106***		-0.085***
		(0.008)		(0.008)
State FEs	NO	NO	YES	YES
Birth Year FEs	NO	NO	YES	YES
Other Controls	NO	YES	NO	YES
Mean of Dep. Var.	0.15	0.15	0.15	0.15
Std. Dev. of Dep. Var.	3.84	3.84	3.84	3.84
Adj. R-squared	0.000	0.000	0.000	0.001
Observations	6,460,650	6,460,650	6,460,650	6,460,650

Note: Dependent variable: Probability to work in life sciences (multiplied by 100 for interpretability). Other controls: Indicator variables for asian (race/ethnicities), other (race/ethnicities), multiple (race/ethnicities), and survey year fixed effects. Standard errors clustered at the state level in parenthesis. Single, double, and triple asterisks indicate statistical significance at the 5%, 1%, and 0.1% levels, respectively. Data source: American Community Survey.

Table 4 – Placebo tests: Effect of evolution coverage in Science Standards on knowledge about non-evolution scientific topics

	Main Outcome:	Placebo Outcomes (Knowledge on the following Non-Evolution Scientific Topic):									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Evolution	Motion	Matter and Mass	Energy	Reproduction	Climate	Pollution	Earth	Tectonics	Universe	Average
Evolution Score	0.058**	-0.006	0.013	-0.014	0.024	-0.026	-0.014	0.039	0.009	0.003	0.006
	(0.019)	(0.045)	(0.047)	(0.024)	(0.028)	(0.046)	(0.059)	(0.023)	(0.020)	(0.051)	(0.012)
State FEs	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Birth Year FEs	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Mean of Dep. Var.	0.32	0.51	0.30	0.38	0.38	0.39	0.15	0.41	0.17	0.31	0.35
Std. Dev. of Dep. Var.	0.42	0.43	0.43	0.43	0.42	0.39	0.27	0.42	0.27	0.42	0.28
Adj. R-squared	0.049	0.090	0.140	0.110	0.100	0.073	0.077	0.140	0.312	0.049	0.168
Observations	15,520	9,510	17,000	22,910	18,610	19,080	4,770	13,710	6,730	6,260	32,850

Note: Dependent variables: Shares of questions answered correctly about scientific topics indicated in the column headers. Controls: Indicator variables for gender, races/ethnicities, subsidized lunch status, English language learner status, disability status, parental education, home possessions (separate Indicator variables for computer and books), and test year fixed effects. Standard errors clustered at the state level in parenthesis. Single, double, and triple asterisks indicate statistical significance at the 5%, 1%, and 0.1% levels, respectively. Data source: U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996-2009 Science Assessments for Grade 12

Table 5 – Placebo tests: Effect of evolution coverage in Science Standards on evolution knowledge in private schools

	Evolution Knowledge		
	(1) Only Public School Students	(2) Only Private School Students	(3) Overall
Evolution Score	0.058**	0.003	0.046*
	(0.019)	(0.062)	(0.018)
State FEs	YES	YES	YES
Birth Year FEs	YES	YES	YES
Controls	YES	YES	YES
Mean of Dep. Var.	0.32	0.43	0.34
Std. Dev. of Dep. Var.	0.42	0.38	0.41
Adj. R-squared	0.049	0.045	0.056
Observations	15,520	3,160	18,680

Note: Regressions by students' school type as indicated in the column headers. Dependent variable: Share of questions about evolution answered correctly. Controls: Indicator variables for gender, races/ethnicities, subsidized lunch status, English language learner status, disability status, parental education, home possessions (separate Indicator variables for computer and books), and test year fixed effects. Standard errors clustered at the state level in parenthesis. Single, double, and triple asterisks indicate statistical significance at the 5%, 1%, and 0.1% levels, respectively. Data source: U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996-2009 Science Assessments for Grade 12

Table 6 – Placebo tests: Effect of evolution coverage in Science Standards on non-evolution scientific topics

	Main Outcome:	Placebo Outcomes: Non-Evolution Scientific Topics									
	(1) Evolution	(2) Earth	(3) Radioactivity	(4) Reproduction	(5) Lasers	(6) Electrons	(7) Antibiotics	(8) Universe	(9) Tectonics	(10) Sun	(11) Average
Evolution Score	0.333**	0.000	-0.125	0.192	0.042	-0.133	0.175	-0.191	-0.179	-0.266	-0.053
	(0.107)	(0.091)	(0.138)	(0.107)	(0.181)	(0.144)	(0.158)	(0.113)	(0.091)	(0.164)	(0.057)
State FEs	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Birth Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Mean of Dep. Var.	0.58	0.88	0.66	0.62	0.47	0.57	0.51	0.45	0.85	0.79	0.65
Std. Dev. of Dep. Var.	0.49	0.32	0.47	0.48	0.50	0.49	0.50	0.50	0.36	0.41	0.22
Adj. R-squared	0.107	0.051	0.074	0.035	0.091	0.038	0.092	0.113	0.054	0.090	0.158
Observations	1,801	1,800	1,797	1,747	1,799	1,800	1,801	1,796	1,801	1,801	1,801

Note: Dependent variables: Questions answered correctly about scientific topics indicated in the column headers. Controls: Indicator variables for gender, races/ethnicities, parents born abroad, parental education, having lived with parents in adolescence, raised in rural area, religion raised in (Indicator variables for mainline protestantism, evangelical protestantism, catholicism, no religion, judaism, buddhism, hinduism, other eastern, islam, orthodox-christian, christian, native american, inter-nondenominational, other religion), and survey year fixed effects. Standard errors clustered at the state level in parenthesis. Single, double, and triple asterisks indicate statistical significance at the 5%, 1%, and 0.1% levels, respectively. Data source: General Social Survey.

Table 7 – Placebo tests: Effect of evolution coverage in Science Standards on religious outcomes

	Main Outcome:	Religious Placebo Outcomes: Believing					Religious Placebo Outcomes: Belonging and Activities					Religious Placebo Outcomes: Overall			Religious Placebo Outcomes: Average
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	Evolution	God	Bible	Afterlife	Rebirth	Strong Believer	Religious Affiliation	Church-going	Church Activities	Personal Prayer	Missionize	Spiritual Person	Religious Person	Fundamentalist	Average
Evolution Score	0.333**	-0.021	-0.009	-0.023	-0.097	-0.091	0.099	0.102	-0.072	-0.108	-0.028	0.060	-0.206	0.015	-0.029
	(0.107)	(0.096)	(0.114)	(0.128)	(0.123)	(0.150)	(0.109)	(0.120)	(0.091)	(0.113)	(0.073)	(0.101)	(0.162)	(0.129)	(0.068)
State FEs	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Birth Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Mean of Dep. Var.	0.58	0.87	0.72	0.73	0.34	0.32	0.70	0.35	0.17	0.65	0.41	0.56	0.43	0.24	0.50
Std. Dev. of Dep. Var.	0.49	0.33	0.45	0.45	0.47	0.47	0.46	0.48	0.38	0.48	0.49	0.50	0.50	0.43	0.28
Adj. R-squared	0.107	0.104	0.086	0.029	0.134	0.086	0.163	0.081	0.040	0.149	0.130	0.061	0.077	0.244	0.201
Observations	1,801	1,797	1,794	1,797	1,796	1,783	1,799	1,801	1,801	1,798	1,801	1,801	1,799	1,718	1,801

Note: Dependent variables: Main outcome and religious outcomes indicated in the column headers. Controls: Indicator variables for gender, races/ethnicities, parents born abroad, parental education, having lived with parents in adolescence, raised in rural area, religion raised in (Indicator variables for mainline protestantism, evangelical protestantism, catholicism, no religion, judaism, buddhism, hinduism, other eastern, islam, orthodox-christian, christian, native american, inter-nondenominational, other religion), and survey year fixed effects. Standard errors clustered at the state level in parenthesis. Single, double, and triple asterisks indicate statistical significance at the 5%, 1%, and 0.1% levels, respectively. Data source: General Social Survey.

Table 8 – Placebo tests: Effect of evolution coverage in Science Standards on political outcomes

	Main Outcome:	Political Placebo Outcomes: General		Political Placebo Outcomes: In favor of:							Political Placebo Outcomes: Increase governmental spending for:							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
	Evolution	Repub-lican	Conser-vative	Prayer in Public Schools	Sex Education in Public Schools	Same-Sex Marriage	Abor-tion	Marijuana Legali-zation	Capital Punish-ment	Gun Control	Immi-gration	Environ-ment	Alternative Energy Sources	Educa-tion	Scientific Research	Reducing Income Differences	Assistance to the Poor	Conditions of Blacks
Evolution Score	0.333**	0.028	-0.018	-0.061	0.085	0.084	-0.257	-0.006	-0.101	-0.013	-0.082	-0.062	0.045	-0.047	-0.116	0.137	0.148	-0.044
	(0.107)	(0.114)	(0.132)	(0.104)	(0.065)	(0.225)	(0.188)	(0.153)	(0.162)	(0.135)	(0.141)	(0.105)	(0.146)	(0.104)	(0.138)	(0.100)	(0.101)	(0.116)
State FEs	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Birth Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Mean of Dep. Var.	0.58	0.28	0.26	0.45	0.94	0.64	0.45	0.55	0.61	0.70	0.16	0.71	0.59	0.81	0.37	0.54	0.49	0.36
Std. Dev. of Dep. Var.	0.49	0.45	0.44	0.50	0.25	0.48	0.50	0.50	0.49	0.46	0.36	0.45	0.49	0.39	0.48	0.50	0.50	0.48
Adj. R-squared	0.107	0.058	0.024	0.087	0.048	0.110	0.028	0.079	0.063	0.060	-0.001	0.018	0.011	0.027	0.012	0.001	0.060	0.095
Observations	1,801	1,792	1,791	1,200	1,200	1,056	1,059	1,336	1,788	1,063	1,174	1,801	1,195	1,801	1,799	1,337	1,798	1,788

Note: Dependent variables: Main outcome and political outcomes indicated in the column headers. Controls: Indicator variables for gender, races/ethnicities, parents born abroad, parental education, having lived with parents in adolescence, raised in rural area, religion raised in (Indicator variables for mainline protestantism, evangelical protestantism, catholicism, no religion, judaism, buddhism, hinduism, other eastern, islam, orthodox-christian, christian, native american, inter-nondenominational, other religion), and survey year fixed effects. Standard errors clustered at the state level in parenthesis. Single, double, and triple asterisks indicate statistical significance at the 5%, 1%, and 0.1% levels, respectively. Data source: General Social Survey.

Table 9 – Effect of evolution coverage in Science Standards on probability to work in broader scientific occupational subfields

	(1) Life Sciences	(2) Physical Sciences	(3) Social Sciences	(4) Science Technicians	(5) Overall: All Sciences
Evolution Score	0.035*	0.042*	0.031	-0.027	0.081*
	(0.014)	(0.018)	(0.028)	(0.053)	(0.037)
State FEs	YES	YES	YES	YES	YES
Birth Year FEs	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES
Mean of Dep. Var.	0.15	0.22	0.16	0.32	0.85
Std. Dev. of Dep. Var.	3.84	4.68	4.03	5.62	9.16
Adj. R-squared	0.00064	0.00083	0.00096	0.00073	0.00166
Observations	6,460,650	6,460,650	6,460,650	6,460,650	6,460,650

Note: Dependent variable: Probability to work in occupational field indicated in the column header (multiplied by 100 for interpretability). Controls: Indicator variables for gender, races/ethnicities, and survey year fixed effects. Standard errors clustered at the state level in parenthesis. Single, double, and triple asterisks indicate statistical significance at the 5%, 1%, and 0.1% levels, respectively. Data source: American Community Survey.

Table 10 – Placebo test: Effect of evolution coverage in Science Standards on probability to work in non-scientific occupational fields

	Main Outcome:	Placebo Outcomes: Non-Scientific Occupational Fields												
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Sciences	Management	Business Operations	Finance	IT	Engineering	Social	Legal	Education	Arts	Healthcare	Healthcare Support	Protective Services	Food
Evolution Score	0.081*	0.281	0.127	0.120	0.115	0.023	0.133	0.145	-0.015	0.074	-0.053	-0.045	0.035	0.125
	(0.037)	(0.191)	(0.099)	(0.079)	(0.080)	(0.068)	(0.097)	(0.078)	(0.241)	(0.111)	(0.189)	(0.182)	(0.201)	(0.386)
State FEs	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Birth Year FEs	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Mean of Dep. Var.	0.85	5.44	1.87	1.63	1.97	1.39	1.39	0.82	5.58	2.04	4.33	2.63	2.13	7.88
Std. Dev. of Dep. Var.	9.16	22.68	13.54	12.67	13.89	11.69	11.70	9.01	22.96	14.15	20.36	15.99	14.43	26.94
Adj. R-squared	0.00166	0.01926	0.00489	0.00421	0.01092	0.00774	0.00417	0.00382	0.02060	0.00198	0.02620	0.01644	0.00655	0.01962
Observations	6,460,650	6,460,650	6,460,650	6,460,650	6,460,650	6,460,650	6,460,650	6,460,650	6,460,650	6,460,650	6,460,650	6,460,650	6,460,650	6,460,650

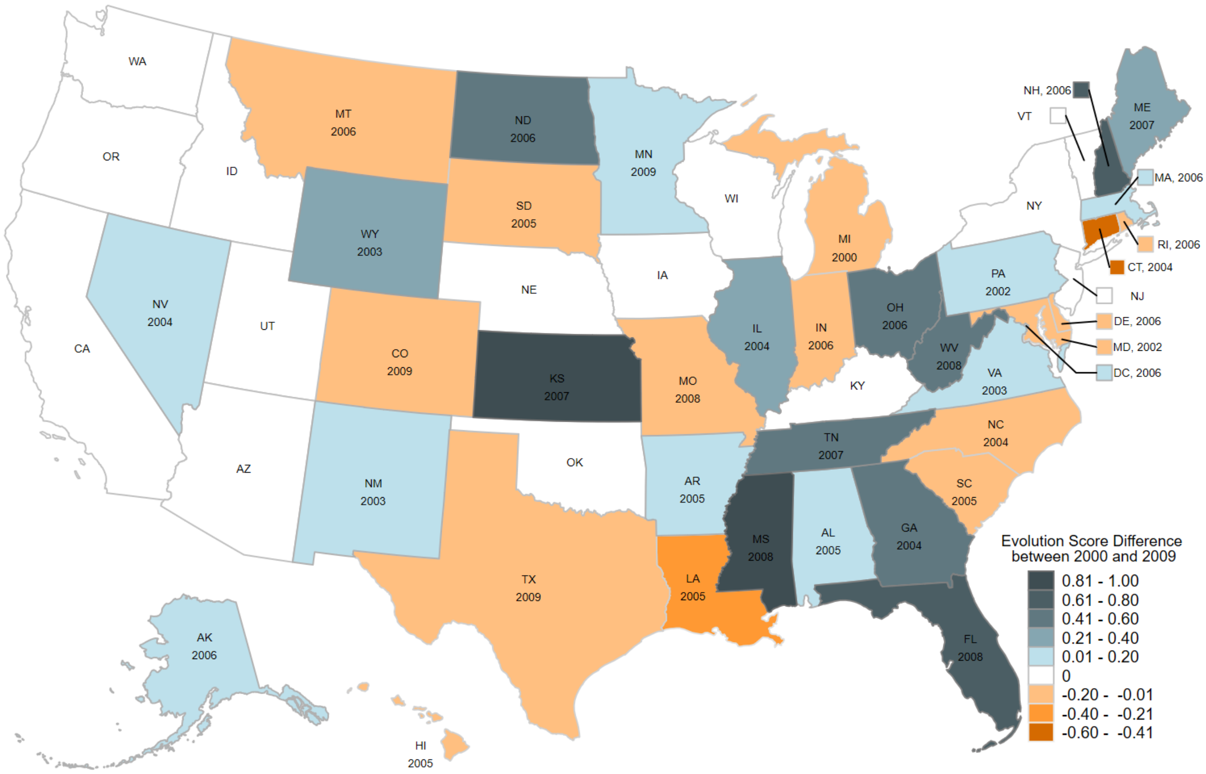
Note: Dependent variable: Probability to work in occupational field indicated in the column header (multiplied by 100 for interpretability). Controls: Indicator variables for gender, races/ethnicities, and survey year fixed effects. Standard errors clustered at the state level in parenthesis. Single, double, and triple asterisks indicate statistical significance at the 5%, 1%, and 0.1% levels, respectively. Data source: American Community Survey.

Table 10 (continued) – Placebo test: Effect of evolution coverage in Science Standards on probability to work in non-scientific occupational fields

	Placebo Outcomes: Non-Scientific Occupational Fields											
	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)
	Buildings	Personal Care	Sales	Office	Farming	Construc-tion	Extrac-tion	Installa-tion	Produc-tion	Transporta-tion	Armed Forces	Unemployed/ Not in Labor Market
Evolution Score	0.073	-0.078	-0.502	-0.059	-0.011	-0.227	0.058	0.060	-0.171	0.190	0.046	-0.525
	(0.283)	(0.284)	(0.267)	(0.488)	(0.111)	(0.249)	(0.047)	(0.117)	(0.220)	(0.329)	(0.080)	(1.778)
State FEs	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Birth Year FEs	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Mean of Dep. Var.	2.84	3.96	11.42	13.25	0.66	4.45	0.21	2.80	4.87	5.35	0.75	9.48
Std. Dev. of Dep. Var.	16.61	19.51	31.81	33.90	8.07	20.63	4.60	16.50	21.53	22.50	8.62	29.30
Adj. R-squared	0.00622	0.01477	0.01027	0.02388	0.00547	0.04532	0.00463	0.02608	0.01894	0.02964	0.00522	0.03058
Observations	6,460,650	6,460,650	6,460,650	6,460,650	6,460,650	6,460,650	6,460,650	6,460,650	6,460,650	6,460,650	6,460,650	6,460,650

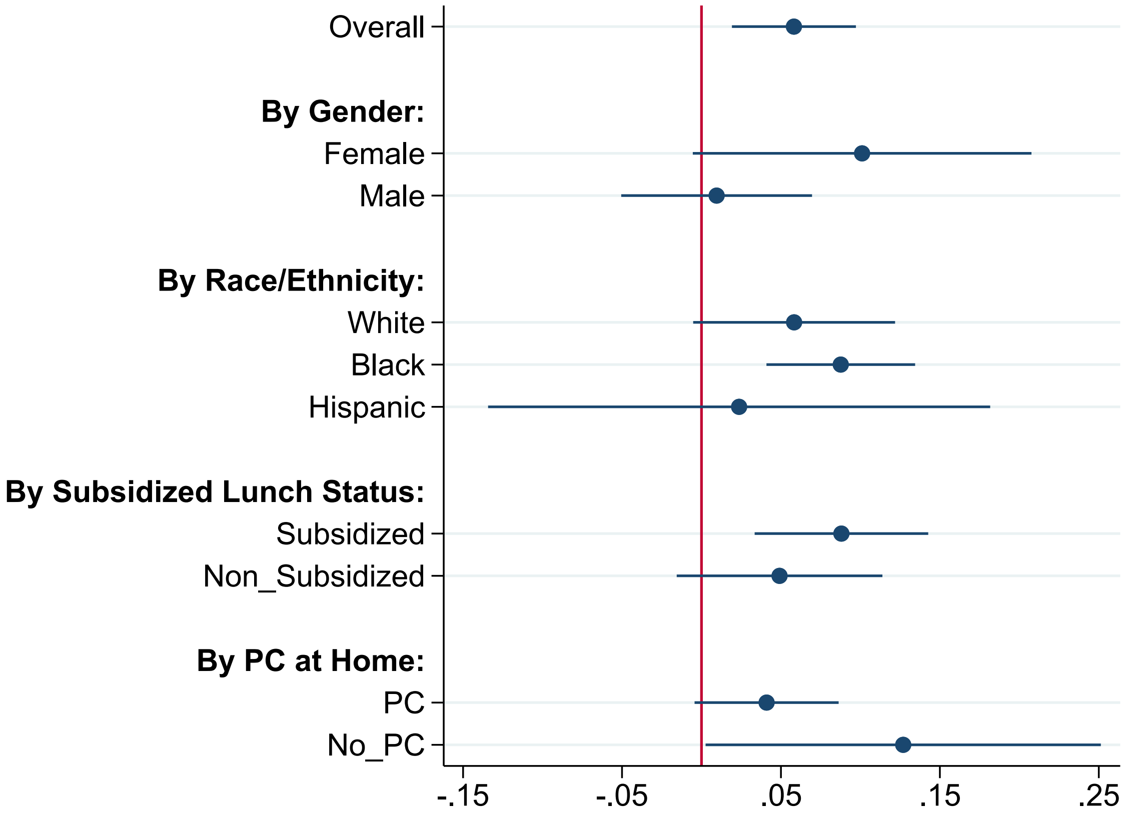
Note: Dependent variable: Probability to work in occupational field indicated in the column header (multiplied by 100 for interpretability). Controls: Indicator variables for gender, races/ethnicities, and survey year fixed effects. Standard errors clustered at the state level in parenthesis. Single, double, and triple asterisks indicate statistical significance at the 5%, 1%, and 0.1% levels, respectively. Data source: American Community Survey.

Figure 1 – US map of evolution score difference between 2000 and 2009



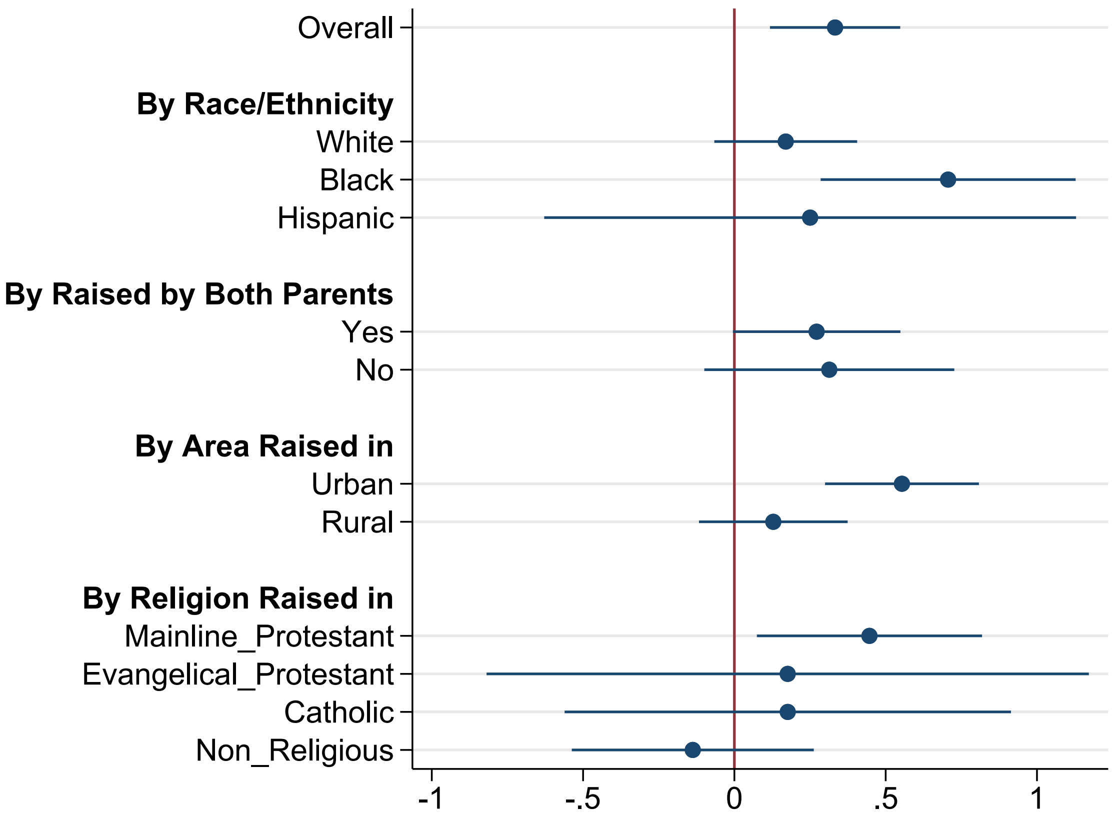
Note: Map depicts the evolution score difference, which I define as the evolution score of 2009 minus the evolution score of 2000. A positive (negative) difference implies an increase (decrease) in the evolution score between 2000 and 2009, as indicated by blue (orange) coloring. White coloring indicates no change of the evolution score between 2000 and 2009. The years reported below the two-letter state codes mark the respective reform years. A list of the evolution score differences and reform years underlying this map is provided in Table A.2. Data source: Lerner (2000b), Mead and Mates (2009)

Figure 2 – Effect of evolution coverage in Science Standards on evolution knowledge in school, by subgroups



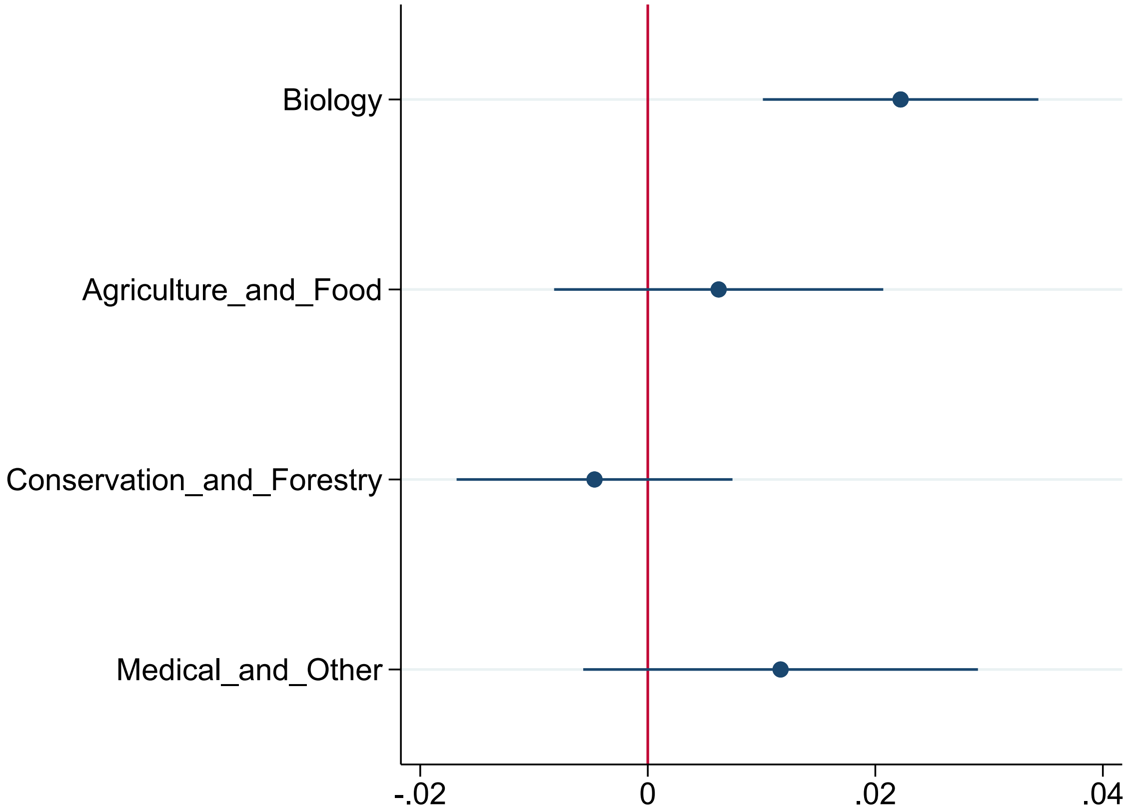
Note: Figure displays Effect of evolution coverage in Science Standards on share of questions about evolution answered correctly, by individual subgroup as indicated in rows. Controls: Indicator variables for gender, races/ethnicities, subsidized lunch status, English language learner status, disability status, parental education, home possessions (separate Indicator variables for computer and books), and fixed effects for state, birth year, and test year. Standard errors clustered at the state level. 95% confidence intervals displayed. Data source: U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996-2009 Science Assessments for Grade 12

Figure 3 – Effect of evolution coverage in Science Standards on evolution approval in adulthood, by subgroups



Note: Figure displays Effect of evolution coverage in Science Standards on approval of evolution in adulthood ("Human beings, as we know them today, developed from earlier species of animals - Is that true or false?", Indicator variable, 1=true, 0=false; don't know), by individual subgroup as indicated in rows. Controls: Indicator variables for gender, races/ethnicities, parents born abroad, parental education, having lived with parents in adolescence, raised in rural area, religion raised in (Indicator variables for mainline protestantism, evangelical protestantism, catholicism, no religion, judaism, buddhism, hinduism, other eastern, islam, orthodox-christian, christian, native american, inter-nondenominational, other religion), and fixed effects for state, birth year, and test year. Standard errors clustered at the state level. 95% confidence intervals displayed. Data source: General Social Survey

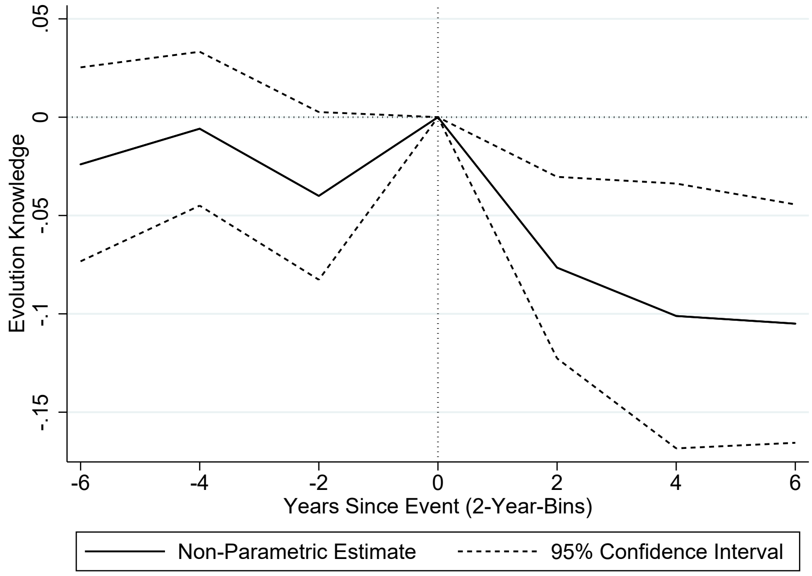
Figure 4 – Effect of evolution coverage in Science Standards on probability to work in life sciences, by subfields of life sciences



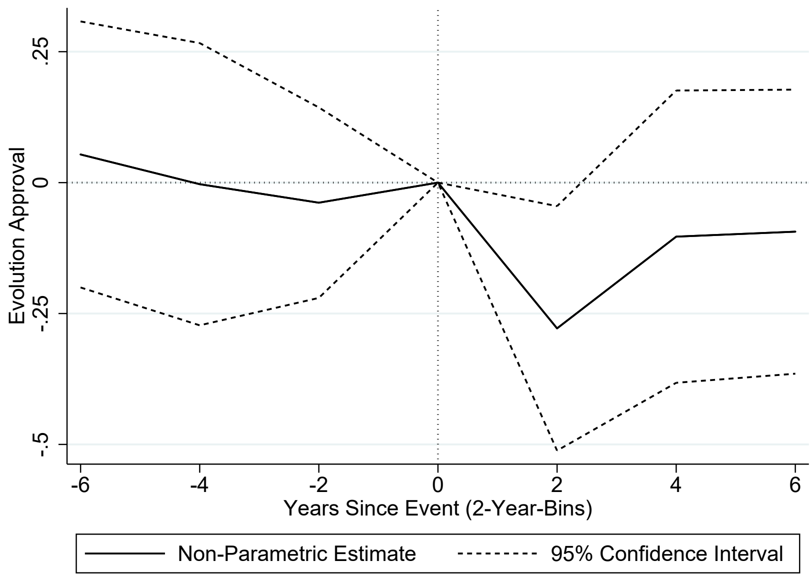
Note: Figure displays Effect of evolution coverage in Science Standards on probability to work in life sciences, by subfields of life sciences as indicated in rows (multiplied by 100 for interpretability). Controls: Indicator variables for gender, races/ethnicities and fixed effects for state, birth year, and test year. Standard errors clustered at the state level. 95% confidence intervals displayed. Data source: American Community Survey

Figure 5 – Event-study graphs: Reforms that reduce evolution coverage in Science Standards

(a) Evolution knowledge in school



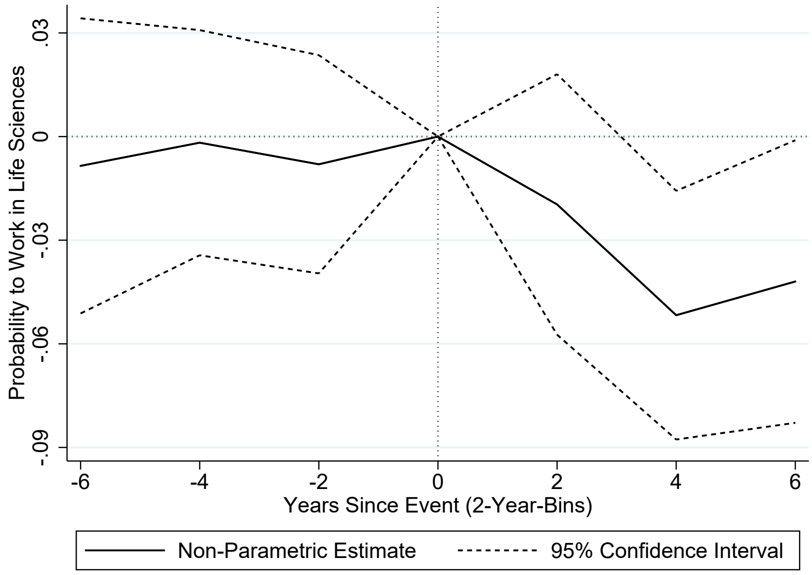
(b) Evolution approval in adulthood



Note: Continuation on next page

Figure 5 (continued) – Event-study graphs: Reforms that reduce evolution coverage in Science Standards

(c) Occupational Choice: Working in Life Sciences



Note: Coefficients from non-parametric event-study regressions and their 95% confidence intervals. Dependent variable: (a) Share of questions about evolution answered correctly; (b) Approval to Evolution ("Human beings, as we know them today, developed from earlier species of animals - Is that true or false?", Indicator variable, 1=true, 0=false; don't know); (c) Probability to work in life sciences (multiplied by 100 for interpretability). Controls: (a) Indicator variables for gender, races/ethnicities, subsidized lunch status, English language learner status, disability status, parental education, home possessions (separate indicator variables for computer and books), as well as state, birth year and test year fixed effects; (b) Indicator variables for gender, races/ethnicities, parents born abroad, parental education, having lived with parents in adolescence, raised in rural area, religion raised in (indicator variables for mainline protestantism, evangelical protestantism, catholicism, no religion, judaism, buddhism, hinduism, other eastern, islam, orthodox-christian, christian, native american, inter-nondenominational, other religion), as well as state, birth year, and survey year fixed effects; (c) Indicator variables for gender, races/ethnicities, as well as state, birth year, and survey year fixed effects. Numbers on horizontal axis refer to final year of respective two-year bins; i.e., 0 = last two years prior to treatment (excluded category), 2 = first two years of treatment. Inference: Clustering at state level. The p values of omnibus hypothesis tests of zero pre- and post-event effects are respectively: (a) 0.186 and 0.012; (b) 0.838 and 0.103; (c) 0.912 and 0.011. Data sources: (a) U.S. Department of Education, National Center for Education Statistics, 1996-2009 National Assessment of Educational Progress; (b) General Social Survey; (c) American Community Survey.

A SUPPLEMENTARY APPENDIX

A.1 Evidence from High School Biology Teachers

This supplementary analysis provides suggestive evidence that teachers base their evolution teaching on the evolution coverage of the Science Standard in power in their state. To show this, I draw on the National Survey of High School Biology Teachers conducted by the Survey Research Center of Penn State University in 2007. The survey focuses on the biology teachers' approach to teaching evolution (and creationism) in the classroom, as well as their educational background and personal attitudes on evolution. The sample consists of a nationally representative sample of high school biology teachers who are teaching in a public school where grades 9 and 10 are offered, who taught a high school biology class in at least the previous year, and who had not recently retired (see Berkman et al. (2008) and Berkman and Plutzer (2011) for more information).

First, I report that the large majority of biology teachers states that they align their evolution teaching with the evolution coverage of their Science Standard. Specifically, 88 percent of high school biology teachers strongly agree or agree with the statement "When I do teach evolution, I focus heavily on what students need to know to meet state science standards" (see Figure A.1).

Second, I show that high school biology teachers who are exposed to a more comprehensive evolution coverage in their Science Standard spend more time on teaching evolution. To demonstrate this, I link information on the time spent on teaching evolution (and various other pro-evolution and pro-creationism teaching strategies) to the evolution score measuring the evolution coverage of the Science Standard in power in the state of the teacher in 2007, the year of the survey. The between-states model is specified as follows:

$$Y_{is} = \beta \cdot Evolution\_Score_s + \gamma \cdot \mathbf{X_i} + \eta_c + \epsilon_{is} \tag{3}$$

where Y_{is} is the outcome of interest of teacher i, who teaches in state s and is surveyed in 2007. The treatment variable $Evolution\_Score_s$ measures the evolution coverage in the Science Standard in state s in 2007. β is the parameter of interest capturing the conditional association of the outcome with being exposed to a very comprehensive coverage of evolution ($Evolution\_Score_s$=1) as opposed to being exposed to no or a non-scientific/creationist coverage of evolution ($Evolution\_Score_s$=0). The vector $\mathbf{X_i}$ contains control variables, η_c captures census division fixed effects, and an error term completes the model. The standard errors are clustered at the state level.

In contrast to the main effects shown in this paper, these conditional associations should be interpreted as suggestive rather than causal evidence. Due to the fact that the teacher data is only available for one year, there is no within-state variation over time that would allow to identify effects from reforms of Science Standards. Instead, the variation here stems from differences between states at one point in time. The main concern for a causal interpretation is that not only the evolution coverage of education standards differs between states, but many other factors including teachers' own attitude on evolution. To partially account for that, I control for detailed teacher characteristics including information on their education about biology and evolution, and their personal attitude and knowledge on evolution. Second, I control for census division fixed effects which ensures that the identifying variation stems from between-state comparisons within relatively homogeneous subgroups of states.

The conditional associations show that teachers with similar characteristics in the same census division in different states who are exposed to an evolution score of one, i.e. to a very comprehensive coverage of evolution, as opposed to an evolution score of zero, i.e. to no or a non-scientific/creationist coverage of evolution, are 33 percentage points more likely to spend at least 5 class hours per year on evolution (Table A.1). This positive, large, and significant association is specific to teaching hours spent on evolution. Other strategies regarding the teaching of evolution (and creationism) do not significantly differ by the evolution score. Taken together, the results presented in this supplementary analysis suggest that biology teachers (i) focus their evolution teaching on what students need to know to meet Science Standards, and (ii) adjust the time spent on teaching evolution accordingly, while other teaching strategies such as the expression of personal opinions on the validity of evolution do not differ.

A.2 Data Appendix

A.2.1 NAEP: Evolution Knowledge in School

The NAEP is a congressionally mandated project also known as the Nation's Report Card. It is administered by the National Center for Education Statistics (NCES), a body within the Institute of Education Sciences (IES) and the US Department of Education. Throughout the paper I use data from the Main-NAEP and not the Long-Term Trend NAEP, as the Main-NAEP has much larger sample sizes, is state-representative and, particularly relevant for this analysis, also covers science.

I categorize a question as addressing evolution if it contains the words "evolution" or "natural selection", or if it contains words that are based on the same word stem, such as "evolutionary".[24] I transform each question into a binary variable that is set equal to one if the correct answer was given, and equal to zero for any other answer, whether it is incorrect, partially correct, off task, etc. (the specific available categories depend on the question type). Figure A.4 presents two sample questions, one on general Darwinian theory, and one on evolutionary trees. For each student, I calculate the share of questions on evolution that the student answered correctly. This share serves as the main outcome variable measuring a student's knowledge on evolution. I analogously group questions into nine categories of scientific topics other than evolution.[25] Table A.13 shows that knowledge on evolution is in general positively correlated with knowledge on non-evolution scientific topics.

[24]Sometimes, the dataset does not contain the full wording of the questions but question keywords due to data protection reasons. I code such cases analogously, i.e. as addressing evolution if their keywords contain the words "evolution" or "natural selection", or if they contain words that are based on the same word stem.

[25]Notably, the number of questions available for each scientific topic in the pool of NAEP questions differs across scientific topics. Furthermore, each student receives only a subset of the pool of questions during the test. This test design explains why the number of questions answered on a given scientific topic differs across students. To address this issue, I calculate the share of questions answered correctly on a given scientific topic instead of the number of questions answered correctly. Moreover, this test design also explains why the number of students answering questions on a given scientific topic differs across scientific topics, resulting in varying sample sizes across scientific topics. These sample size differences are not a result of spurious selection, but are induced by the test design.

In the preferred sample cut of keeping individuals who enter high school after 1990 and before 2010, I use the NAEP tests for science in grade 12 from 1996, 2000, 2005, and 2009. Regarding missings, I keep all students without missings on basic controls such as gender, and who come from birth cohorts of at least 10 observations. I set missings of other control variables to zero and add separate explanatory binary variables to account for these missings.[26]

The descriptive statistics for the main treatment, outcome, and control variables are presented in Table A.14. The treatment variable "evolution score" captures the score of the evolution coverage of the State Science Standard in power in the state and year of a student's high school entry. The average evolution score equals 0.65, implying that students were on average exposed to a "satisfactory" evolution coverage.[27] The main outcome variable "evolution knowledge" is defined as the share of questions on evolution a students answers correctly. The fact that only 32 percent of questions on evolution are answered correctly on average underscores the difficulty of the test. For instance, the shares of students giving correct answers to the sample questions reported in Figure A.4 equal 54 percent and 28 percent, respectively. Regarding non-evolution scientific topics, the average share of questions answered correctly amounts to 35 percent, indicating that the average difficulty of questions on evolution is largely similar to the overall difficulty. With regards to control variables, about half of the sample are female (51 percent). The shares of Whites, Blacks, Hispanics and Asians amount to 57 percent, 19 percent, 16 percent, and 6 percent, respectively. The various variables on the socioeconomic status indicate that a non-negligible share of students from grade 12 lives in underprivileged circumstances as measured by subsidized lunch status (30 percent), having no PC at home (16 percent), or disability status (11 percent).

[26] The results are robust to not imputing the missings, as shown in Table A.7.

[27] Lerner (2000b) classifies evolution scores between 0.60 and 0.79 as "satisfactory".

A.2.2 GSS: Evolution Approval in Adulthood

The GSS data in the main sample comes from the waves from 2006, 2010, 2012, 2014, and 2016. Regarding correlations, the approval of evolution is almost only positively correlated with the other scientific outcomes, see Table A.15. For all religious variables, I find a negative raw correlation with evolution approval as is visible in Table A.16. The correlations between the political variables and evolution approval depend on the specific variable, see Table A.17. For example, being in favor of same-sex marriage or marijuana legalization is positively correlated with evolution approval, while there is a negative correlation for identifying as Republican or being in favor of prayers in public schools.

Table A.18 shows the descriptive statistics for the main treatment, outcome and control variables. The individuals in the sample were exposed to an evolution score of 0.63 on average which is very similar to corresponding sample average in NAEP, as expected given the comparable sample cut. Regarding the main outcome variable evolution approval, I find that 58 percent of sample say that the aforementioned statement about evolution is true. Regarding non-evolution scientific topics, six of the nine non-evolution scientific topics display higher rates of correct answers than evolution, with an average of 64 percent across these nine topics. Looking at religious outcomes, I note that 87 percent of respondents believe in God, and 70 percent are affiliated with a church. To give examples on political and partisan topics, 94 percent come out in favor of sex education in public schools, while the approval rates of same-sex marriage (64 percent) and abortion (46 percent) are considerably lower in this sample. With regard to the religious upbringing of these individuals, I observe that the most common religion/denomination an individual was raised in is Mainline Protestantism (37 percent), followed by Catholicism (32 percent), Non-Religious/Agnosticism/Atheism (13 percent), and Evangelicalism (10 percent).

A.2.3 ACS: Occupational Choice

The estimation sample combines ACS waves from 2000-2017. The descriptive statistics are presented in Table A.19. For the treatment variable, I find that the average evolution score exposure equals 0.68, which is similar to the corresponding averages from the analyses using the NAEP and the GSS. Regarding the outcome variables, all indicator variables for occupational fields are multiplied by 100 to ease the readability of descriptive statistics and reform effects. Hence, the descriptive statistics including mean and standard deviation are multiplied by 100 as well. For example, the sample mean of respondents working in life sciences equals 0.15, which implies that 0.15 percent of the sample work in this field. 0.84 percent of the sample work in any scientific field. Out of all 26 occupational fields, the largest sample shares are found for respondents working in office (13.2 percent) and in sales (11.5 percent).

A.3 Supplementary Tables and Figures

Table A.1 – Conditional associations of evolution coverage in Science Standards with pro-evolution and pro-creationism teaching strategies

	Pro-Evolution Teaching				Pro-Creationism Teaching			
	(1) Teaching Hours On Evolution	(2) Emphasize Consensus about Evolution	(3) Agree: Evolution Is Unifying Theme	(4) Emphasize Scientists Reject Creationism	(5) Teaching Hours On Creationism	(6) Emphasize Evolution May Be Wrong	(7) Emphasize Creationism As Valid Alternative	(8) Believe Evolution Not Needed For Good Course
Evolution Score	0.333**	0.041	0.116	0.193	0.008	-0.091	-0.051	-0.027
	(0.120)	(0.087)	(0.148)	(0.129)	(0.023)	(0.094)	(0.169)	(0.072)
Controls	YES	YES	YES	YES	YES	YES	YES	YES
Mean of Dep. Var.	0.67	0.79	0.65	0.52	0.01	0.71	0.30	0.13
Std. Dev. of Dep. Var.	0.47	0.41	0.48	0.50	0.11	0.45	0.46	0.33
Adj. R-squared	0.134	0.105	0.163	0.117	0.013	0.091	0.191	0.127
Observations	814	802	794	368	808	804	390	806

Note: Dependent variables (indicator variables) indicated in the column headers as follows : (1) Teacher typically spends at least 5 class hours in biology course for the year on general evolutionary processes; (2) When teaching evolution, teacher emphasizes the broad consensus that evolution is fact even as scientists disagree about the specific mechanisms through which evolution occurred; (3) Teacher agrees that evolution serves as the unifying theme for the content of the course; (4) When teaching creationism or intelligent design, teacher emphasizes that almost all scientists reject these as valid accounts of the origin of species; (5) Teacher typically spends at least 5 class hours in biology course for the year on intelligent design or creationism; (6) When teaching evolution, teacher emphasizes the possibility that portions of evolutionary theory may be proven wrong; (7) When teaching creationism or intelligent design, teacher emphasizes that this is a valid, scientific alternative to Darwinian explanations for the origin of species; (8) Teacher believes it is possible to offer an excellent general biology course for high school students that includes no mention of Darwin or evolutionary theory. Controls: Teacher's gender, age, years of teaching experience, undergraduate and graduate courses (separate variables for undergraduate and graduate credit hours in biology; specific college-level course in evolution; major, minor, or special emphasis in science education, biology, other science, statistics, or education), college degrees (separate variables for associate degree; Bachelor of Arts; Bachelor of Science; Master's degree in education; Master's degree in science; PhD in education; PhD in science), type of teaching certificate, teacher's continuing education about scientific debates of last years (separate variables for textbooks; science journalism; science education websites; scientific journals; or taking science courses), teacher's own view about evolution regardless of classroom activities (separate variables for creationist view; acknowledgment of evolution as guided by God; non-religious view on evolution), teacher's self-assessed knowledge about evolution (separate variables for excellent, very good, typical, or not good), high school biology assessment test in place, and census division fixed effects. Standard errors clustered at the state level in parenthesis. Single, double, and triple asterisks indicate statistical significance at the 5%, 1%, and 0.1% levels, respectively. Data source: National Survey for High School Biology Teachers, 2007.

Table A.2 – Evolution scores and reform year, by state

State	Evolution Score: 2009	Evolution Score: 2000	Evolution Score Difference 2009 - 2000	Reform Year	Only One Reform Event
Alabama	0.21	0.09	0.12	2005	NO
Alaska	0.59	0.48	0.11	2006	NO
Arkansas	0.66	0.55	0.11	2005	YES
DC	0.96	0.80	0.16	2006	YES
Florida	0.91	0.16	0.75	2008	YES
Georgia	0.66	0.07	0.59	2004	YES
Illinois	0.82	0.45	0.37	2004	YES
Kansas	0.96	0.00	0.96	2007	NO
Maine	0.68	0.30	0.38	2007	YES
Massachusetts	0.84	0.82	0.02	2006	NO
Minnesota	0.89	0.86	0.03	2009	NO
Mississippi	0.86	0.05	0.81	2008	NO
Nevada	0.77	0.70	0.07	2004	YES
New Hampshire	0.91	0.23	0.68	2006	YES
New Mexico	0.91	0.73	0.18	2003	YES
North Dakota	0.64	0.09	0.55	2006	NO
Ohio	0.86	0.28	0.58	2006	NO
Pennsylvania	0.96	0.91	0.05	2002	YES
Tennessee	0.55	0.02	0.53	2007	NO
Virginia	0.68	0.50	0.18	2003	YES
West Virginia	0.46	0.03	0.43	2008	NO
Wyoming	0.61	0.36	0.25	2003	YES
Colorado	0.82	0.86	-0.04	2009	NO
Connecticut	0.59	1.00	-0.41	2004	YES
Delaware	0.80	0.91	-0.11	2006	YES
Hawaii	0.75	0.91	-0.16	2005	YES
Indiana	0.96	1.00	-0.04	2006	NO
Louisiana	0.27	0.64	-0.37	2005	NO
Maryland	0.73	0.77	-0.04	2002	NO
Michigan	0.80	0.84	-0.04	2000	YES
Missouri	0.78	0.82	-0.04	2008	NO
Montana	0.75	0.82	-0.07	2006	YES
North Carolina	0.82	1.00	-0.18	2004	YES
Rhode Island	0.82	1.00	-0.18	2006	YES
South Carolina	0.91	0.95	-0.04	2005	NO
South Dakota	0.77	0.82	-0.05	2005	YES
Texas	0.46	0.64	-0.18	2009	YES
Arizona	0.82	0.82	0.00	-	-
California	1.00	1.00	0.00	-	-
Idaho	0.82	0.82	0.00	-	-
Iowa	0.77	No Standard	-	-	-
Kentucky	0.55	0.55	0.00	-	-
Nebraska	0.66	0.66	0.00	-	-
New Jersey	1.00	1.00	0.00	-	-
New York	0.68	0.68	0.00	-	-
Oklahoma	0.25	0.25	0.00	-	-
Oregon	0.82	0.82	0.00	-	-
Utah	0.82	0.82	0.00	-	-
Vermont	0.86	0.86	0.00	-	-
Washington	0.86	0.86	0.00	-	-
Wisconsin	0.55	0.55	0.00	-	-

Note: Table reports the evolution score from 2009 based on Mead and Mates (2009), the evolution score from 2000 based on Lerner (2000b), and the difference of the evolution scores (evolution score from 2009 minus evolution score from 2000). States are listed in two pannels, postive or negative/zero evolution score change. For states that changed their evolution score, the respective year of the (last) reform as noted in Mead and Mates (2009) is also provided, and whether this reform is the only reform event between 2000 and 2009. The latter information on the only reform event is based on Gross (2005), Swanson (2005) as well as my own examination of state education websites.

Table A.3 – Effect of evolution coverage in Science Standards on probability to work in life sciences, by subgroups

	By Gender		By Race/Ethnicity		
	(1)	(2)	(3)	(4)	(5)
	Females	Males	Whites	Blacks	Hispanics
Evolution Score	0.052*	0.018	0.038*	0.012	0.004
	(0.020)	(0.020)	(0.016)	(0.016)	(0.034)
State FEs	YES	YES	YES	YES	YES
Birth Year FEs	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES
Mean of Dep. Var.	0.15	0.14	0.16	0.04	0.06
Std. Dev. of Dep. Var.	3.92	3.75	4.05	2.06	2.44
Adj. R-squared	0.00068	0.00063	0.00047	0.00022	0.00030
Observations	3,220,042	3,240,608	5,023,449	789,587	765,295

Note: Regressions by selected subgroups, as indicated in the columns headers. Dependent variable: Probability to work in life sciences (multiplied by 100 for interpretability). Controls: Dummies for gender, races/ethnicities, and survey year fixed effects. Standard errors clustered at the state level in parenthesis. Single, double, and triple asterisks indicate statistical significance at the 5%, 1%, and 0.1% levels, respectively. Data source: American Community Survey.

Table A.4 – Effect of evolution coverage in Science Standards on evolution knowledge in school: CS estimator

	Evolution Knowledge	
	States with decreasing evolution score	States with increasing evolution score
	(1)	(2)
Evolution Score	0.056***	0.028
	(0.017)	(0.022)

Note: Dependent variable: Share of questions about evolution answered correctly. CS estimator (Callaway and Sant'Anna, 2021), accounting for heterogeneous treatment effects and staggered treatment timing. Simple aggregation of absolute value of all post treatment effects, using doubly robust inverse probability weighting. Controls: Never treated observations and not yet treated observations. Standard errors clustered at the state level in parenthesis. Single, double, and triple asterisks indicate statistical significance at the 5%, 1%, and 0.1% levels, respectively. Data source: U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996-2009 Science Assessments for Grade 12

Table A.5 – Effect of evolution coverage in Science Standards on evolution approval in adulthood: CS estimator

	Evolution Approval	
	States with decreasing evolution score	States with increasing evolution score
	(1)	(2)
Evolution Score	0.274	0.198
	(0.194)	(0.156)

Note: Dependent variable: Approval to Evolution ("Human beings, as we know them today, developed from earlier species of animals - Is that true or false?", Indicator variable, 1=true, 0=false; don't know). CS estimator (Callaway and Sant'Anna, 2021), accounting for heterogeneous treatment effects and staggered treatment timing. Simple aggregation of absolute value of all post treatment effects, using doubly robust inverse probability weighting. Controls: Never treated observations and not yet treated observations. Standard errors clustered at the state level in parenthesis. Single, double, and triple asterisks indicate statistical significance at the 5%, 1%, and 0.1% levels, respectively. Data source: General Social Survey

Table A.6 – Effect of evolution coverage in Science Standards on probability to work in life sciences: CS estimator

	Life Sciences	
	States with decreasing evolution score	States with increasing evolution score
	(1)	(2)
Evolution Score	0.036*	0.007
	(0.016)	(0.011)

Note: Dependent variable: Probability to work in life sciences (multiplied by 100 for interpretability). CS estimator (Callaway and Sant'Anna, 2021), accounting for heterogeneous treatment effects and staggered treatment timing. Simple aggregation of absolute value of all post treatment effects, using doubly robust inverse probability weighting. Controls: Never treated observations and not yet treated observations. Standard errors clustered at the state level in parenthesis. Single, double, and triple asterisks indicate statistical significance at the 5%, 1%, and 0.1% levels, respectively. Data source: American Community Survey

Table A.7 – Effect of evolution coverage in Science Standards on evolution knowledge, further robustness checks

	(1) Close Elections	(2) Control: Governor's Party	(3) State Specific Time Trends	(4) Only One Reform Event	(5) Sample Start: 1995	(6) Sample Start: 2000	(7) Outcome Coding: Indicator Variation	(8) Logit	(9) Probit	(10) Drop Missings
Evolution Score	0.083***	0.059**	0.042	0.079**	0.042*	0.033	0.051*	0.065*	0.063*	0.063**
	(0.021)	(0.020)	(0.068)	(0.022)	(0.016)	(0.023)	(0.022)	(0.032)	(0.031)	(0.022)
State FEs	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Birth Year FEs	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Mean of Dep. Var.	0.33	0.32	0.32	0.32	0.31	0.30	0.35	0.32	0.32	0.33
Std. Dev. of Dep. Var.	0.42	0.42	0.42	0.42	0.42	0.44	0.43	0.42	0.42	0.42
Adj. R-squared	0.046	0.049	0.048	0.049	0.045	0.038	0.041	0.083	0.083	0.043
Observations	5,200	15,520	15,520	7,000	14,030	11,390	14,470	15,510	15,510	13,550

Note: Robustness checks indicated in the column headers as follows: (1) Sample only includes states where the members of the State Board of Education are appointed by the governor, and where the governor in office at the time of the reform was voted into office with a margin of less than 10 percentage points compared to the runner-up; (2) Regressions control for political affiliation of governor ruling in the state and year of the student's high school entry; (3) Regressions include state-specific linear and quadratic time trends; (4) Sample only includes individuals from states that had only one reform event between 2000 and 2009, see Table A.2 for more details; (5) Sample only includes individuals who entered high school after 1994; (6) Sample only includes individuals who entered high school after 1999; (7) Re-coding of dependent variable: Share of questions about evolution answered correctly. Indicator variable, 1=true, 0=false, missing=omitted/not reached/off-task/etc. (dependent on the question type); (8) Re-coding of dependent variable: Individuals are dropped from the sample if the question on evolution approval contains the word "elephants" instead of "human beings" (9) Coefficient reports average marginal treatment effect of logit specification; (10) Coefficient reports average marginal treatment effect of probit specification; (11) Sample excludes individuals who have missing values on controls instead of imputing them. Dependent variable: Share of questions about evolution answered correctly. Controls: Dummies for gender, races/ethnicities, subsidized lunch status, English language learner status, disability status, parental education, home possessions (separate dummies for computer and books), and test year fixed effects. Standard errors clustered at the state level in parenthesis. Single, double, and triple asterisks indicate statistical significance at the 5%, 1%, and 0.1% levels, respectively. Data source: U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996-2009 Science Assessments for Grade 12

Table A.8 – Effect of evolution coverage in Science Standards on evolution approval in adulthood, further robustness checks

	(1) Close Elections	(2) Control: Governor's Party	(3) State Specific Time Trends	(4) Only One Reform event	(5) Sample Start: 1995	(6) Sample Start: 2000	(7) Outcome Coding Variation 1	(8) Outcome Coding Variation 2	(9) Logit	(10) Probit	(11) Drop Missings
Evolution Score	0.605**	0.332**	0.625**	0.394*	0.257*	0.313	0.288*	0.426**	0.347**	0.329*	0.304*
	(0.188)	(0.112)	(0.218)	(0.163)	(0.116)	(0.171)	(0.138)	(0.145)	(0.129)	(0.130)	(0.136)
State FEs	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Birth Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Mean of Dep. Var.	0.58	0.58	0.58	0.57	0.59	0.61	0.66	0.55	0.58	0.58	0.58
Std. Dev. of Dep. Var.	0.49	0.49	0.49	0.49	0.49	0.49	0.47	0.50	0.49	0.49	0.49
Adj. R-squared	0.102	0.107	0.096	0.115	0.092	0.077	0.127	0.102	0.117	0.117	0.110
Observations	589	1,801	1,801	709	1,299	654	1,571	1,617	1,780	1,780	1,751

Note: Robustness checks indicated in the column headers as follows: (1) Sample only includes states where the members of the State Board of Education are appointed by the governor, and where the governor in office at the time of the reform was voted into office with a margin of less than 10 percentage points compared to the runner-up; (2) Regressions control for political affiliation of governor ruling in the state and year of the student's high school entry; (3) Regressions include state-specific linear and quadratic time trends; (4) Sample only includes individuals who entered high school after 1994; (5) Sample only includes individuals from states that had only one reform event between 2000 and 2009, see Table A.2 for more details; (6) Sample only includes individuals who entered high school after 1999; (7) Sample excludes individuals whose dependent variable question on evolution replaces the words "human beings" with the word "elephants"; (8) Recoding of dependent variable: Approval to Evolution ("Human beings, as we know them today, developed from earlier species of animals - Is that true or false?", Indicator variable, 1=true, 0=false; missing=don't know); (9) Coefficient reports average marginal treatment effect of logit specification; (10) Coefficient reports average marginal treatment effect of probit specification; (11) Sample excludes individuals who have missing values on parental controls (parents born abroad, parental education) instead of imputing these values. Dependent variable: Approval to Evolution ("Human beings, as we know them today, developed from earlier species of animals - Is that true or false?", Indicator variable, 1=true, 0=false; don't know; unless noted otherwise). Controls: Dummies for gender, races/ethnicities, parents born abroad, parental education, having lived with parents in adolescence, raised in rural area, religion raised in (dummies for mainline protestantism, evangelical protestantism, catholicism, no religion, judaism, buddhism, hinduism, other eastern, islam, orthodox-christian, christian, native american, inter-nondenominational, other religion), and survey year fixed effects. Standard errors clustered at the state level in parenthesis. Single, double, and triple asterisks indicate statistical significance at the 5%, 1%, and 0.1% levels, respectively. Data source: General Social Survey.

Table A.9 – Effect of evolution coverage in Science Standards on probability to work in life sciences, further robustness checks

	(1) Close Elections	(2) Control: Governor's Party	(3) State Specific Time Trends	(4) Only One Reform Event	(5) Sample Start: 1995	(6) Sample Start: 2000	(7) Logit	(8) Probit
Evolution Score	0.039	0.036*	0.025	0.031	0.036**	0.029*	0.033	0.035
	(0.025)	(0.014)	(0.025)	(0.021)	(0.013)	(0.012)	(0.028)	(0.026)
State FEs	YES	YES	YES	YES	YES	YES	YES	YES
Birth Year FEs	YES	YES	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES	YES	YES
Mean of Dep. Var.	0.14	0.15	0.15	0.14	0.13	0.10	0.15	0.15
Std. Dev. of Dep. Var.	3.80	3.84	3.84	3.77	3.58	3.10	3.84	3.84
Adj. R-squared	0.001	0.001	0.001	0.001	0.001	0.001		
Pseudo R-squared							0.032	0.032
Observations	2,022,927	6,460,650	6,460,650	2,522,283	4,821,487	2,762,694	6,460,650	6,460,650

Note: Robustness checks indicated in the column headers as follows: (1) Sample only includes states where the members of the State Board of Education are appointed by the governor, and where the governor in office at the time of the reform was voted into office with a margin of less than 10 percentage points compared to the runner-up; (2) Regressions control for political affiliation of governor ruling in the state and year of the student's high school entry; (3) Regressions include state-specific linear and quadratic time trends; (4) Sample only includes individuals from states that had only one reform event between 2000 and 2009, see Table A.2 for more details; (5) Sample only includes individuals who entered high school after 1994; (6) Sample only includes individuals who entered high school after 1999; (7) Coefficient reports average marginal treatment effect of logit specification; (8) Coefficient reports average marginal treatment effect of probit specification. Dependent variable: Probability to work in life sciences (multiplied by 100 for interpretability). Controls: Dummies for gender, races/ethnicities, and survey year fixed effects. Standard errors clustered at the state level in parenthesis. Single, double, and triple asterisks indicate statistical significance at the 5%, 1%, and 0.1% levels, respectively. Data source: American Community Survey.

Table A.10 – Effect of evolution coverage in Science Standards on evolution knowledge in school, by evolution score indicator variables

	Evolution Knowledge								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Evolution Score > 0.90	0.028								
	(0.018)								
Evolution Score > 0.80		0.013							
		(0.014)							
Evolution Score > 0.70			0.018						
			(0.013)						
Evolution Score > 0.60				0.023*					
				(0.009)					
Evolution Score > 0.50					0.023*				
					(0.009)				
Evolution Score > 0.40						0.018			
						(0.011)			
Evolution Score > 0.30							0.025*		
							(0.012)		
Evolution Score > 0.20								0.032**	
								(0.010)	
Evolution Score > 0.10									0.032**
									(0.010)
State FEs	YES	YES	YES	YES	YES	YES	YES	YES	YES
Birth Year FEs	YES	YES	YES	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Mean of Dep. Var.	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
Std. Dev. of Dep. Var.	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42
Adj. R-squared	0.049	0.049	0.049	0.049	0.049	0.049	0.049	0.049	0.049
Observations	15,520	15,520	15,520	15,520	15,520	15,520	15,520	15,520	15,520

Note: Dependent variable: Share of questions about evolution answered correctly. Explanatory variables: Evolution score indicator variables (equals one if evolution score is larger than indicated level, and zero otherwise). Controls: Dummies for gender, races/ethnicities, subsidized lunch status, English language learner status, disability status, parental education, home possessions (separate dummies for computer and books), and test year fixed effects. Standard errors clustered at the state level in parenthesis. Single, double, and triple asterisks indicate statistical significance at the 5%, 1%, and 0.1% levels, respectively. Data source: U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996-2009 Science Assessments for Grade 12

Table A.11 – Effect of evolution coverage in Science Standards on evolution approval in adulthood, by evolution score indicator variables

	Evolution Approval								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Evolution Score > 0.90	0.115								
	(0.114)								
Evolution Score > 0.80		0.174*							
		(0.073)							
Evolution Score > 0.70			0.199*						
			(0.092)						
Evolution Score > 0.60				0.125					
				(0.068)					
Evolution Score > 0.50					0.138				
					(0.072)				
Evolution Score > 0.40						0.245***			
						(0.060)			
Evolution Score > 0.30							0.219**		
							(0.071)		
Evolution Score > 0.20								0.150	
								(0.109)	
Evolution Score > 0.10									0.071
									(0.107)
State FEs	YES	YES	YES	YES	YES	YES	YES	YES	YES
Birth Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Mean of Dep. Var.	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58
Std. Dev. of Dep. Var.	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49
Adj. R-squared	0.102	0.104	0.104	0.104	0.104	0.106	0.104	0.103	0.102
Observations	1,801	1,801	1,801	1,801	1,801	1,801	1,801	1,801	1,801

Note: Dependent variable: Approval to Evolution ("Human beings, as we know them today, developed from earlier species of animals - Is that true or false?", Indicator variable, 1=true, 0=false; don't know). Controls: Dummies for gender, races/ethnicities, parents born abroad, parental education, having lived with parents in adolescence, raised in rural area, religion raised in (dummies for mainline protestantism, evangelical protestantism, catholicism, no religion, judaism, buddhism, hinduism, other eastern, islam, orthodox-christian, christian, native american, inter-nondenominational, other religion), and survey year fixed effects. Standard errors clustered at the state level in parenthesis. Single, double, and triple asterisks indicate statistical significance at the 5%, 1%, and 0.1% levels, respectively. Data source: General Social Survey.

Table A.12 – Effect of evolution coverage in Science Standards on probability to work in life sciences, by evolution score indicator variables

	Life Sciences								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Evolution Score > 0.90	0.003 (0.019)								
Evolution Score > 0.80		0.022* (0.010)							
Evolution Score > 0.70			0.023* (0.009)						
Evolution Score > 0.60				0.012 (0.007)					
Evolution Score > 0.50					0.013 (0.008)				
Evolution Score > 0.40						0.019 (0.010)			
Evolution Score > 0.30							0.020 (0.012)		
Evolution Score > 0.20								0.036** (0.012)	
Evolution Score > 0.10									0.027** (0.010)
State FEs	YES	YES	YES	YES	YES	YES	YES	YES	YES
Birth Year FEs	YES	YES	YES	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Mean of Dep. Var.	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Std. Dev. of Dep. Var.	3.84	3.84	3.84	3.84	3.84	3.84	3.84	3.84	3.84
Adj. R-squared	0.00064	0.00064	0.00064	0.00064	0.00064	0.00064	0.00064	0.00064	0.00064
Observations	6,460,650	6,460,650	6,460,650	6,460,650	6,460,650	6,460,650	6,460,650	6,460,650	6,460,650

Note: Dependent variable: Probability to work in life sciences (multiplied by 100 for interpretability). Explanatory variables: Evolution score dummies (equals one if evolution score is larger than indicated level, and zero otherwise). Controls: Dummies for gender, races/ethnicities, and survey year fixed effects. Standard errors clustered at the state level in parenthesis. Single, double, and triple asterisks indicate statistical significance at the 5%, 1%, and 0.1% levels, respectively. Data source: American Community Survey.

Table A.13 – Correlation coefficients of knowledge about evolution and other scientific areas

	Evolution Knowledge
Motion	0.0894***
Matter and Mass	0.0836***
Energy	0.129***
Reproduction	0.283***
Climate	0.0524***
Pollution	0.150***
Earth	0.0924***
Tectonics	0.0183
Universe	0.117***
Non-Evolution Scientific Topics: Average	0.233***

Note: Single, double, and triple asterisks indicate statistical significance at the 5%, 1%, and 0.1% levels, respectively. Data source: U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996-2009 Science Assessments for Grade 12

Table A.14 – Descriptive statistics of NAEP data

	Mean	Std. Dev.	Min.	Max.
Treatment Variable:				
Evolution Score	0.65	0.31	0.00	1.00
Main Outcome:				
Evolution Knowledge	0.32	0.42	0.00	1.00
Placebo Outcomes - Non-Evolution Scientific Topics:				
Motion	0.51	0.43	0.00	1.00
Matter and Mass	0.30	0.43	0.00	1.00
Energy	0.38	0.43	0.00	1.00
Reproduction	0.38	0.42	0.00	1.00
Climate	0.39	0.39	0.00	1.00
Pollution	0.15	0.28	0.00	1.00
Earth	0.41	0.42	0.00	1.00
Tectonics	0.17	0.27	0.00	1.00
Universe	0.32	0.42	0.00	1.00
Non-Evolution Scientific Topics: Average	0.35	0.28	0.00	1.00
Controls:				
Female	0.51	0.50	0.00	1.00
Race/Ethnicity: White	0.57	0.49	0.00	1.00
Race/Ethnicity: Black	0.19	0.39	0.00	1.00
Race/Ethnicity: Hispanic	0.16	0.37	0.00	1.00
Race/Ethnicity: Asian	0.06	0.23	0.00	1.00
Race/Ethnicity: Other	0.01	0.11	0.00	1.00
English Language Learner	0.05	0.22	0.00	1.00
Disabled	0.11	0.32	0.00	1.00
Subsidized Lunch	0.30	0.46	0.00	1.00
Parental Education: Did not finish High School	0.09	0.29	0.00	1.00
Parental Education: Graduated High School	0.20	0.40	0.00	1.00
Parental Education: Some education after High School	0.26	0.44	0.00	1.00
Parental Education: Graduated College	0.44	0.50	0.00	1.00
Computer at Home	0.84	0.37	0.00	1.00
Books at Home: 0−10	0.23	0.42	0.00	1.00
Books at Home: 11−25	0.27	0.44	0.00	1.00
Books at Home: 26−100	0.33	0.47	0.00	1.00
Books at Home: >100	0.17	0.38	0.00	1.00

Note: Descriptive statistics (mean, standard deviation, minimum, maximum) for treatment, outcome, and control variables. Data source: U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996-2009 Science Assessments for Grade 12

Table A.15 – Correlation coefficients of approval of evolution and other scientific areas

	Evolution Approval
Earth	0.120***
Radioactivity	0.145***
Reproduction	-0.0222
Lasers	0.106***
Electrons	0.169***
Antibiotics	0.107***
Universe	0.415***
Tectonics	0.248***
Sun	0.109***
Non-Evolution Scientific Topics: Average	0.314***

Note: Single, double, and triple asterisks indicate statistical significance at the 5%, 1%, and 0.1% levels, respectively. Data source: General Social Survey.

Table A.16 – Correlation coefficients of evolution approval and religious outcomes

	Evolution Approval
God	-0.194***
Bible	-0.272***
Afterlife	-0.106***
Rebirth	-0.313***
Strong Believer	-0.284***
Religious Affiliation	-0.212***
Church-going	-0.267***
Church Activities	-0.203***
Personal Prayer	-0.282***
Missionize	-0.275***
Spiritual Person	-0.158***
Religious Person	-0.241***
Fundamentalist	-0.248***
Religious Outcomes: Average	-0.374***

Note: Single, double, and triple asterisks indicate statistical significance at the 5%, 1%, and 0.1% levels, respectively. Data source: General Social Survey.

Table A.17 – Correlation coefficients of evolution approval and political outcomes

	Evolution Approval
Republican	-0.120***
Conservative	-0.126***
Prayer in Public Schools	-0.236***
Sex Education in Public Schools	0.198***
Same-Sex Marriage	0.287***
Abortion	0.240***
Marijuana Legalization	0.128***
Capital Punishment	-0.0136
Gun Control	0.0279
Immigration	0.00435
Environment	0.0890***
Alternative Energy Sources	0.0880**
Education	0.0560*
Scientific Research	0.163***
Reducing Income Differences	0.0912***
Assistance to the Poor	-0.00113
Conditions of Blacks	0.0594*

Note: Single, double, and triple asterisks indicate statistical significance at the 5%, 1%, and 0.1% levels, respectively. Data source: General Social Survey.

Table A.18 – Descriptive statistics of GSS data

	Mean	Std. Dev.	Min.	Max.
Treatment Variable:				
Evolution Score	0.63	0.33	0.00	1.00
Main Outcome:				
Evolution Approval	0.58	0.49	0.00	1.00
Placebo Outcomes - Non-Evolution Scientific Topics:				
Earth	0.88	0.33	0.00	1.00
Radioactivity	0.65	0.48	0.00	1.00
Reproduction	0.62	0.48	0.00	1.00
Lasers	0.47	0.50	0.00	1.00
Electrons	0.57	0.50	0.00	1.00
Antibiotics	0.51	0.50	0.00	1.00
Universe	0.45	0.50	0.00	1.00
Tectonics	0.85	0.36	0.00	1.00
Sun	0.79	0.41	0.00	1.00
Non-Evolution Scientific Topics: Average	0.64	0.22	0.00	1.00
Placebo Outcomes - Religious Attitudes:				
God	0.87	0.33	0.00	1.00
Bible	0.72	0.45	0.00	1.00
Afterlife	0.72	0.45	0.00	1.00
Rebirth	0.34	0.47	0.00	1.00
Strong Believer	0.32	0.47	0.00	1.00
Religious Affiliation	0.70	0.46	0.00	1.00
Church-going	0.35	0.48	0.00	1.00
Church Activities	0.17	0.38	0.00	1.00
Personal Prayer	0.65	0.48	0.00	1.00
Missionize	0.41	0.49	0.00	1.00
Spiritual Person	0.56	0.50	0.00	1.00
Religious Person	0.43	0.49	0.00	1.00
Fundamentalist	0.24	0.43	0.00	1.00
Religious Outcomes: Average	0.50	0.28	0.00	1.00
Placebo Outcomes - Political Attitudes:				
Republican	0.28	0.45	0.00	1.00
Conservative	0.26	0.44	0.00	1.00
Prayer in Public Schools	0.45	0.50	0.00	1.00
Sex Education in Public Schools	0.94	0.24	0.00	1.00
Same-Sex Marriage	0.64	0.48	0.00	1.00
Abortion	0.45	0.50	0.00	1.00
Marijuana Legalization	0.55	0.50	0.00	1.00
Capital Punishment	0.61	0.49	0.00	1.00
Gun Control	0.70	0.46	0.00	1.00
Immigration	0.15	0.36	0.00	1.00

Table A.17 (continued) – Descriptive statistics of GSS data

	Mean	Std. Dev.	Min.	Max.
Placebo Outcomes - Political Attitudes (continued):				
Environment	0.71	0.45	0.00	1.00
Alternative Energy Sources	0.59	0.49	0.00	1.00
Education	0.81	0.40	0.00	1.00
Scientific Research	0.37	0.48	0.00	1.00
Reducing Income Differences	0.53	0.50	0.00	1.00
Assistance to the Poor	0.49	0.50	0.00	1.00
Conditions of Blacks	0.36	0.48	0.00	1.00
Controls:				
Female	0.57	0.50	0.00	1.00
Race/Ethnicity: White	0.70	0.46	0.00	1.00
Race/Ethnicity: Black	0.19	0.39	0.00	1.00
Race/Ethnicity: Other	0.12	0.32	0.00	1.00
Race/Ethnicity: Hispanic	0.16	0.37	0.00	1.00
Raised in Rural Area	0.49	0.50	0.00	1.00
Parents born in US	0.19	0.39	0.00	1.00
Parents born abroad	0.81	0.39	0.00	1.00
Parental Education: No Highschool	0.11	0.31	0.00	1.00
Parental Education: Highschool	0.50	0.50	0.00	1.00
Parental Education: More than Highschool	0.39	0.49	0.00	1.00
Growing up: Both Parents	0.55	0.50	0.00	1.00
Growing up: One Parent, one Stepparent	0.12	0.33	0.00	1.00
Growing up: Single Parent	0.25	0.43	0.00	1.00
Growing up: Other	0.05	0.22	0.00	1.00
Raised as Protestant: Mainline	0.37	0.48	0.00	1.00
Raised as Protestant: Evangelical	0.09	0.29	0.00	1.00
Raised as Catholic	0.32	0.47	0.00	1.00
Raised as Jew	0.01	0.10	0.00	1.00
Raised as Non-Religious	0.14	0.34	0.00	1.00
Raised as Other	0.01	0.08	0.00	1.00
Raised as Buddhist	0.00	0.06	0.00	1.00
Raised as Hindu	0.00	0.05	0.00	1.00
Raised as Other Eastern Rel.	0.00	0.03	0.00	1.00
Raised as Muslim	0.00	0.06	0.00	1.00
Raised as Orthodox-Christian	0.00	0.05	0.00	1.00
Raised as Christian	0.04	0.20	0.00	1.00
Raised as Native American	0.00	0.03	0.00	1.00
Raised as Inter-Nondenominational	0.00	0.02	0.00	1.00

Note: Descriptive statistics (mean, standard deviation, minimum, maximum) for treatment, outcome, and controls variables. Data source: General Social Survey.

Table A.19 – Descriptive statistics of ACS data

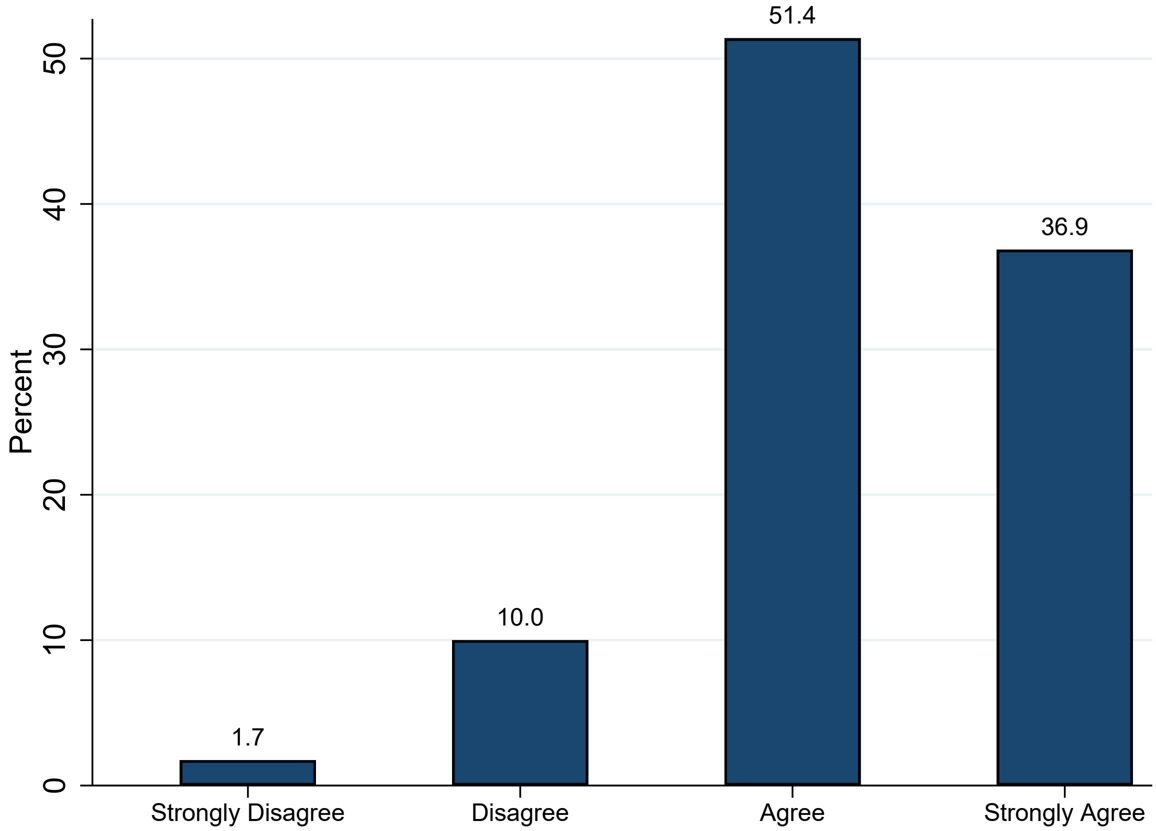
	Mean	Std. Dev.	Min.	Max.
Treatment Variable:				
Evolution Score	0.67	0.30	0.00	1.00
Main Outcomes - Working in scientific fields:				
Life Sciences	0.15	3.84	0.00	100.00
Physical Sciences	0.22	4.68	0.00	100.00
Social Sciences	0.16	4.03	0.00	100.00
Science Technicians	0.32	5.62	0.00	100.00
Overall: All Sciences	0.85	9.16	0.00	100.00
Placebo Outcomes - Working in non-scientific fields:				
Management	5.44	22.68	0.00	100.00
Analysts	1.87	13.54	0.00	100.00
Finance	1.63	12.67	0.00	100.00
IT	1.97	13.89	0.00	100.00
Engineering	1.39	11.69	0.00	100.00
Social	1.39	11.70	0.00	100.00
Legal	0.82	9.01	0.00	100.00
Education	5.58	22.96	0.00	100.00
Arts	2.04	14.15	0.00	100.00
Health Care	4.33	20.36	0.00	100.00
Health Care Support	2.63	15.99	0.00	100.00
Protective Services	2.13	14.43	0.00	100.00
Food	7.88	26.94	0.00	100.00
Buildings	2.84	16.61	0.00	100.00
Personal Care	3.96	19.51	0.00	100.00
Sales	11.42	31.81	0.00	100.00
Office	13.25	33.90	0.00	100.00
Farming	0.66	8.07	0.00	100.00
Construction	4.45	20.63	0.00	100.00
Extraction	0.21	4.60	0.00	100.00
Installation	2.80	16.50	0.00	100.00
Production	4.87	21.53	0.00	100.00
Transportation	5.35	22.50	0.00	100.00
Armed Forces	0.75	8.62	0.00	100.00
Unemployed / Not in Labor Market	9.48	29.30	0.00	100.00

Table A.18 (continued) – Descriptive statistics of ACS data

	Mean	Std. Dev.	Min.	Max.
Controls:				
Female	0.50	0.50	0.00	1.00
Race/Ethnicity: White	0.78	0.42	0.00	1.00
Race/Ethnicity: Black	0.12	0.33	0.00	1.00
Race/Ethnicity: Asian	0.02	0.16	0.00	1.00
Race/Ethnicity: Native	0.01	0.11	0.00	1.00
Race/Ethnicity: Other	0.03	0.18	0.00	1.00
Race/Ethnicity: Multiple	0.03	0.17	0.00	1.00
Race/Ethnicity: Hispanic	0.12	0.32	0.00	1.00

Note: Descriptive statistics (mean, standard deviation, minimum, maximum) for treatment, outcome (multiplied by 100 for interpretability), and controls variables. Data source: American Community Survey.

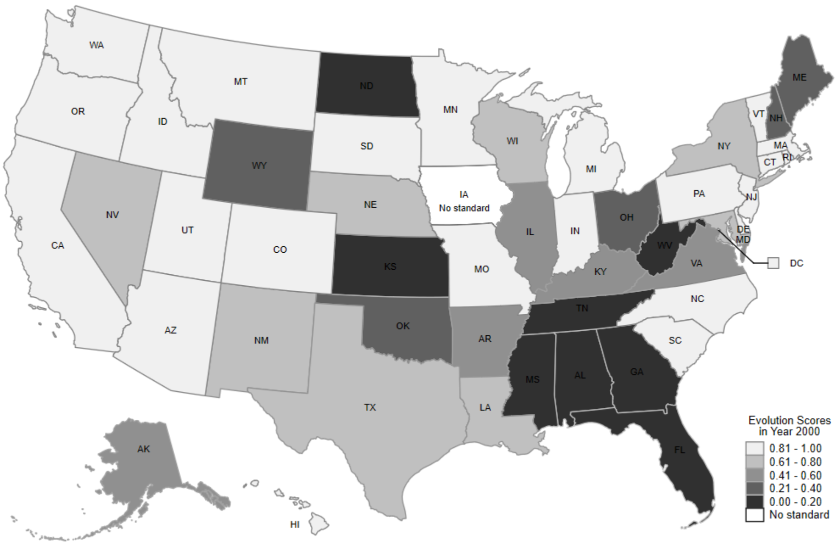
Figure A.1 – Teachers' focus on Science Standards when teaching evolution



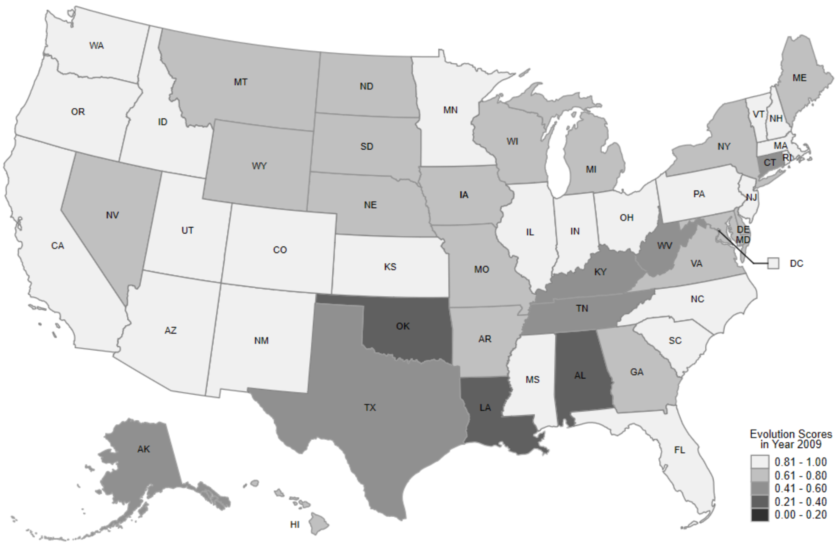
Note: Histogram depicts answer categories on agreement with the statement "When I do teach evolution, I focus heavily on what students need to know to meet state science standards". Data Source: National Survey for High School Biology Teachers, 2007.

Figure A.2 – US map of evolution scores

(a) Year 2000



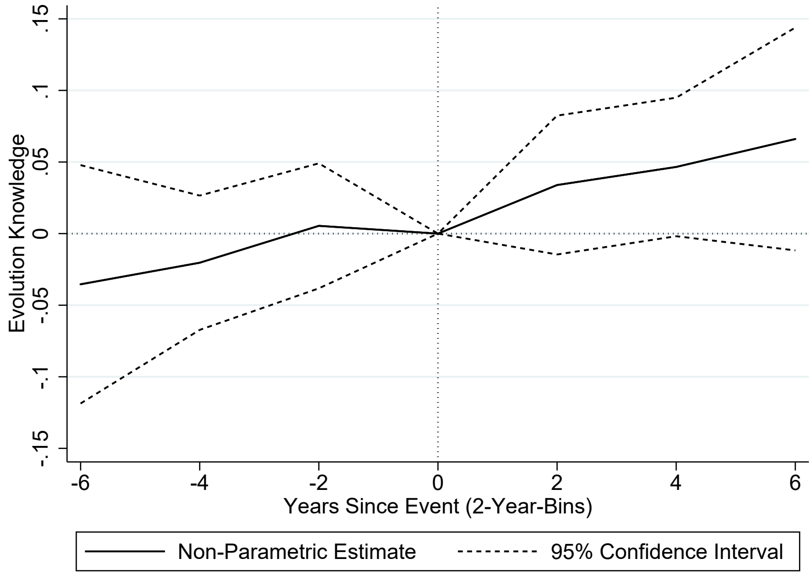
(b) Year 2009



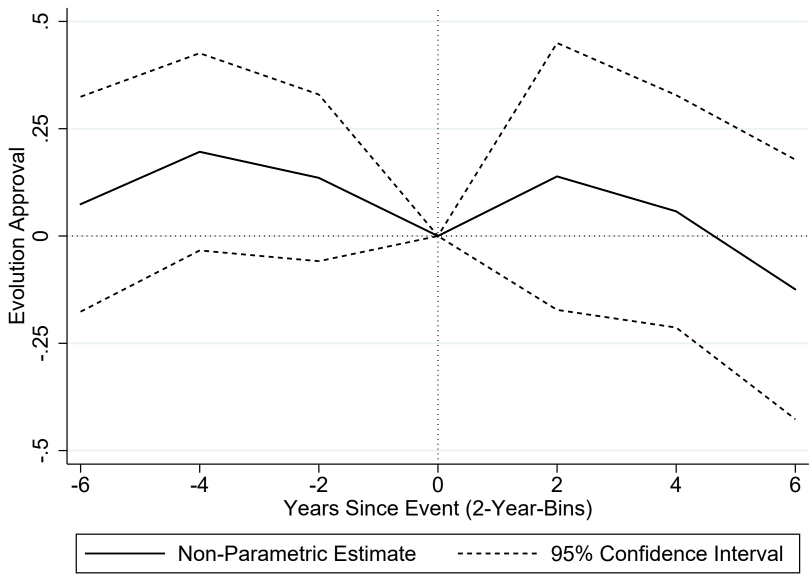
Note: Map depicts the evolution score of US States in 2000 and 2009, respectively. The evolution score measures the coverage of evolution in Science Standards, as reported in Lerner (2000b) and Mead and Mates (2009). An evolution score of 0 indicates no or a non-scientific/creationist coverage of evolution, and a score of 1 a very comprehensive coverage of evolution. A list of the evolution scores underlying this map is provided in Table A.2. Data source: Lerner (2000b) and Mead and Mates (2009)

Figure A.3 – Event-study graphs: Reforms that expand evolution coverage in Science Standards

(a) Evolution knowledge in school



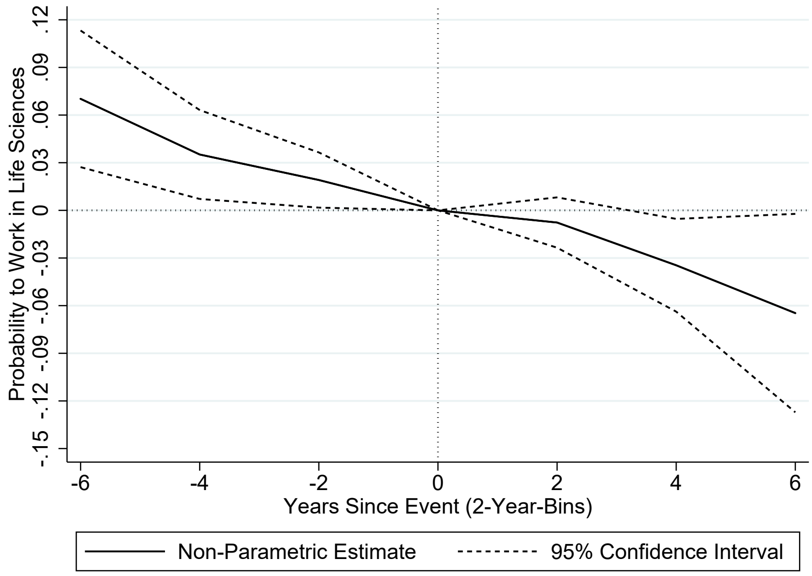
(b) Evolution approval in adulthood



Note: Continuation on next page

Figure A.3 (continued) – Event-study graphs: Reforms that reduce evolution coverage in Science Standards

(c) Occupational Choice: Working in Life Sciences



Note: Coefficients from non-parametric event-study regressions and their 95% confidence intervals. Dependent variable: (a) Share of questions about evolution answered correctly; (b) Approval to Evolution ("Human beings, as we know them today, developed from earlier species of animals - Is that true or false?", Indicator variable, 1=true, 0=false; don't know); (c) Probability to work in life sciences (multiplied by 100 for interpretability). Controls: (a) Indicator variables for gender, races/ethnicities, subsidized lunch status, English language learner status, disability status, parental education, home possessions (separate indicator variables for computer and books), as well as state, birth year and test year fixed effects; (b) Indicator variables for gender, races/ethnicities, parents born abroad, parental education, having lived with parents in adolescence, raised in rural area, religion raised in (indicator variables for mainline protestantism, evangelical protestantism, catholicism, no religion, judaism, buddhism, hinduism, other eastern, islam, orthodox-christian, christian, native american, inter-nondenominational, other religion), as well as state, birth year, and survey year fixed effects; (c) Indicator variables for gender, races/ethnicities, as well as state, birth year, and survey year fixed effects. Numbers on horizontal axis refer to final year of respective two-year bins; i.e., 0 = last two years prior to treatment (excluded category), 2 = first two years of treatment. Inference: Clustering at state level. The p values of omnibus hypothesis tests of zero pre- and post-event effects are respectively: (a) 0.769 and 0.281; (b) 0.207 and 0.147; (c) 0.021 and 0.105. Data sources: (a) U.S. Department of Education, National Center for Education Statistics, 1996-2009 National Assessment of Educational Progress; (b) General Social Survey; (c) American Community Survey.

Figure A.4 – Two NAEP sample questions on evolution knowledge

(a) Sample Question 1

Which of the following is NOT a part of Darwin's theory of evolution by natural selection?

A. Individuals in a population vary in many ways.

B. Some individuals possess features that enable them to survive better than individuals lacking those features.

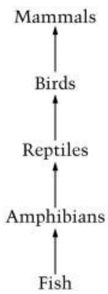
C. More offspring are produced than can generally survive.

D. Changes in an individual's genetic material are usually harmful.

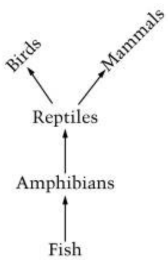
(b) Sample Question 2

According to evolutionary theory, which of the following evolutionary trees best describes the relationship between groups of vertebrates?

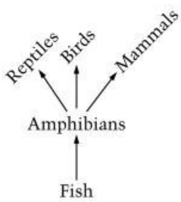
A.



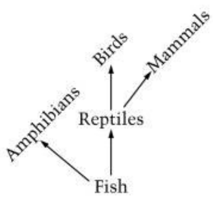
B.



C.



D.



Note: Sample question on evolution knowledge from NAEP Science Test, Grade 12, Year 2000. Question also accessible online at NAEP question tool. Question 1: Answer D is correct. Question 2: Answer B is correct. Data source: U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2000 Science Assessment for Grade 12