

« "How realistic is to teach Evolution as the Unifying Theory of Biology via a University course? Reporting an experience" »

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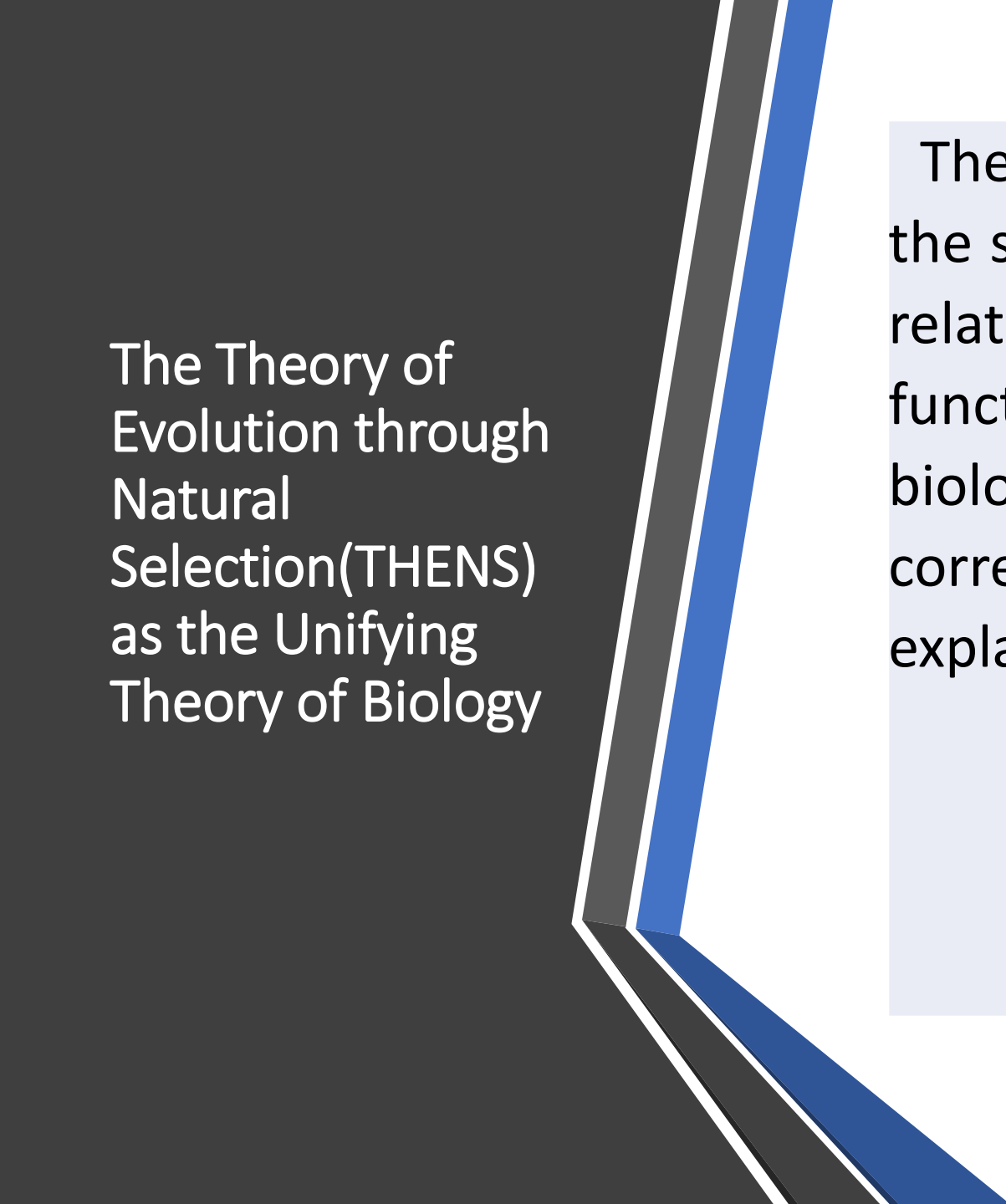
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About the Uniqueness in the Teaching of Biology

Has a Unifying Theory. I.e. Evolution through Natural Selection (ThENS)

ENS as the Central Unifying Theory of Biology

- The Theory of Evolution is a milestone in the History of Science and is defined as the ***Central Unifying Theory*** for the science of Biology because it can simultaneously explain both the diversity and unity of life (National Research Council, 1985).
- “***Without the light of Evolution, biology becomes a pile of various events, some of which are interesting or curious, but do not constitute an image with meaning (Dobzhansky, 1973).***”



The Theory of Evolution through Natural Selection (THENS) as the Unifying Theory of Biology

The (THENS) is relevant to every aspect of the science of biology. It demonstrates the relationships that exist between different functions, structures, and branches of biology, which would otherwise show no correlation between them. Thus, it can explain both the diversity and unity of life.

The Paradox in the Teaching of Biology

- Although all International and Ethnic Organizations suggest that ENS should be the Foundation upon which the teaching of Biology should be built upon... The chapter of Evolution is always last in rank in Textbooks and Curricula. Or not taught at all.



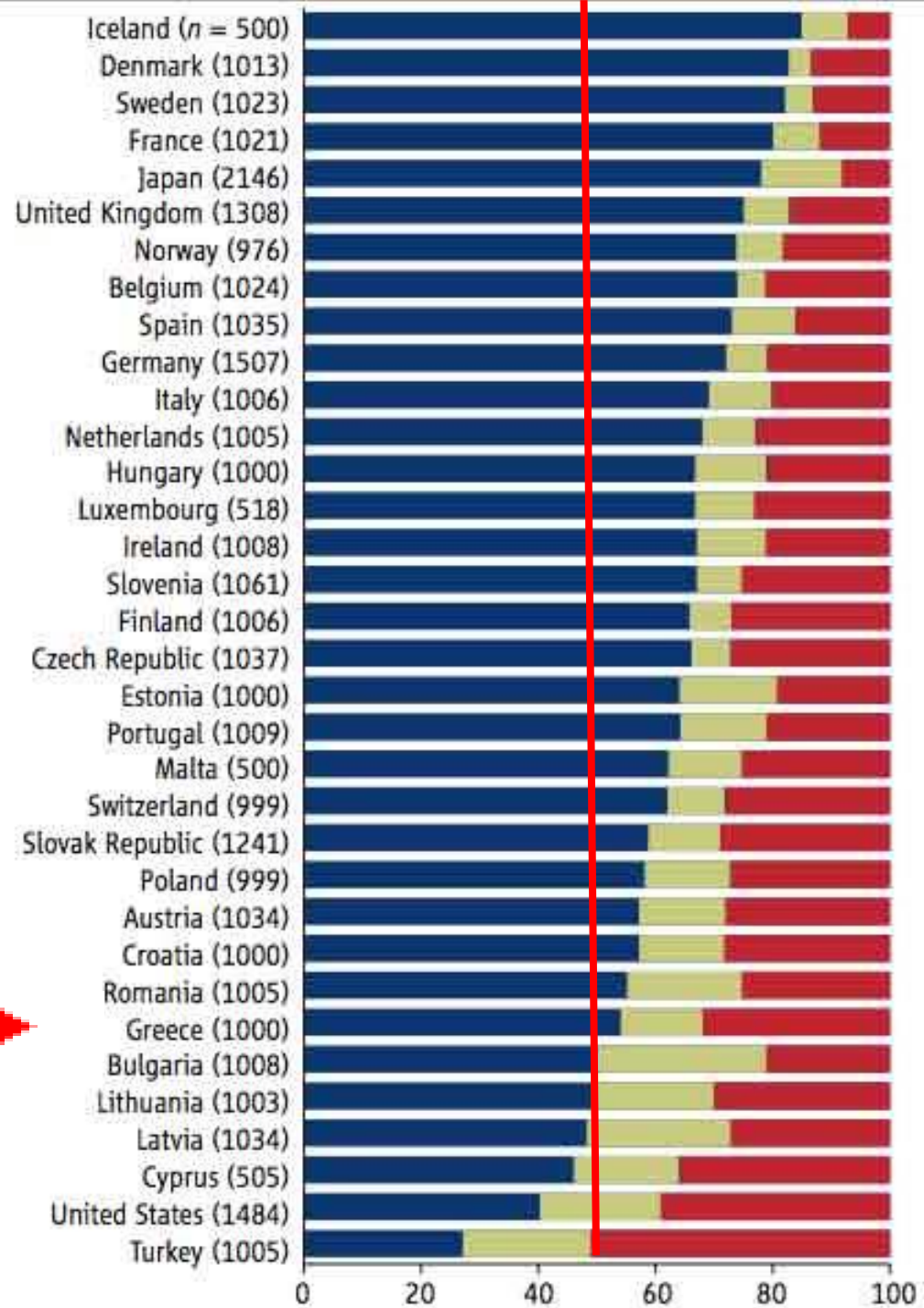
The result of the “Paradox”: Acceptance of Evolution Theory

34 countries worldwide

Miller, J.D., Scott E.C. & Okamoto ,
S. (2006) Science communication:
public acceptance of evolution.
Science, 313, 765–766

Response

True Not sure False



Questions to be answered:

Is it worthy or feasible to apply a university (or school) general biology course that may go beyond the usual structure of such courses and be designed by using the THES as its' central unifying theory?

What about the need of prerequisite Concepts /structures/Functions? What about its' reception?
- Evaluation of the teaching experience.

About the Structure of course

- To what extent such a general course can begin with a general introduction to THES, in one hand, and, to what degree can be followed all the other modules or chapters, that usually are considered as prerequisite chapters and concepts before the students are familiarized with the THES?



The Course

The Course Title: *Teaching Biology with Evolution as the Unifying Theory.*

WHERE? *The School of Education, The National and Kapodestrian University of Athens, and (for some years) The Graduate School of the Dept of Biology...etc.*

WHEN? The last 20 Winter semesters.

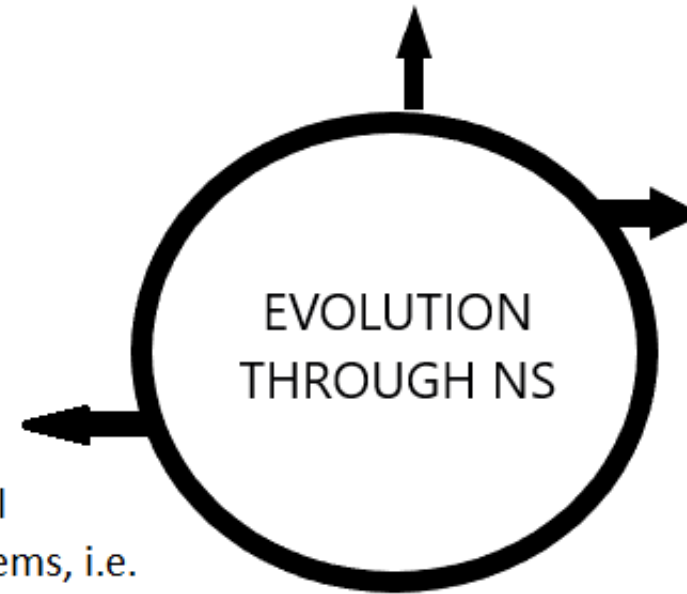
The Course: Title: *Teaching Biology with Evolution through Natural Selection as her Unifying Theory*

- Starting with the chapter of Evolution. Emphasis on Fossils. Soil sedimentary deposits.
- Students cannot easily imagine the process: Example with Thermopile.
- *-Have you been lately to Thermopylae? If NO, look to the following picture:*
- *-Do the Straits of Thermopylae, exist today?*
- *-If no, how the sea came to stand, nowadays, some ten kms away of the mountain?*



INDIVIDUAL LESSON-
CHAPTERS WERE
TAUGHT IN A SECOND
PHASE AND
FOLLOWED THE
TEACHING OF
EVOLUTION THAT
WAS USED AS THE
FOUNDATION OF THE
COURSE

Genetics: Mistakes in the genetic material
of individuals



Taxonomy as the
result of random
changes in the
genetic material-
and action of
Natural Selection-
Speciation.

Other Biological
functions/ Systems, i.e.
NS, presented as
"Evolution of the NS".
[From Radial Symmetry to
Bilateral and from Fish to
Chimpanzee and Man].

Some evaluation results: about the necessity of prerequisite concepts

Question	Answer
"Was the course material taught well organized?"	Well = 40% Very Well = 23.33%.
How necessary do you judge the prerequisites of the course?	Much (necessary) = 6.67% Very much =20% (Total = 26.67%)
How do you judge the level of difficulty of the course for its year"?	Difficult + Very Difficult = 26.67%
In cases where there were written and/or oral assignments: Did this paper help you	Much and Very much= 26.67+50= 76.67%.

THE STUDENTS' EVALUATION

Students' POSITIVE evaluation of biology course, which was using THES as its unifying theory
(%), N=120. Academic year 2019/20

Question/answer	Not at all or zero	A little or non- satisfactory	Moderate	Much or satisfactory	Very much
Q1. It helped me to conquer basic concepts that it dealt with.	1.37	4.11	6.85	46.58	41.10
Q2. Degree of new knowledge added.	0.00	5.48	6.85	41.10	46.58
Q3. The course offers necessary scientific tools for approaching & understanding the subject of your studies in general.	1.37	4.11	21.92	42.47	30.14
Q4. <u>Good organization & presentation of the syllabus in course.</u>	0.00	1.37	10.96	36.99	49.32
Q8. The course met your expectations.	1.37	2.74	8.22	49.32	38.36
Q9. Evaluate the quality of the course as	1.37	1.37	5.48	52.05	39.73

Can the students reach *a population type of thinking* through a general course of biology, merely by using the THES as its' cardinal theory?

Some characteristics of "*Population way of Thinking*" (according to Meyer):

Understanding that Natural Selections uses **individual variability** but acts on **populations**.

That **individual variability** is due to random-continually happening-mutations.

Getting-rid from *proximate* and *teleological* explanations about biological phenomena and procedures.

First year students of education answers regarding the THES before and after the course

Pre-Course Survey (2019/20)	
Acceptance of THES (MATE)	74.45 \pm 8.8
Understanding of THES	7.63 \pm 2.61
Understanding of the NOS	60.83 \pm 4.9
Religiosity	14.1 \pm 3.77
Thinking dispositions (AOT)	144.44 \pm 10.78
Post-Course Survey (2019/20)	
Acceptance of THES (MATE)	80.56 \pm 8.72
Understanding of THES	10.51 \pm 3.19
Understanding of the NOS	61.41 \pm 4.92
Religiosity	13.64 \pm 4.12

Percentage of correct answers to CINS* for various student groups

Group of students	Percentage of correct answers (%)
Students of education–biology course not attended	15
Students of education–biology course attended	50
Students-biology majors of 1 st , 2 nd , & 3 rd year	60
Students-biology majors of 4 th year	75

*CINS = Conceptual Inventory of Natural Selection by Anderson, D.L., et al., *Journal of Research in Science Teaching*, 39, 952-978.

Conclusion: This kind of the course-structure by itself it is not enough condition for students to get a “true population way of thinking”

- The results of our research suggest that this kind of teaching a General Biology Course helped students to move to a conceptual stage of a primitive “*population thinking*”.
- That the conceptual conquest of a complete corpus of the THES is a long and holistic procedure that in addition to placing the THES in the center of any biology course, it is needed an enrichment with the teaching of NOS in concert with the introduction of modern pedagogical practices, such as *inquiry*, *problem solving*, and a *constructivist* approach of teaching.

