

HOW SCIENCE WORKS by JOHN ELLIS
studentska početnica iz prirodoslovlja
kao izniman primjer promicanja znanosti

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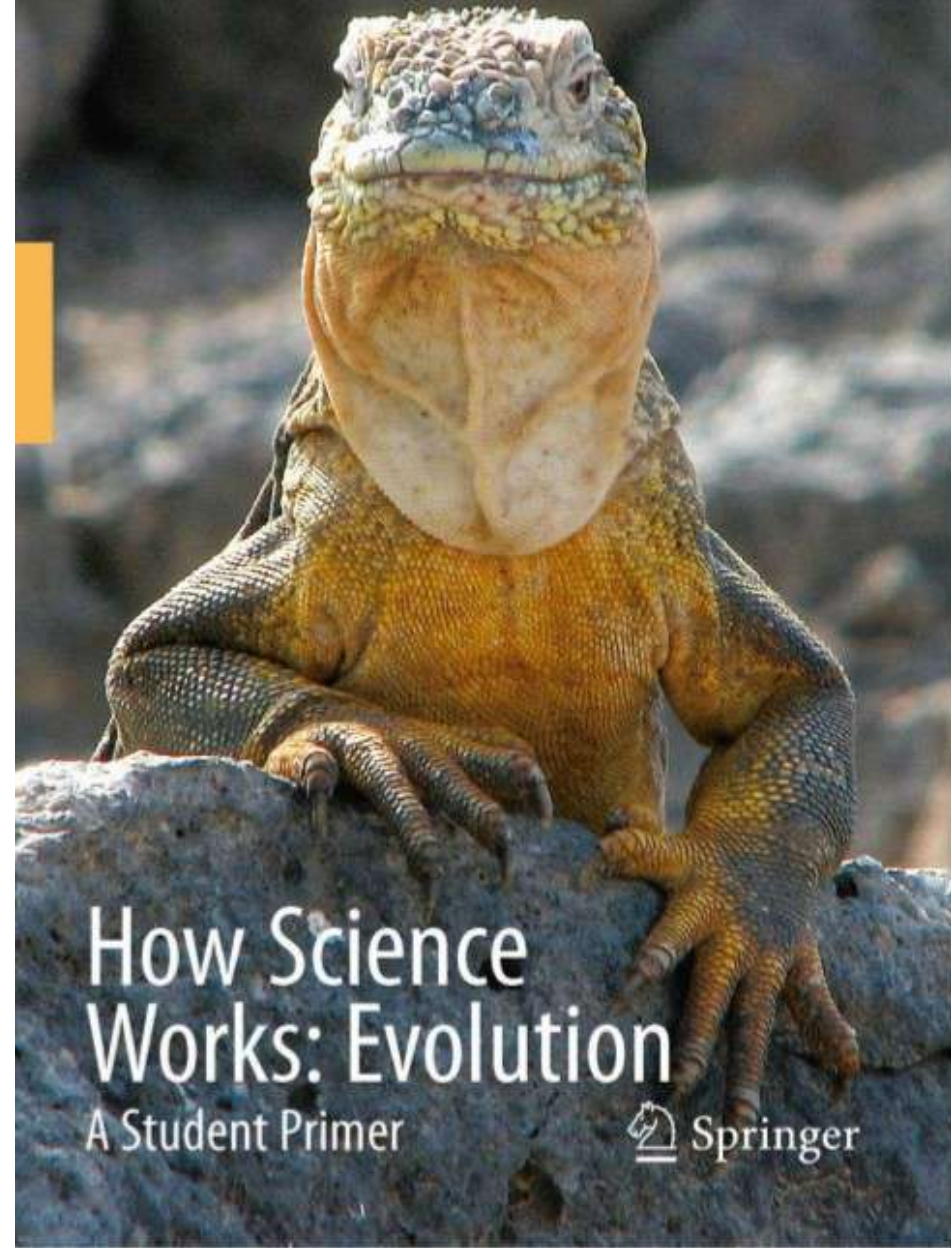
Promicanje i komuniciranje znanosti II
Knjižnica HAZU, 24. listopada 2013.

Inspirirano knjigom:

John Ellis

**How Science Works:
Evolution: A Student Primer**
Springer (2010)

John Ellis



How Science
Works: Evolution

A Student Primer

 Springer

ZAHVALA

Harry Kroto

(što je gostovao u Zagrebu u srpnju 2011. i donio knjigu)

Danko Bosanac

(što je ugostio Harryja Krotoa i posudio nam knjigu)

John Ellis

(što nam je ustupio svoju prezentaciju uvodnog predavanja koje je održao 2. listopada 2012. bruošima biologije na Sveučilištu Warwick)

Popularizacija vs **promocija** znanosti

POPULARIZACIJA

- # potiče zanimanje za znanstvene teme
- # pokazuje što je novo ili zanimljivo u znanosti
- # "znanost je zabavna"

PROMOCIJA

- # pokazuje zašto se isplati investirati u razvoj znanosti
- # pokazuje što je znanost i kako funkcionira
- # "znanost je korisna" (za društvo i za pojedinca)

Što predviđa nastavni plan i program?



FIZIKA

CILJ

Nastava fizike treba učenicima omogućiti **razumijevanje prirodnih pojava**, osnovno poznavanje metoda i tehnika znanstvenoga istraživanja prirode, primjenu usvojenih spoznaja iz fizike u svakodnevnom životu, tehnici i proizvodnji, te **razvijanje sposobnosti znanstvenoga mišljenja** i samostalnoga rješavanja problema.

Kako se plan i program ostvaruje?

UDŽBENICI FIZIKE, KEMIJE I BIOLOGIJE

- # rijetko spominju, ili uopće ne spominju, riječ znanost
- # još rjeđe tumače što je to znanost
- # razvijanje sposobnosti znanstvenog mišljenja zaobilaze

- # preferiraju nabranje i definiranje (pogotovo biologija)
- # razumijevanje potiskuju u drugi plan ili čak ignoriraju

Primjer iz udžbenika iz biologije

20-30 novih pojmova po lekciji
(čak i do 50)

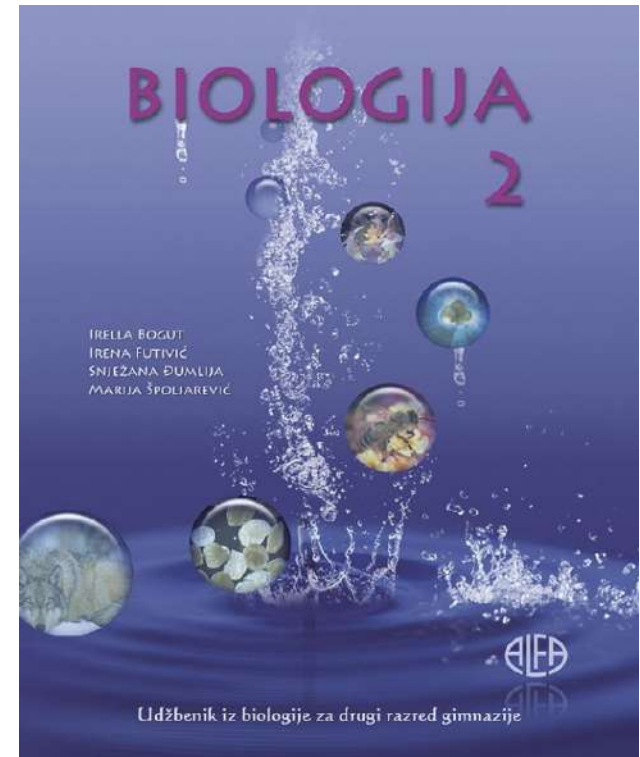
Evolucija je proces u kojem se nasljeđene osobine unutar populacije mijenjaju kroz generacije, tako da mogu nastati genetički različite populacije, ali i nove vrste.

Slučaj iz osobne prakse:

Znaš li što znači riječ evolucija? NE

Znaš li razvoj čega? NE

Znaš li tko je bio Charles Darwin? NE



Primjer udžbenika iz fizike

Postoji u planu i programu, ali ne i u udžbeniku:

Nastavni plan i program za osnovnu školu

7. RAZRED

TEME

1. Uvod u fiziku

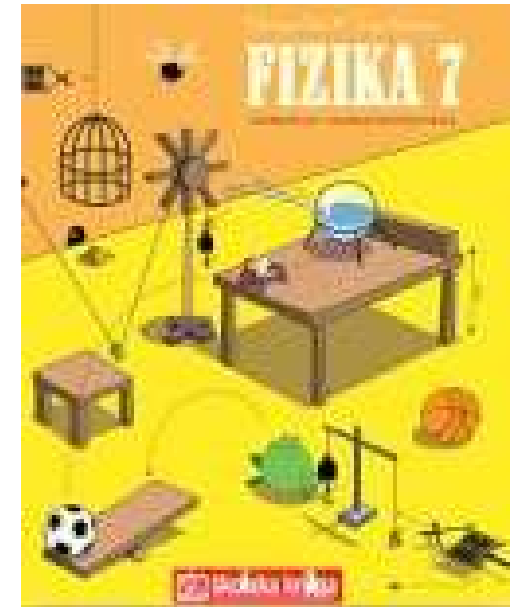
Ključni pojmovi: fizika, metoda, pokus (eksperiment).

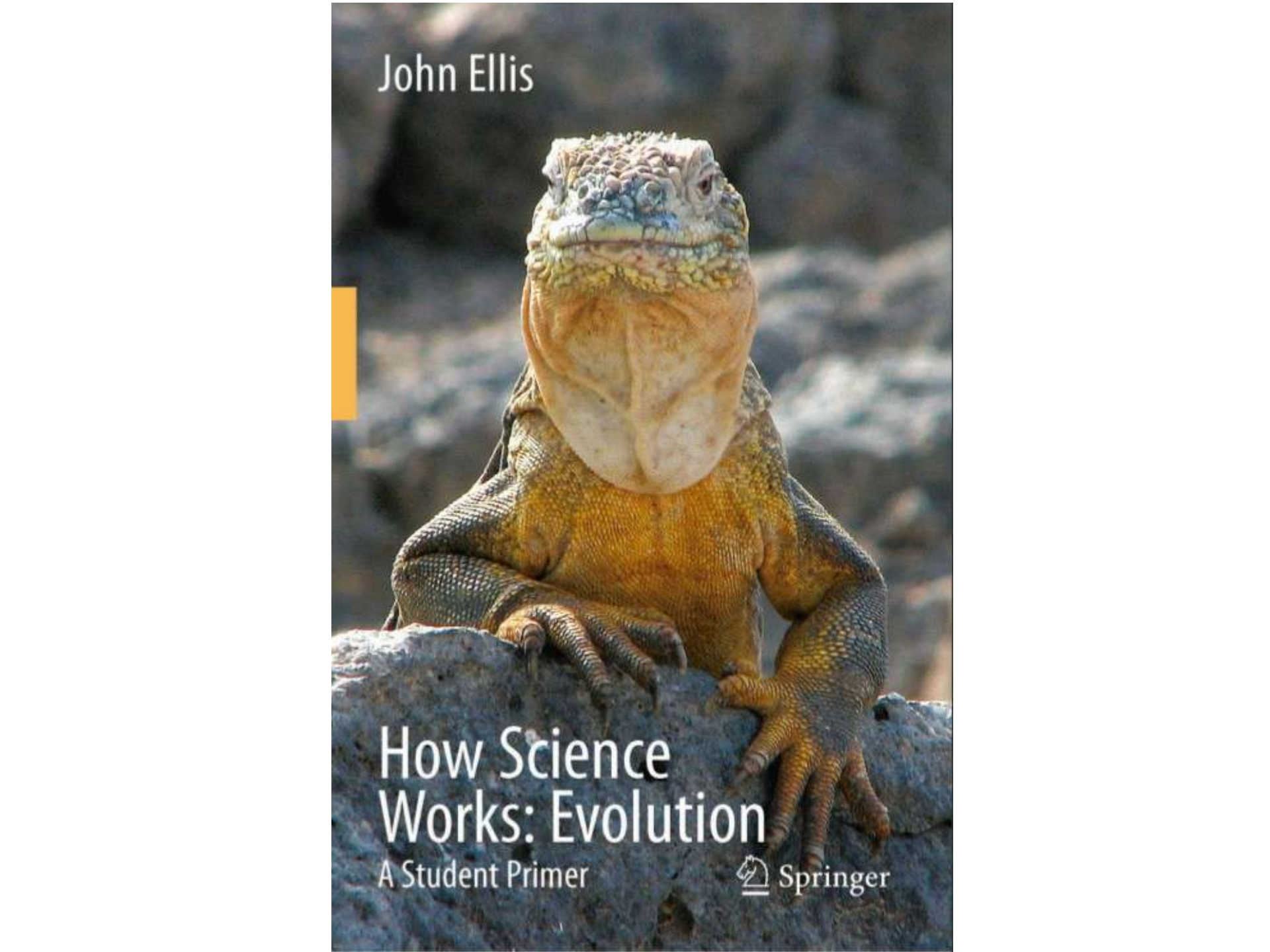
Obrazovna postignuća: opisati čime se bavi fizika; objasniti pojam pokusa (eksperimenta) navodeći primjere.

2. O tijelima

Ključni pojmovi: čvrsta tijela, tekućine, plinovi.

Obrazovna postignuća: opisati i razlikovati čvrsta tijela, tekućine i plinove na primjerima; opisati prijelaze čvrstih tijela u tekućine, tekućina u plinove i obratno.





John Ellis

How Science Works: Evolution

A Student Primer

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HOW SCIENCE WORKS: Evolution

Lecturer : Professor John Ellis

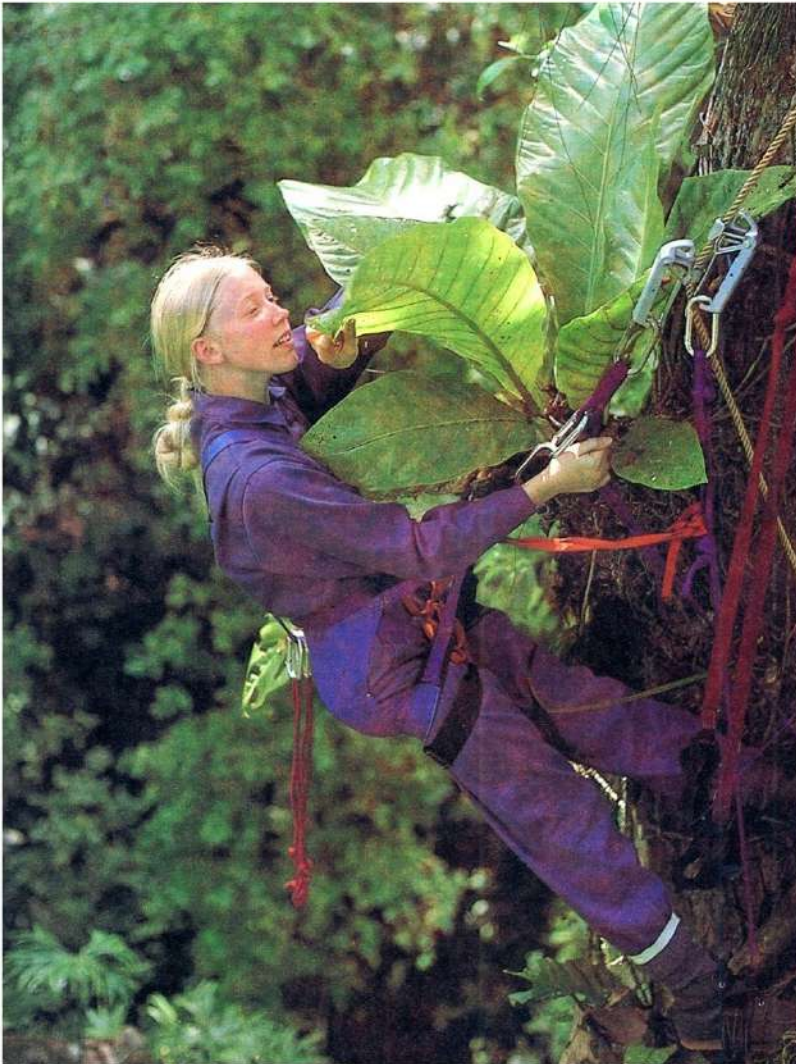
AIMS

1. To discuss evolution as the most powerful unifying theory in biology.

"Nothing in biology makes sense except in the light of evolution"

Theodosius Dobzhansky, 1973

2. To explain how science works and differs from other ways of understanding the world, using examples from evolutionary theory.



TWO WAYS OF EXPLAINING THE WORLD

1. Supernaturalism:

Beyond the obvious physical world is another invisible world containing **active agents** that behave unpredictably

*All known human cultures throughout recorded history embrace this view that is based on **faith**, defined as accepting the authority of revelation, dogma and ancient texts.*

2. Naturalism:

Everything there is belongs to the physical world that we all experience and that behaves according to **unvarying regularities** ("laws of nature")

*This view is very recent, is the dominant view amongst leading scientists today, and is based on **reason** applied to observations and experiments accessible to all.*

THESE EXPLANATIONS ARE MUTUALLY EXCLUSIVE

COMPARISON OF RELIGION AND SCIENCE

Religion is incompatible with the practice of science because science assumes that natural events have only natural causes.

Unlike science, religion lacks a methodology by which its claims can be tested.

This is why there are so many different religious beliefs but only one science.

SCIENCE IS THE ONLY UNIVERSAL HUMAN LANGUAGE

THE DISTINCTIVE ASPECTS OF SCIENCE

3. Uncertainty

Contrary to popular opinion, all scientific understanding is
PROVISIONAL

SCIENCE IS A SET OF **IDEAS** ABOUT
HOW THE UNIVERSE WORKS

These ideas are based on the best observational and experimental data available at the time but are always open to change to accommodate new data. Thus science has an inbuilt self-correcting mechanism that accounts for its unmatched success at improving the human condition.

BUT

**BECAUSE FUTURE DISCOVERIES CANNOT BE PREDICTED
WE CAN NEVER BE CERTAIN THAT NEW DATA WILL NOT
CHANGE EXISTING IDEAS. THUS ALL SCIENCE IS THEORY
AND SCIENTIFIC THEORIES CAN NEVER BE PROVED**

HOW SCIENCE WORKS

THE IMPORTANCE OF DEFINITIONS

FACTS in science are **empirical** observations available in principle to everyone. Facts can be inferred as well as direct.

HYPOTHESES are imaginary **but testable** speculations that might explain some facts.

THEORIES are coherent conceptual models that explain whole sets of facts and that **withstand falsifiable predictions**.

Good theories are quantitative, propose mechanisms, and lead to the discovery of new phenomena.

**THUS TO BE A GOOD SCIENTIST YOU NEED
CURIOSITY, IMAGINATION AND SKEPTICISM**

HOW SCIENCE WORKS

SUMMARY

Source: US National Academy of Sciences

1. Scientists pose, test and revise multiple hypotheses to explain what they observe in the natural world.
2. Scientists use only natural causes to explain natural observations.
3. Science does not prove or conclude; science is always a work in progress.
4. Science is neither democratic nor dogmatic.
5. Scientific claims are subject to peer review and replication.
6. Science is a human endeavour but it cannot make moral or aesthetic decisions.