Title: Whatâ€™s not to like? Open science will fail unless it takes the costs seriously

Date: Mar 27, 2018 09:00 AM

URL: http://pirsa.org/18030106

Abstract: The Open Science movement focuses on the broad benefits to the scientific enterprise, but its success will depend on the actions of individual scientists. Unless the short-term benefits to the researcher outweigh the costs, only the most altruistic will open up their research efforts to the world. Arguments based on hypothetical future benefits donâ€™t carry much weight, and calls for better tools appear to be mainly driven by tool-designers, not potential users. Iâ€™ll start with two brief case histories (#arseniclife and Apple Academic Press), and then consider what the immediate costs and benefits are and how we might shift the balance between them.

#YAMMM

1. **The #arseniclife debacle:** How 'open' mattered

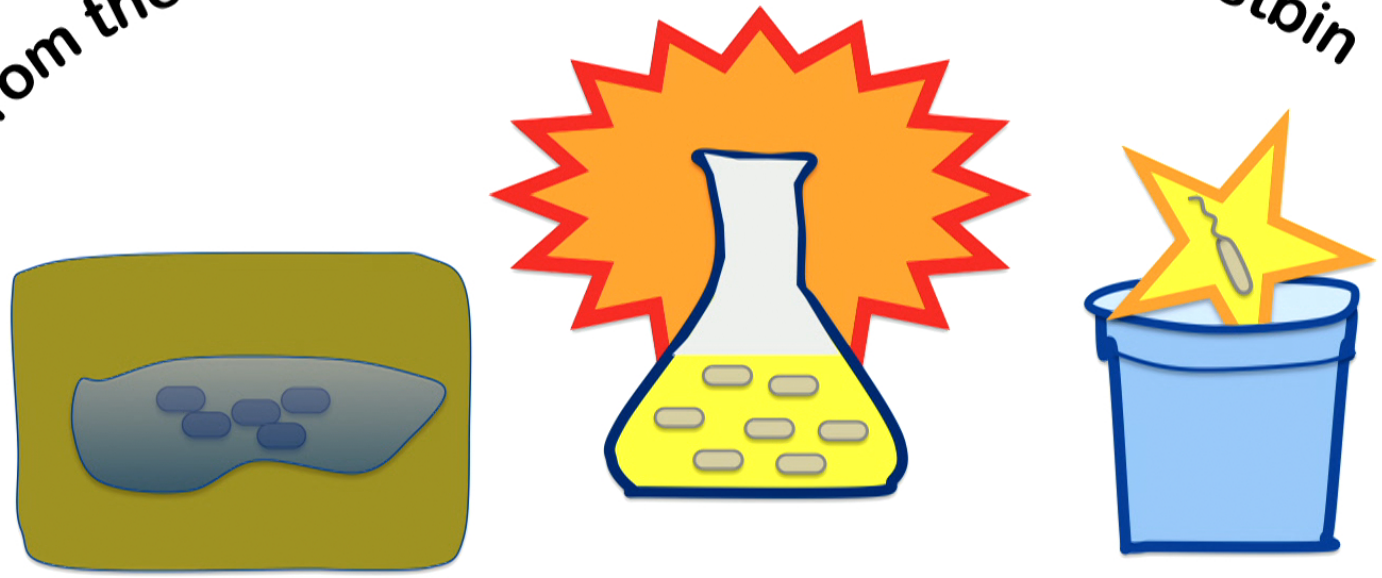
2. **Apple Academic Press:** Unintended consequences of open access publishing

3. **What's in it for me?** Balancing benefits and costs for individual researchers

enlighten us, but make it quick

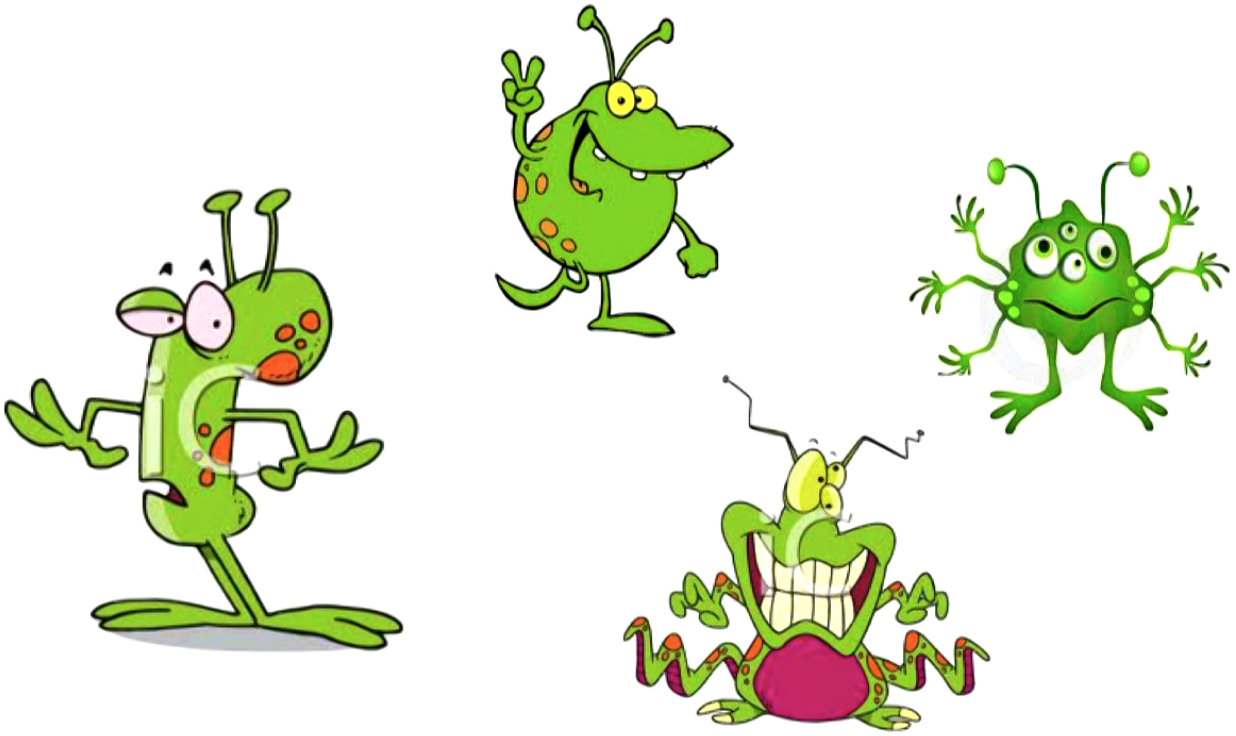
20 slides, 15 seconds each.

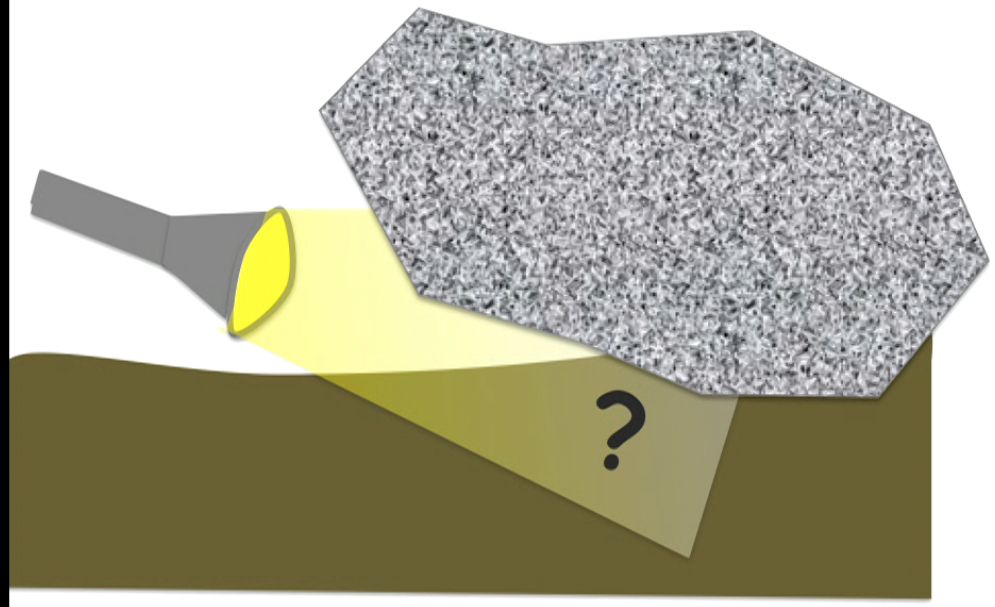
From the shadows to the spotlight to the dustbin



A Tragedy in 3 Acts

Prologue. The Shadow Biosphere

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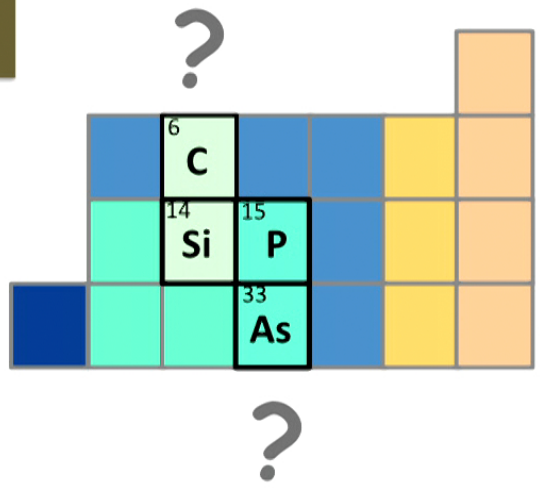
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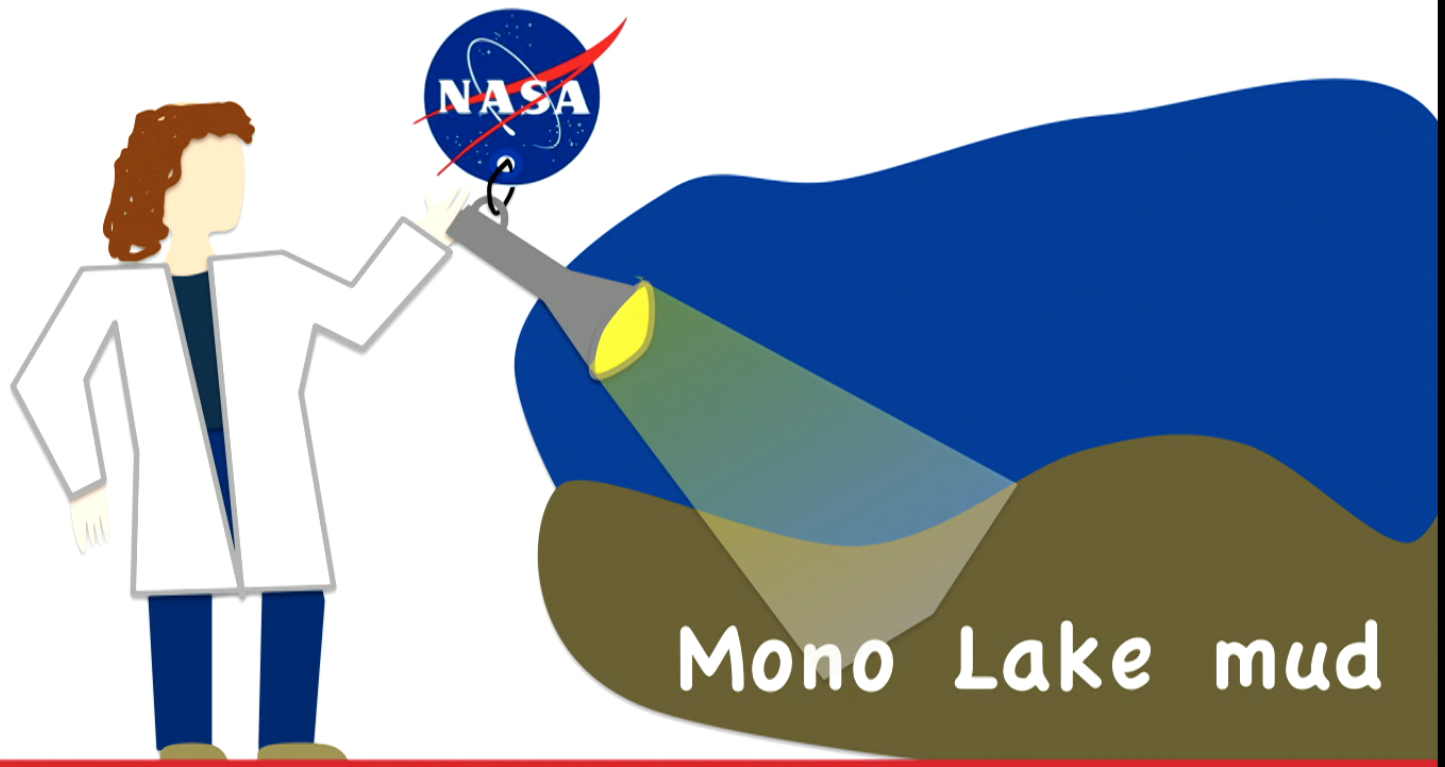
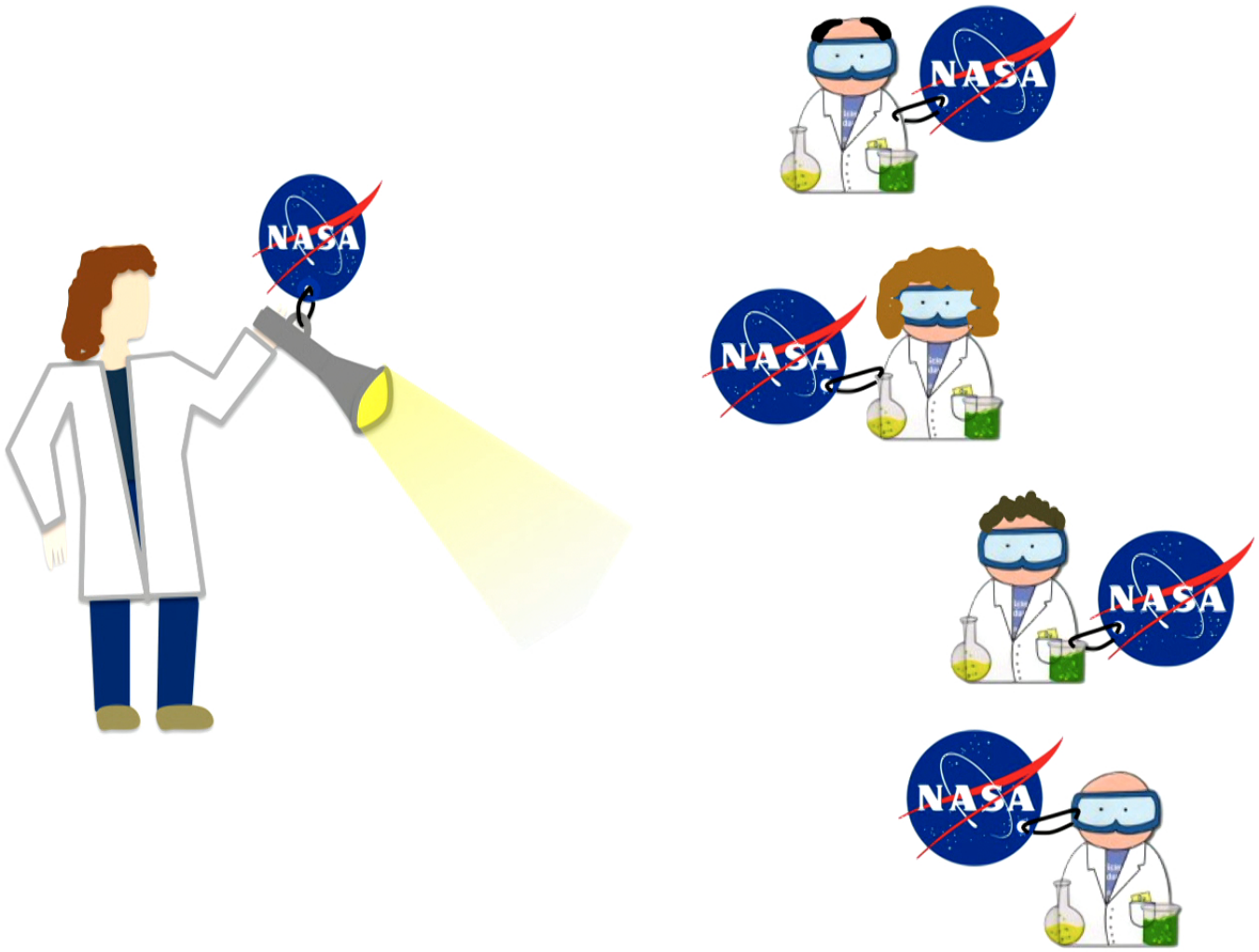
Act I. Out of the Shadows

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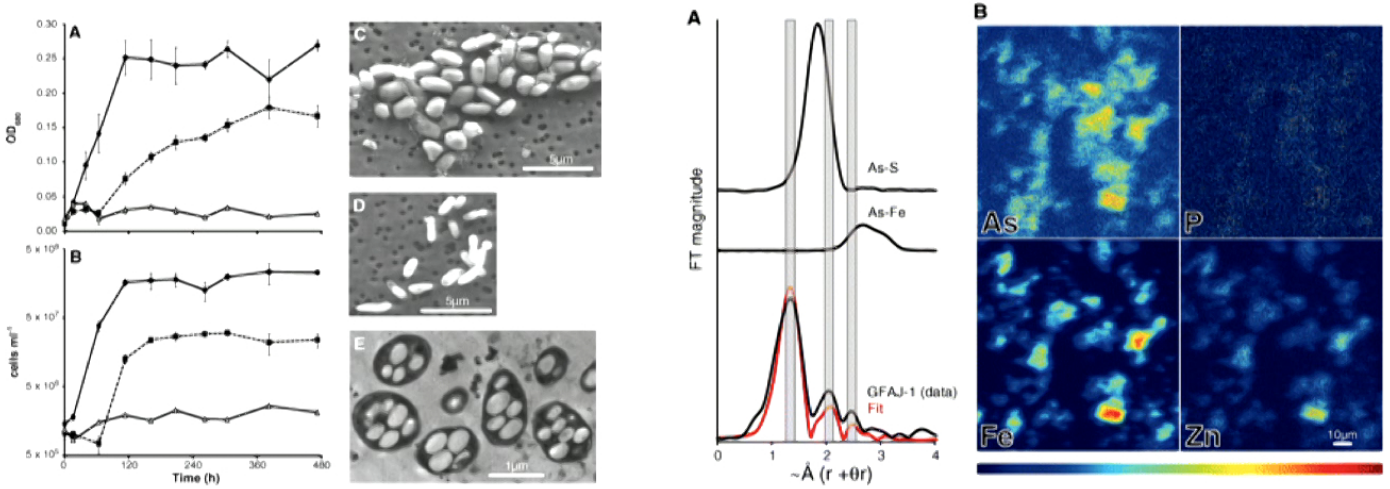
A
B
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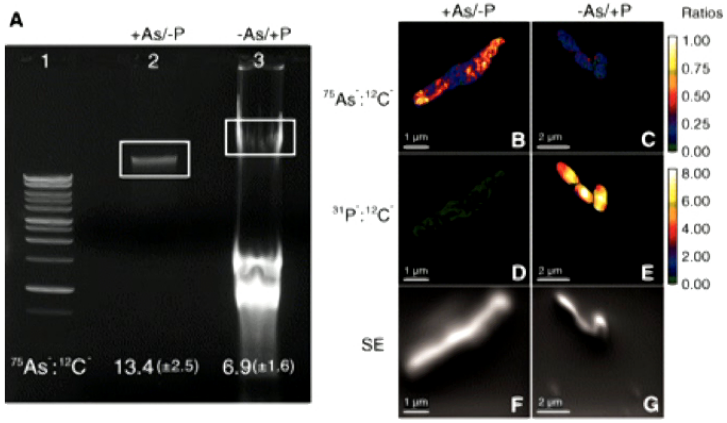
A
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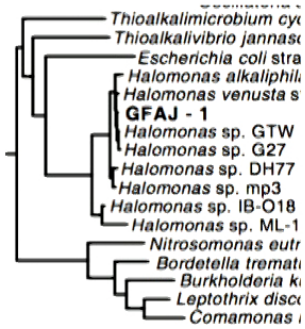
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Halomonas sp. GTW
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Halomonas sp. DH77
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Halomonas sp. ML-1
Nitrosomonas eutr
Bordetella tremat
Burkholderia k
Leptothrix disc
Comamonas


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NASA Discovers New Life! Arsenic Bacteria With DNA Completely Alien To What We Know
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NASA Life Discovery: New Bacteria Makes DNA With Arsenic
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Toxic ... but there's life in California lake
DISCOVERY OF "ARSENIC-BUG" EXPANDS DEFINITION OF LIFE
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Dec. 2, 2010: NASA-supported researchers have discovered the first known microorganism on E
and reproduce using the toxic chemical arsenic. The microorganism, which lives in California's Mo
substitutes arsenic for phosphorus in the backbone of its DNA and other cellular components.
"The definition of life has just expanded," said Ed Weiler, NASA's

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NASA Discovers New Life! Arsenic Bacteria With DNA Completely Alien To What We Know

THE Sun
Thursday, 23 December 2010

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EXCLUSIVE

It's life, but not as we know it

By PAUL SUTHERLAND, Sun Spaceman
Published: 01 Dec 2010

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'Weird life': Clue to alien biology after scientists discover mysterious bacteria that can live on arsenic

By FIONA MACRAE
Last updated at 8:33 AM on 3rd December 2010

NASA has discovered alien life – but it is right here on Earth.

The announcement, at a press conference at the space agency's US headquarters, follows days of frenetic speculation that it was about to reveal the existence of life on another planet.

While the truth – an 'alien' bacterium lurking deep within a Californian lake – is rather closer to home, it markedly raises the odds of ET's existence.

NATIONAL GEOGRAPHIC Daily News

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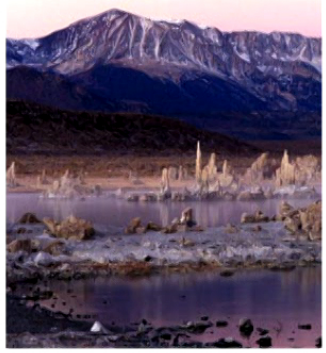
NASA Life Discovery: New Bacteria Makes DNA With Arsenic



Toxic ... but there's life in California lake

Citizen Scientists | Educators | Students | Kids

2010 → Discovery of "Arsenic-bug" Expands ... finition of Life

Discovery of "Arsenic-bug" Expands Definition of Life

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Dec. 2, 2010: NASA-supported researchers have discovered the first known microorganism on E and reproduce using the toxic chemical arsenic. The microorganism, which lives in California's Mo substitutes arsenic for phosphorus in the backbone of its DNA and other cellular components.

"The definition of life has just expanded," said Ed Weiler, NASA's associate administrator for the Science Mission Directorate at the

Act III.
Downfall and Disgrace

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NASA's arsenic microbe science slammed

Slate

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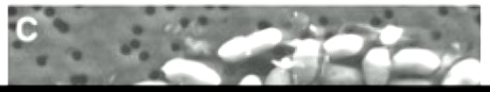
HOME / SCIENCE : THE STATE OF THE UNIVERSE.

"This Paper Should Not Have Been Published"

Scientists see fatal flaws in the NASA study of arse

By Carl Zimmer

Posted Tuesday, Dec. 7, 2010, at 10:53 AM ET



On Thursday, Dec
a new paper calle
Using Arsenic Ins

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Science

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ENVIRONMENT S

Poisoned Debate Encircles a Microbe Study's Result

By DENNIS OVERBYE

010

that NASA experimenters had found a bacterium that seems
on arsenic in place of phosphorus — an element until now
r life — set off a cascading storm of criticism on the Internet,
rrors and sloppiness in the paper published in Science by
and her colleagues, and then about their and NASA's refusal

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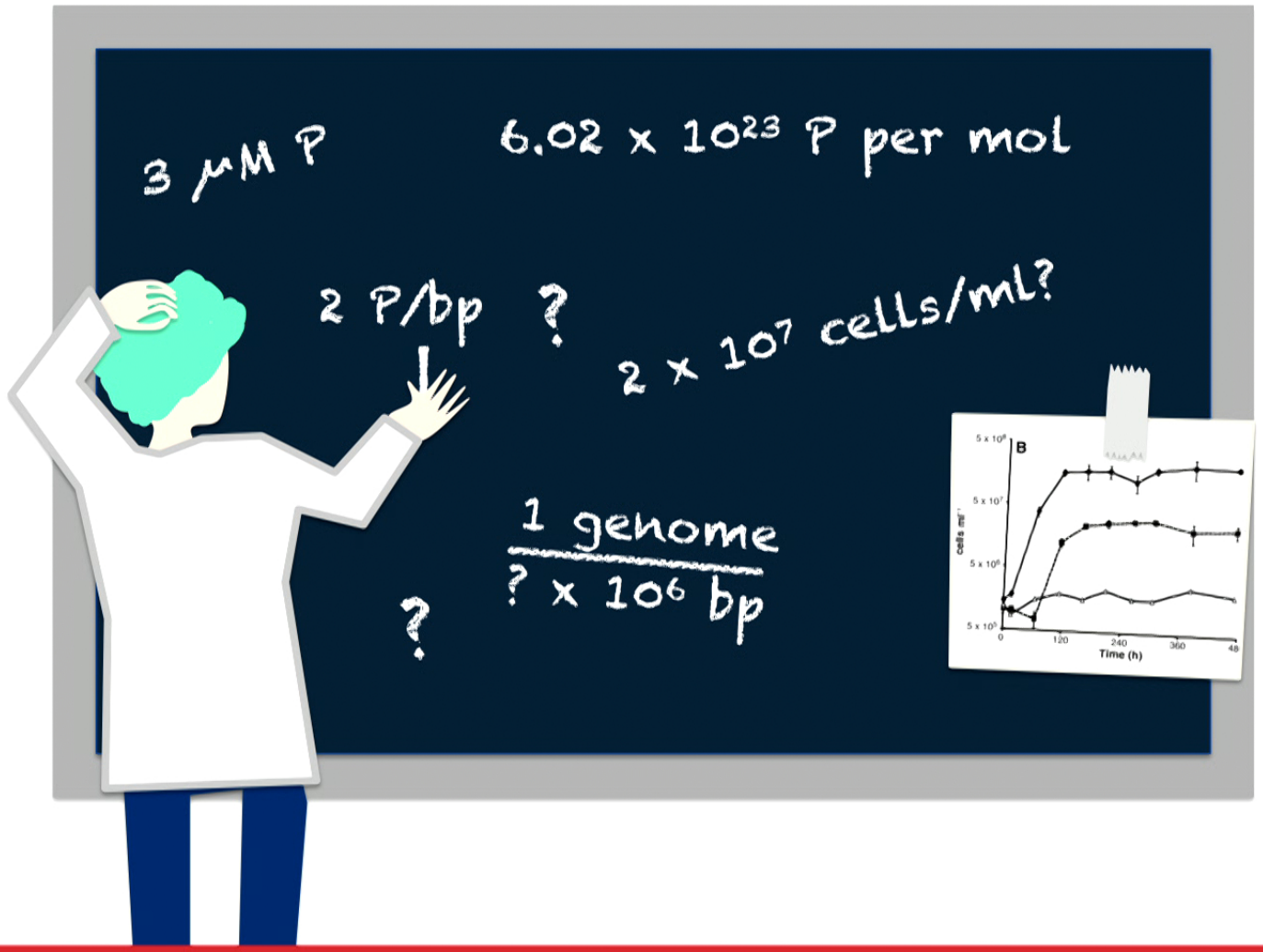
Hi, RosieRe

Doubts Brew About NASA's New Arsenic Life


3 μM P
6.02 x 10^23 P per mol
2 P/bp ?
2 x 10^7 cells/ml?
1 genome
? x 10^6 bp
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B
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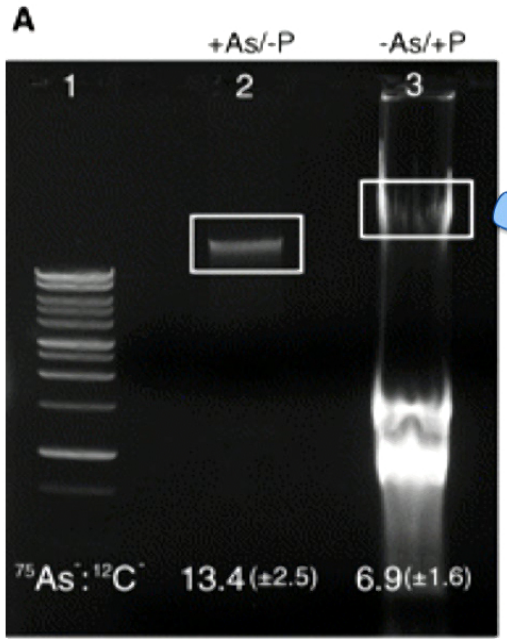
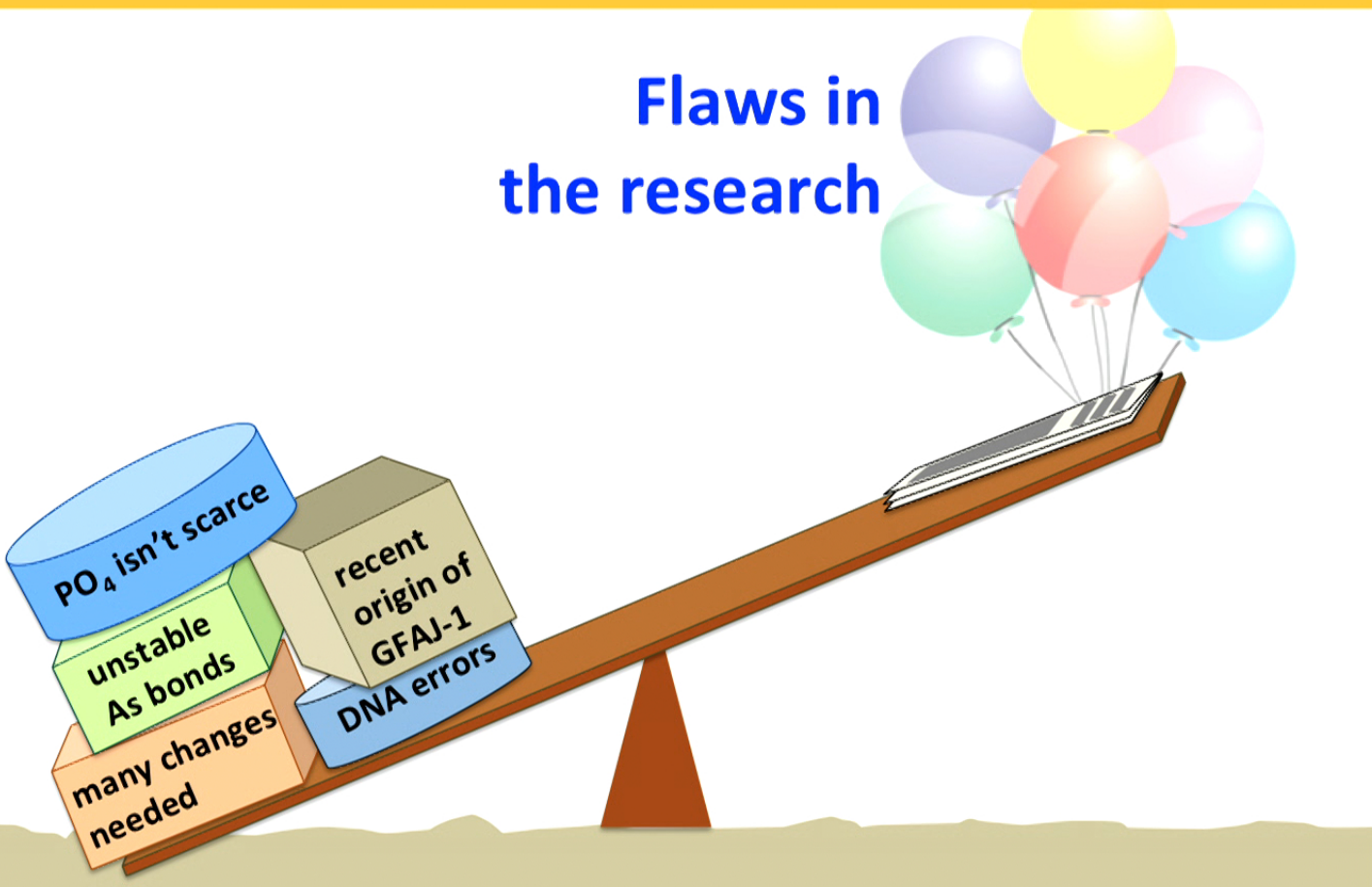
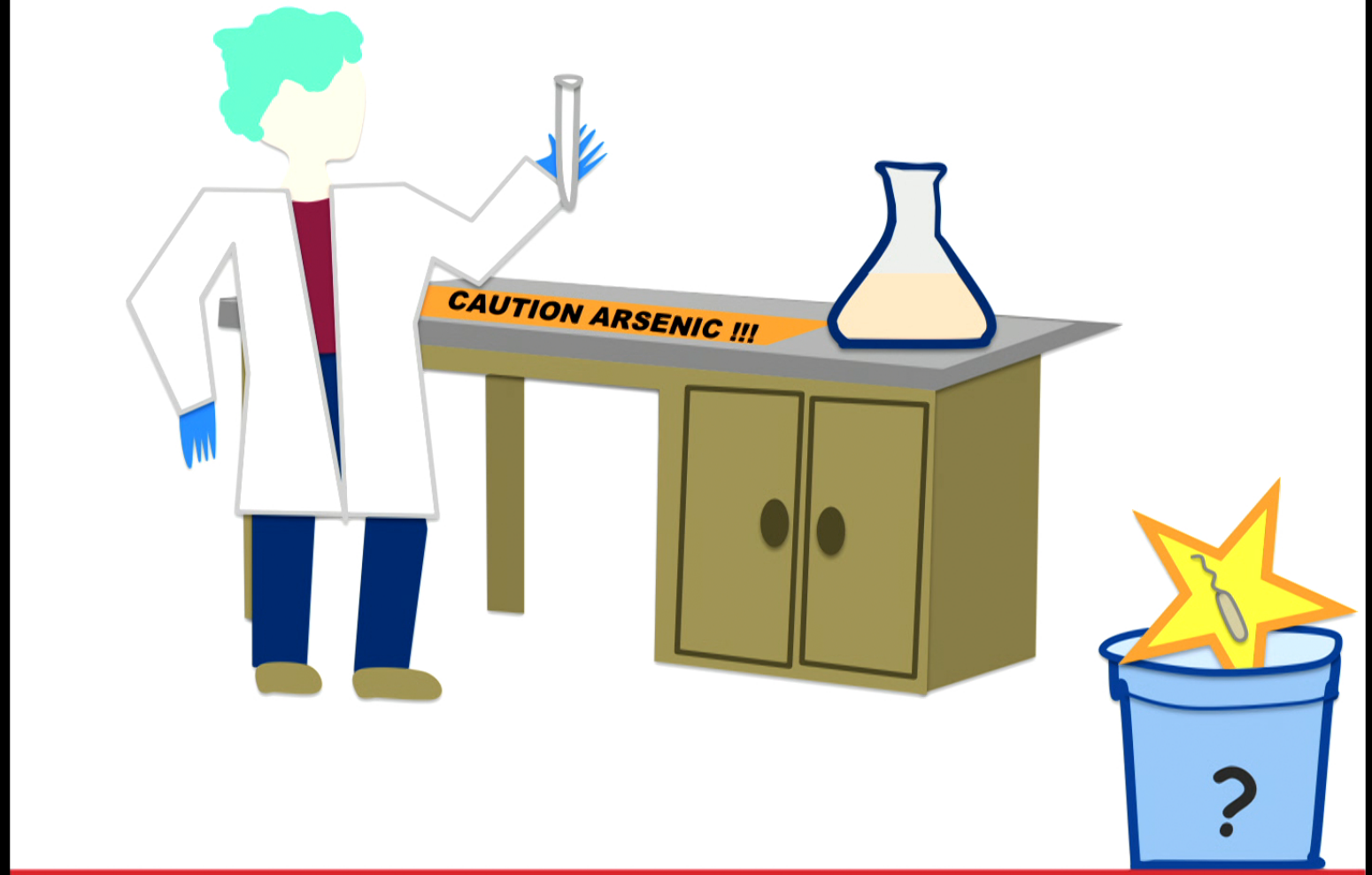
Arsenic in the gel, not in the DNA?



Flaws in the research




CAUTION ARSENIC !!!
?

RRResearch

Not your typical science blog, but an 'open science' research blog. understanding how and why bacteria take up DNA, and getting dis

GFAJ-1 (no real progress to report)

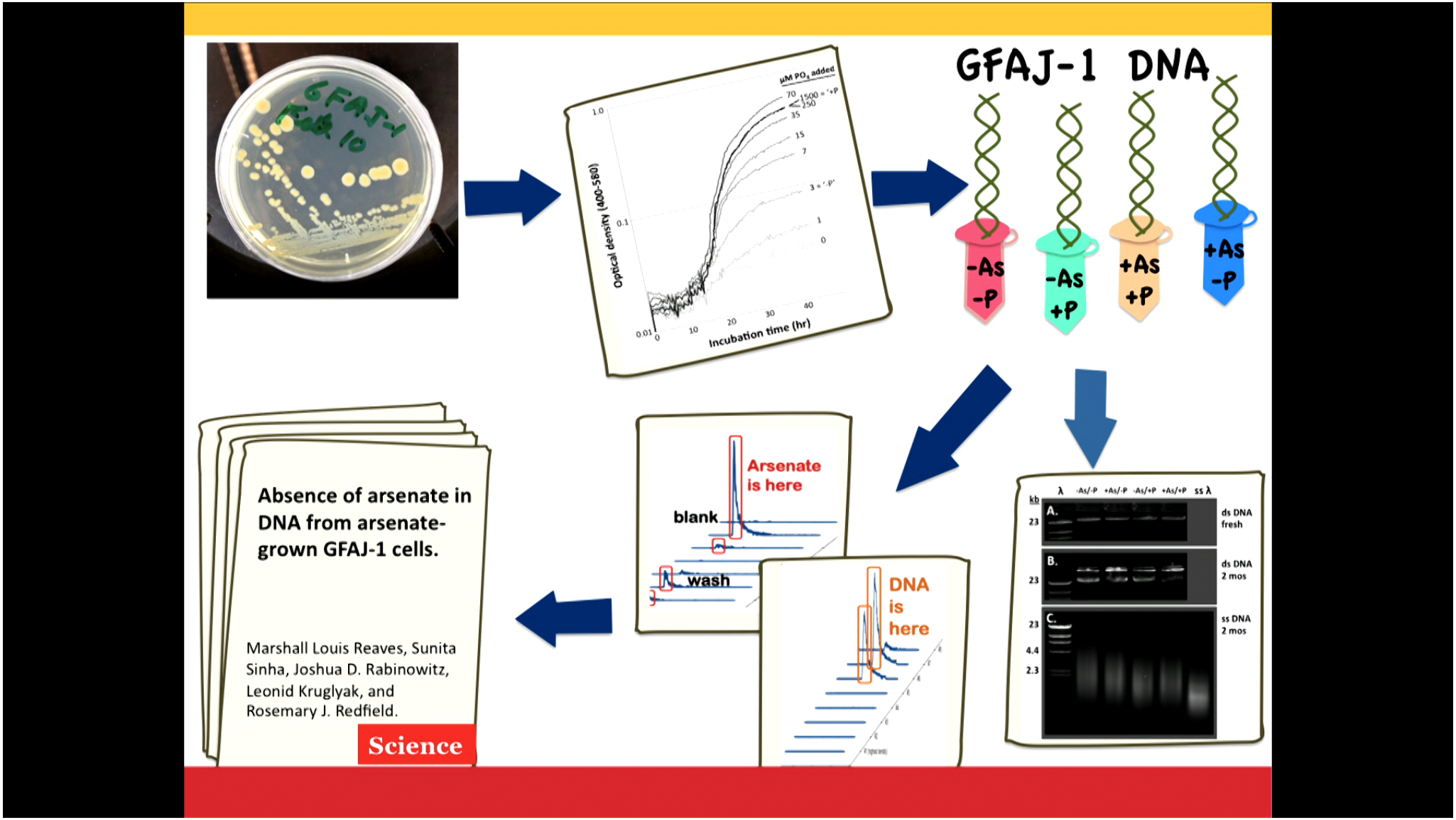
By Rosie Redfield on Wednesday, July 06, 2011

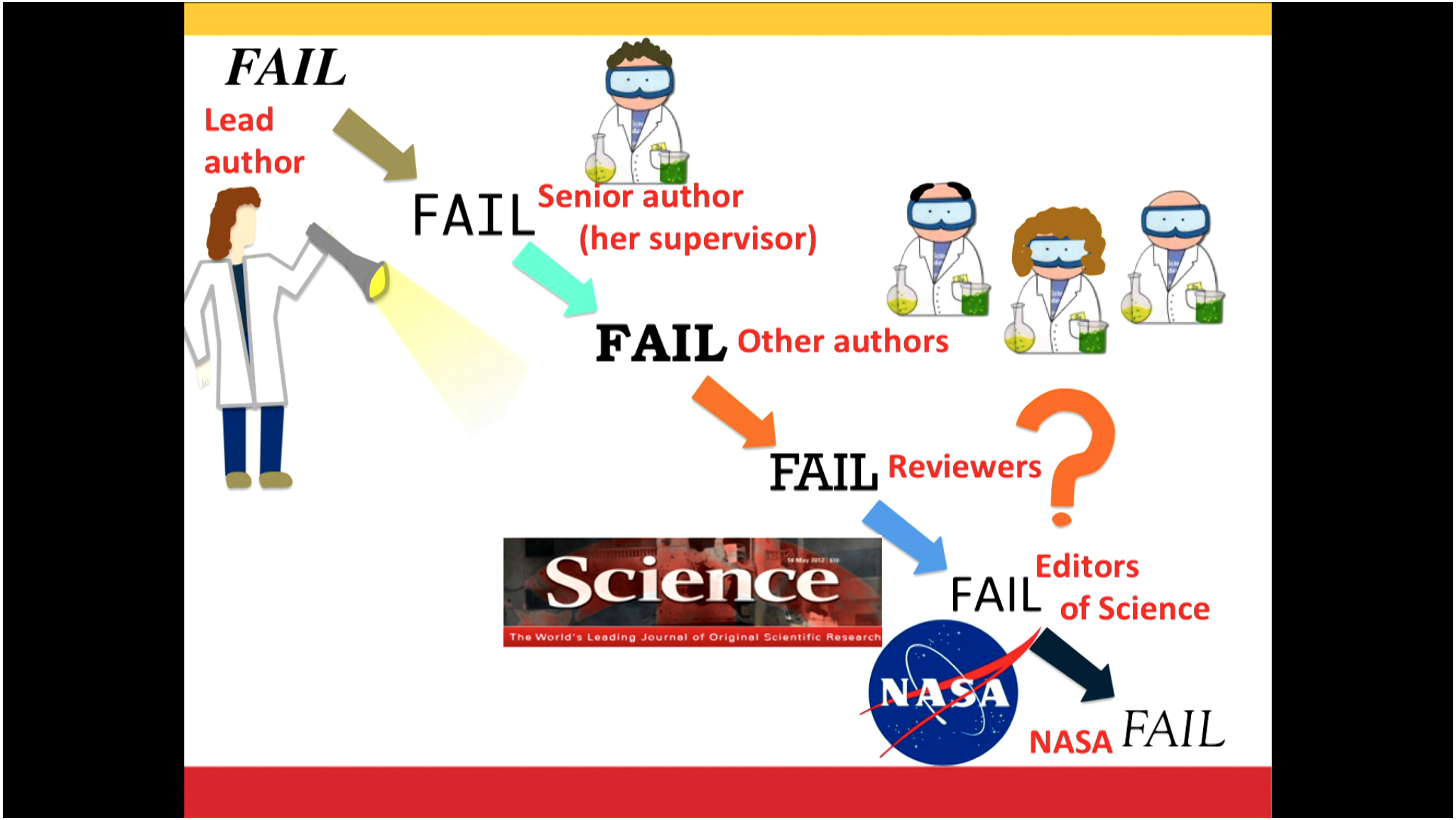
Yes, that last experiment was grasping at straws...

By Rosie Redfield on Tuesday, October 11, 2011

DNA! Lots and lots of lovely GFAJ-1 DNA!

By Rosie Redfield on Friday, November 18, 2011


GFAJ-1
Optical density (400-580)
Incubation time (hr)
GFAJ-1 DNA
-As -P
-As +P
+As +P
+As -P
Arsenate is here
blank
wash
DNA is here
Absence of arsenate in DNA from arsenate-grown GFAJ-1 cells.
Marshall Louis Reaves, Sunita Sinha, Joshua D. Rabinowitz, Leonid Kruglyak, and Rosemary J. Redfield.
Science
ds DNA fresh
ds DNA 2 mos
ss DNA 2 mos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Lead author
FAIL
Senior author (her supervisor)
FAIL
Other authors
FAIL
Reviewers
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OPEN
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CLOSED

Some people changed their minds about openness...

Press Release by NASA (Nov. 29):

Dwayne Brown, NASA Headquarters, Washington

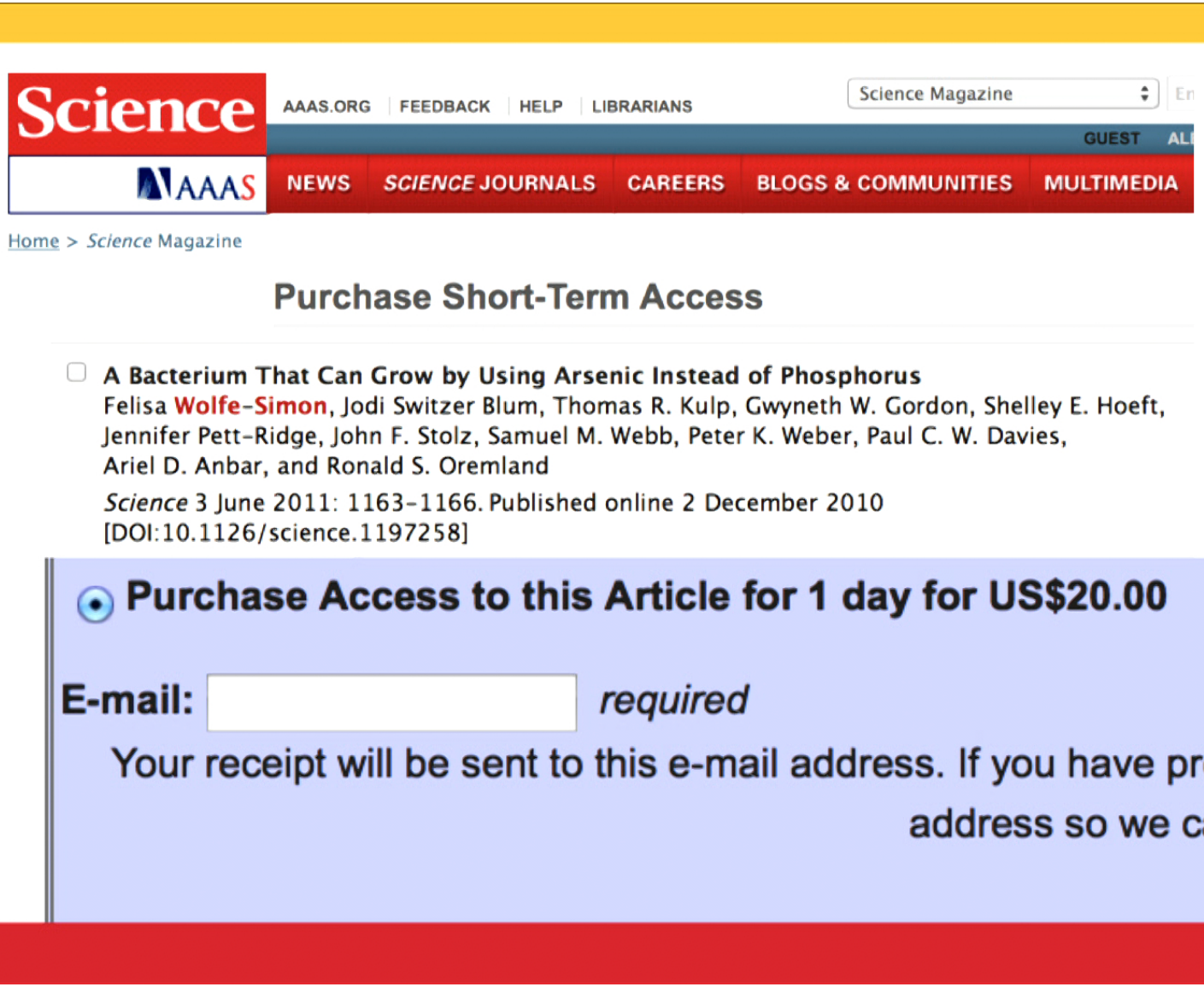
WASHINGTON -- NASA will hold a news conference at 2 p.m. EST on Thursday, Dec. 2, to discuss an astrobiology finding that will impact the search for evidence of extraterrestrial life. Astrobiology is the study of the origin, evolution, distribution and future of life in the universe.

NASA spokesman Dwayne Brown (Dec. 6, quoted by CBC News):

Wolfe-Simon will not be responding to individual criticisms, as the agency doesn't feel it is appropriate to debate the science using the media and bloggers. Instead, it believes that should be done in scientific publications.

Felisa Wolfe-Simon (Dec. 7, quoted by Carl Zimmer):

Any discourse will have to be peer-reviewed in the same manner as our paper was, and go through a vetting process so that all discussion is properly moderated.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Science 3 June 2011: 1163-1166. Published online 2 December 2010
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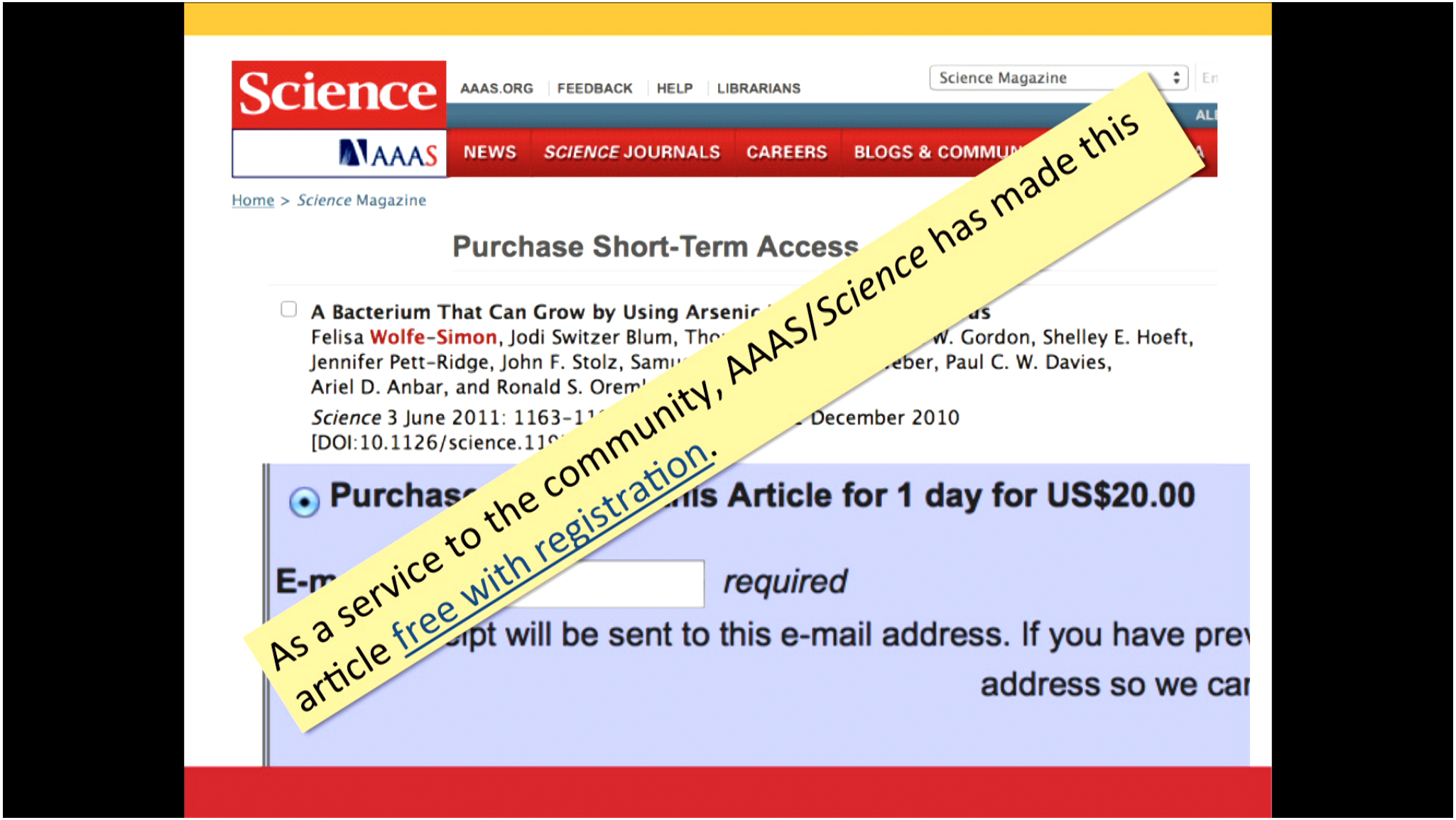
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A Bacterium That Can Grow by Using Arsenic Instead of Phosphorus

Felisa Wolfe-Simon,[1,2*] Jodi Switzer Blum,[2] Thomas R. Kulp,[2] Gwyneth W. Gordon,[3] Shelley E. Hoeft,[2] Jennifer Pett-Ridge,[4] John F. Stolz,[5] Samuel M. Webb,[6] Peter K. Weber,[4] Paul C. W. Davies,[1,7] Ariel D. Anbar,[1,3,8] Ronald S. Oremland[2]

[1]NASA Astrobiology Institute, USA. [2]U.S. Geolog
Arizona State University, Tempe, AZ, USA. [4]Law
Biological Sciences, Duquesne University, Pittsb
CA, USA. [7]BEYOND: Center for Fundamental
of Chemistry and Biochemistry, Arizona State Uni

*To whom correspondence should be addressed. E

Life is mostly composed of the elements carbon, hydrogen, nitrogen, oxygen, sulfur and phosphorus. Although these six elements make up nucleic acids, proteins and lipids and thus the bulk of living matter, it is theoretically possible that some other elements in the periodic table could serve the same functions. Here we describe a bacterium, strain GFAJ-1 of the Halomonadaceae, isolated from Mono Lake, CA, which substitutes arsenic for phosphorus to sustain its growth. Our data show evidence for arsenate in macromolecules that normally contain

A Bacterium That Can Grow by Using Arsenic Instead of Phosphorus

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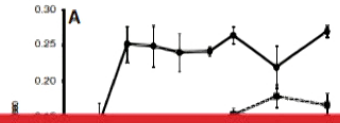
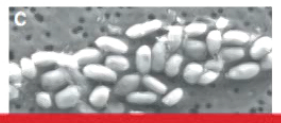
Life is mostly composed of the elements carbon, hydrogen, nitrogen, oxygen, sulfur, and phosphorus. Although these six elements make up nucleic acids, proteins, and lipids and thus the bulk of living matter, it is theoretically possible that some other elements in the periodic table could serve the same functions. Here, we describe a bacterium, strain GFAJ-1 of the Halomonadaceae, isolated from Mono Lake, California, that is able to substitute arsenic for phosphorus to sustain its growth. Our data show evidence for arsenate in macromolecules that normally contain phosphate, most notably nucleic acids and proteins. Exchange of one of the major bio-elements may have profound evolutionary and geochemical importance.

Biological dependence on the six major nutrient elements carbon, hydrogen, nitrogen, oxygen, sulfur, and phosphorus (P) is complemented by a selected array of other elements, usually metals or metalloids present in trace quantities that serve critical cellular functions, such as enzyme co-factors (*1*). There are many cases of these trace elements substituting for one another. A few examples include the substitution of tungsten for molybdenum and cadmium for zinc in some enzyme families (*2*, *3*) and copper for iron as an oxygen-carrier in some arthropods and mollusks (*4*). In these examples and others, the trace elements that interchange sharn be incorporated into some early steps in the pathways [(*6*) and references therein]. However, it is thought that downstream metabolic processes are generally not compatible with As-incorporating molecules because of differences in the reactivities of P and As compounds (*8*). These downstream biochemical pathways may require the more chemically stable P-based metabolites; the lifetimes of more easily hydrolyzed As-bearing molecules are thought to be too short. However, given the similarities of As and P—and by analogy with trace element substitutions—we hypothesized that AsO_4^{3-} could specifically substitute for PO_4^{3-} in an organism possessing mechanisms to cope with the inherent instability of AsO_4^{3-} compounds (*6*). Here, we experimentally tested this hypothesis by using AsO_4^{3-}, combined with no added PO_4^{3-}, to select for and isolate a microbe capable of accomplishing this substitution.

Geomicrobiology of GFAJ-1. Mono Lake, located in eastern California, is a hypersaline and alkaline water body with high dissolved arsenic concentrations [200 μM on average (*9*)]. We used lake sediments as inocula into an aerobic defined artificial medium at pH 9.8 (*10*, *11*) containing 10 mM glucose, vitamins, and trace metals but no added PO_4^{3-} or any additional complex organic supplements (such as yeast extract or peptone), with a regimen of increasing AsO_4^{3-} additions initially spanning the range from 100 μM to 5 mM. These enrichments were taken through many decimal-dilution transfers, greatly reducing any potential carryover of autochthonous phosphorus





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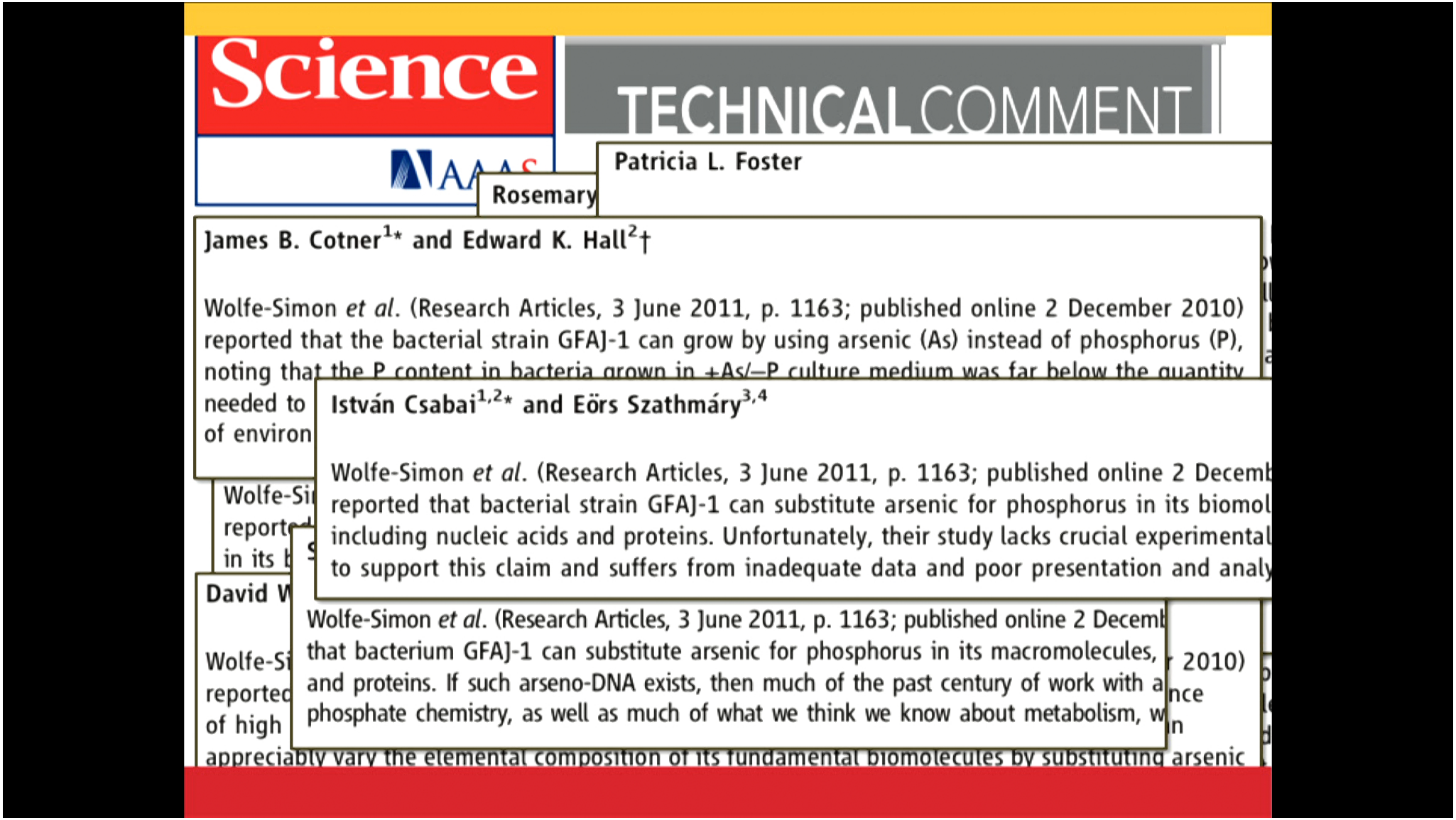
Comment on "A Bacterium That Can Grow by Using Arsenic Instead of Phosphorus"


Science
TECHNICAL COMMENT
Patricia L. Foster
James B. Cotner[1]* and Edward K. Hall[2]†
Wolfe-Simon et al. (Research Articles, 3 June 2011, p. 1163; published online 2 December 2010) reported that the bacterial strain GFAJ-1 can grow by using arsenic (As) instead of phosphorus (P),
István Csabai[1,2]* and Eörs Szathmáry[3,4]
Wolfe-Simon et al. (Research Articles, 3 June 2011, p. 1163; published online 2 Decemb
reported that bacterial strain GFAJ-1 can substitute arsenic for phosphorus in its biomol
including nucleic acids and proteins. Unfortunately, their study lacks crucial experimental
to support this claim and suffers from inadequate data and poor presentation and analy
Wolfe-Simon et al. (Research Articles, 3 June 2011, p. 1163; published online 2 Decemb
that bacterium GFAJ-1 can substitute arsenic for phosphorus in its macromolecules,
and proteins. If such arseno-DNA exists, then much of the past century of work with a
phosphate chemistry, as well as much of what we think we know about metabolism, w

Science

TECHNICAL COMMENT

Patricia L. Foster

Response to Comments on "A Bacterium That Can Grow Using Arsenic Instead of Phosphorus"

Felisa Wolfe-Simon,[1,2]*† Jodi Switzer Blum,[2] Thomas R. Kulp,[2] Gwyneth W. Gordon,[3] Shelley E. Hoeft,[2] Jennifer Pett-Ridge,[4] John F. Stolz,[5] Samuel M. Webb,[6] Peter K. Weber,[4] Paul C. W. Davies,[1,7] Ariel D. Anbar,[3,8] Ronald S. Oremland[2]

Concerns have been raised about our recent study suggesting that arsenic (As) substitutes for phosphorus in major biomolecules of a bacterium that tolerates extreme As concentrations. We welco

" We maintain that our interpretation of As substitution, based on multiple congruent lines of evidence, is viable."

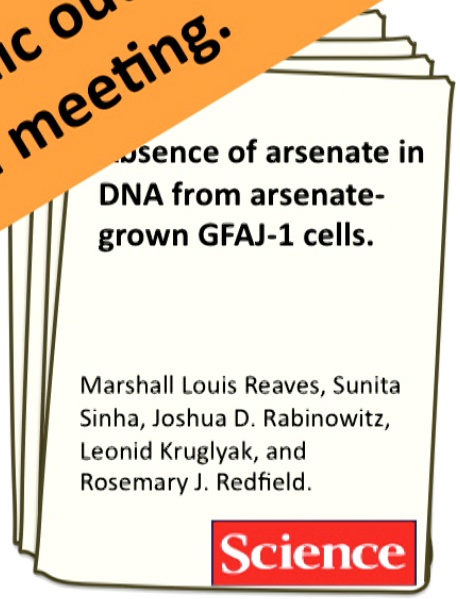
appreciably vary the elemental composition of its fundamental biomolecules by substituting arsenic

The manuscript was available on the arXiv server.

The paper was ‘in press’ at Science .

The manuscript was available on the arXiv server.

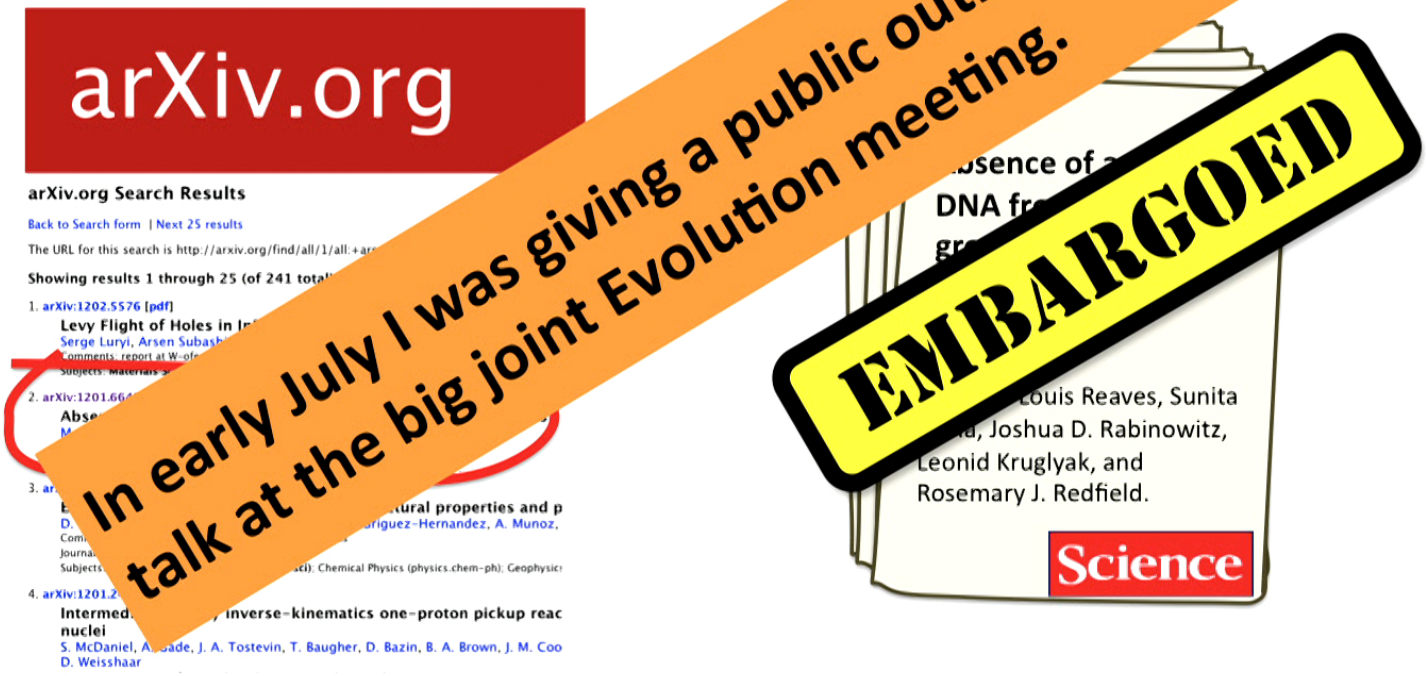
The paper was 'in press' at Science



In early July I was giving a public outreach talk at the big joint Evolution meeting.

The manuscript was available on the arXiv server.

The paper was 'in press' at Science



In early July I was giving a public outreach talk at the big joint Evolution meeting.

Science *had* embargoed it until July 26...

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Of an open internet:

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Of open-access publishing:

- Predatory open-access journals

Unintended consequences of ‘open’

Of open-access publishing:

- Predatory open-access journals

Beall’s list of ‘predatory’ online publishers:

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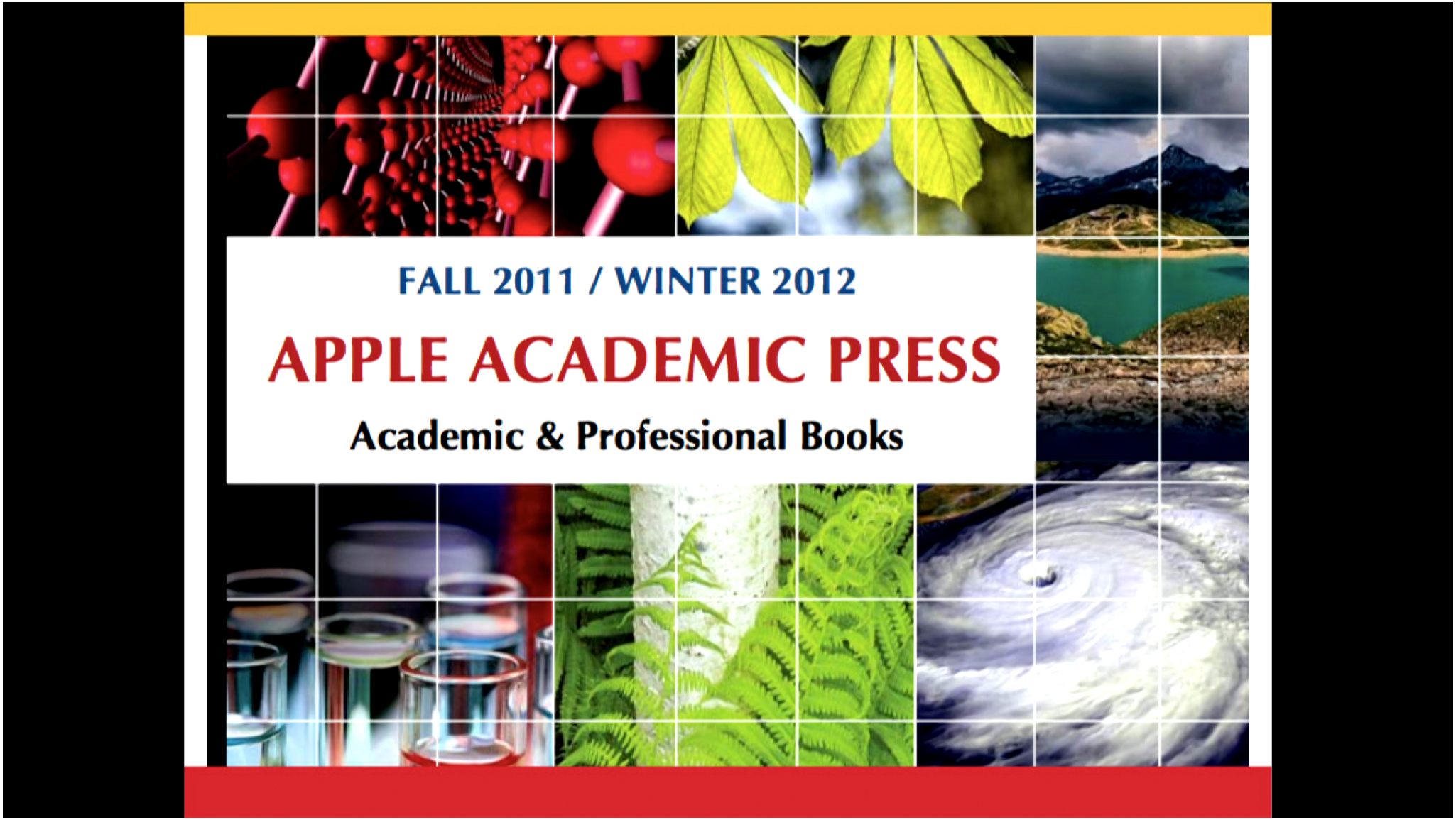
o Academic Journals
o Academic Journals, Inc.
o Academic Journals Online (AJO)
o Academic Publications, Ltd.
o Academic Research Publishing Agency
o Academic Sciences
o Academy & Industry Research Collaboration Center (AIRCC)
o Academy Journals
o Academy of Knowledge Process
o Academy of Science and Engineering (ASE)
o Academy Publish
o Access
o Ada Lovelace Publications
o Advanced Research
o Advancements and Development in Technology International
o AENSI
o Akademik Plus Publication
o American Academic & Scholarly Research Center (AASRC)
o American V-King Scientific Publishing

o Sphinx Knowledge House
o Southern Cross Publishing Group
o
o Swiss Journals
o Technical Journals Online
o
o Thavan E ACT International Journals
o
o Trans Stellar (Transstellar)
o Transnational Research Journals (formerly Universal Research Journals)
o Universal Research Publications
o Valleys International
o VBRI Press
o Victorquest Publications
o
o Wireilla Scientific Publications
o
o World Academy of Research and Publication
o World Academy of Science, Engineering and Technology (WASET)
o World Science Publisher
o World Scientific and Engineering Academy and Society (WSEAS)
o Wudpecker Research Journals

Unintended consequences of ‘open’

Of open-access publishing:

- Predatory open-access journals
- For-profit republication of open-access articles


FALL 2011 / WINTER 2012
APPLE ACADEMIC PRESS
Academic & Professional Books

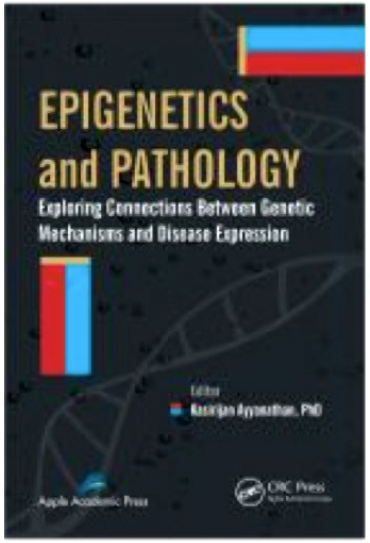
Business model:

- Polished collections of research articles
- Sold through Amazon and scientific publishers, as e-books and print-on-demand
- Jobbers bundle and sell to academic libraries

Contents:

- Some are edited collections of purpose-written articles.
- **Others are collections of open-access articles harvested from PLOS, BioMed Central and 'gold' OA journals:**
  - Open-access source is not made clear.
  - Some articles are mildly edited (e.g. title simplified).
  - Authors ("contributors") are not informed.
  - Editors have little or no expertise in the field.

2013

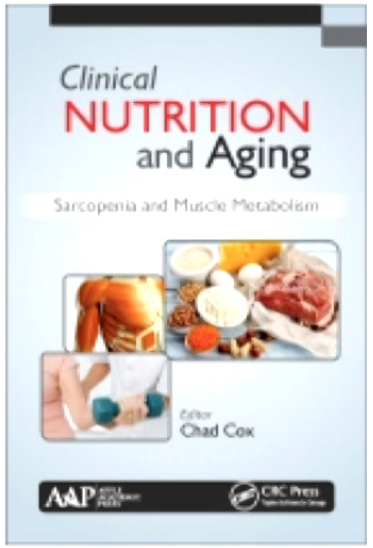


Published. Available now.
Pub Date: November 2013
Hardback Price: $169.95 US
Hard ISBN: 9781926895789
E-Book ISBN: 9781482224825
Pages: 424pp
Binding Type: hardbound

2015

Published. Available now.
Pub Date: March 2015
Hardback Price: $149.95 US
Hard ISBN: 9781771881012
E-Book ISBN: 978-1-4987-1815-8
Pages: 352 pp+index
Binding Type: hardback

2016



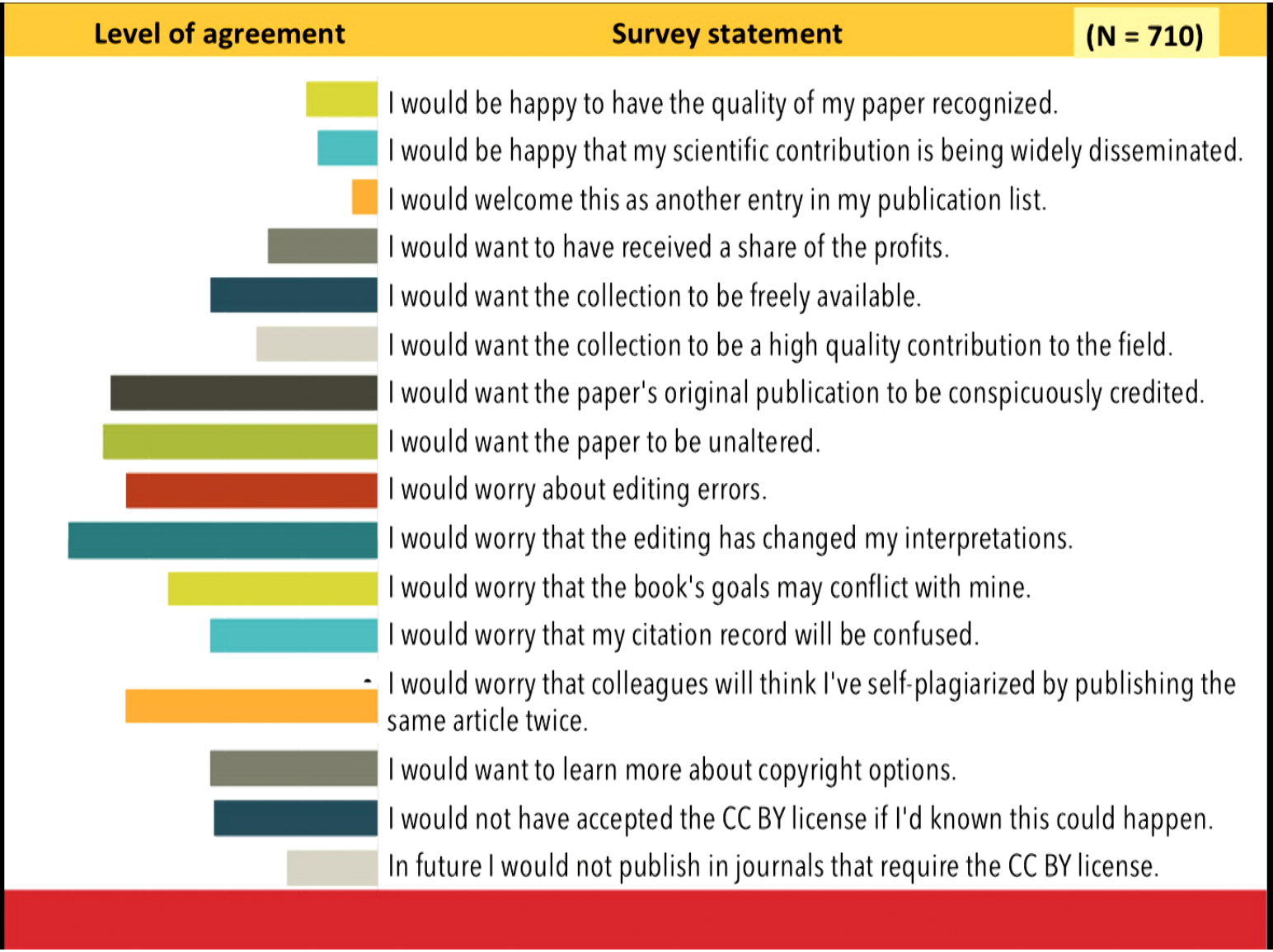
Published. Available now.
Pub Date: March 2016
Hardback Price: $149.95 US
Hard ISBN: 9781771883702
E-Book ISBN: 9781771883719
Pages: 306 pp with index
Binding Type: hardback

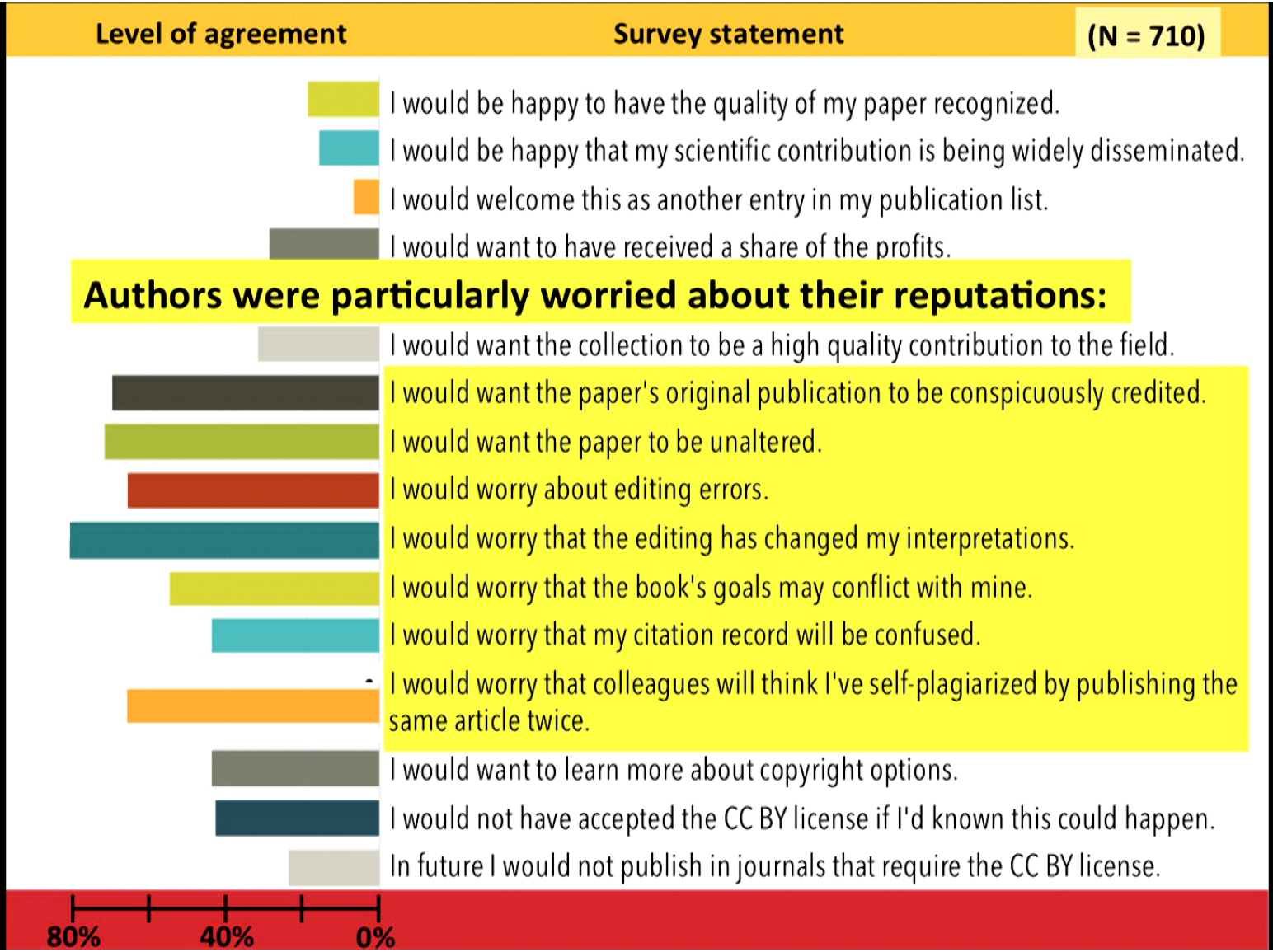
The survey preamble:

Consider this situation (a recent experience of some researchers):

Several years ago you published a paper in an open-access journal published by PLO S or BioMed Central. Now you discover that, without your knowledge, your paper has been included as a chapter in a multi author book. The author list is correct but the paper's title and text have been lightly reedited. You and your co-authors are prominently listed as 'contributors' to the volume, but the original journal citation for the paper is not given or is buried in an 'Authors' Notes appendix. The book looks like a typical multi-author work; the Introduction does not mention that some or all of the 'chapters' have been previously published as journal papers. The book is being sold for about $150 through Amazon.

On checking with the original journal you discover that this re-publication is legal because you agreed to the required Creative Commons-Attribution (CC-BY) copyright license when you published the paper.


Level of agreement
Survey statement
(N = 710)
I would be happy to have the quality of my paper recognized.
I would be happy that my scientific contribution is being widely disseminated.
I would welcome this as another entry in my publication list.
I would want to have received a share of the profits.
I would want the collection to be freely available.
I would want the collection to be a high quality contribution to the field.
I would want the paper's original publication to be conspicuously credited.
I would want the paper to be unaltered.
I would worry about editing errors.
I would worry that the editing has changed my interpretations.
I would worry that the book's goals may conflict with mine.
I would worry that my citation record will be confused.
I would worry that colleagues will think I've self-plagiarized by publishing the same article twice.
I would want to learn more about copyright options.
I would not have accepted the CC BY license if I'd known this could happen.
In future I would not publish in journals that require the CC BY license.


Level of agreement
Survey statement
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I would be happy to have the quality of my paper recognized.
I would be happy that my scientific contribution is being widely disseminated.
I would welcome this as another entry in my publication list.
I would want to have received a share of the profits.
Authors were particularly worried about their reputations:
I would want the collection to be a high quality contribution to the field.
I would want the paper's original publication to be conspicuously credited.
I would want the paper to be unaltered.
I would worry about editing errors.
I would worry that the editing has changed my interpretations.
I would worry that the book's goals may conflict with mine.
I would worry that my citation record will be confused.
I would worry that colleagues will think I've self-plagiarized by publishing the same article twice.
I would want to learn more about copyright options.
I would not have accepted the CC BY license if I'd known this could happen.
In future I would not publish in journals that require the CC BY license.
80%
40%
0%

Some of the authors' comments:

Editing of published manuscripts should be illegal.

I would be surprised and annoyed. I was never told that my work would be re-published somewhere else (I should have the option to decline).

Is there a different license, still making freely available, but restricting this kind of republishing?

I would be angry that others are making a profit of my work while I paid extra to have it FREELY available

I would be infuriated that I was not notified that they stole my work.

Some of the authors' comments:

OA-supporters' comments:

Authors are supposed to read the license agreements they sign, and CC-BY is quite explicit about allowing commercial use.

the authors should be happy their research was selected, not concerned.

You are doing massive harm to the OA cause by trying to scare the children.

BioMed Central
The Open Access Publisher

You retain copyright, licensing the article under a Creative Commons license (CC-BY)

This means that articles can be freely redistributed and reused as long as the article is correctly attributed. For example, a published article can be posted on a personal or institutional homepage, emailed to friends and colleagues, printed and sent to people, archived in a collection, distributed on CD-ROM, included in course-packs, quoted in the press, translated and further distributed as often and widely as possible.

The principle of informed consent in medical research:

Researchers are asking the participants to participate in a clinical trial for the common good.

- The researchers must design the trial to minimize the potential harm to the participants.
- The participants must be told about the possible harm as well as the possible benefit.
- The onus is on the researchers to make sure the participants are aware of the potential for harm as well as for benefit, before they join the trial.
- Ethical behaviour is enforced by Institutional Review Boards

Applying informed consent to open access:

The journal is asking the authors to accept the CC-BY license for the common good.

- The journal's practices should minimize the potential harm to the authors.
- The authors should be told about the possible harm as well as the potential benefits.
- The onus is on the journal to make sure the authors understand the potential for harm as well as for benefit.

BioMed Central
The Open Access Publisher

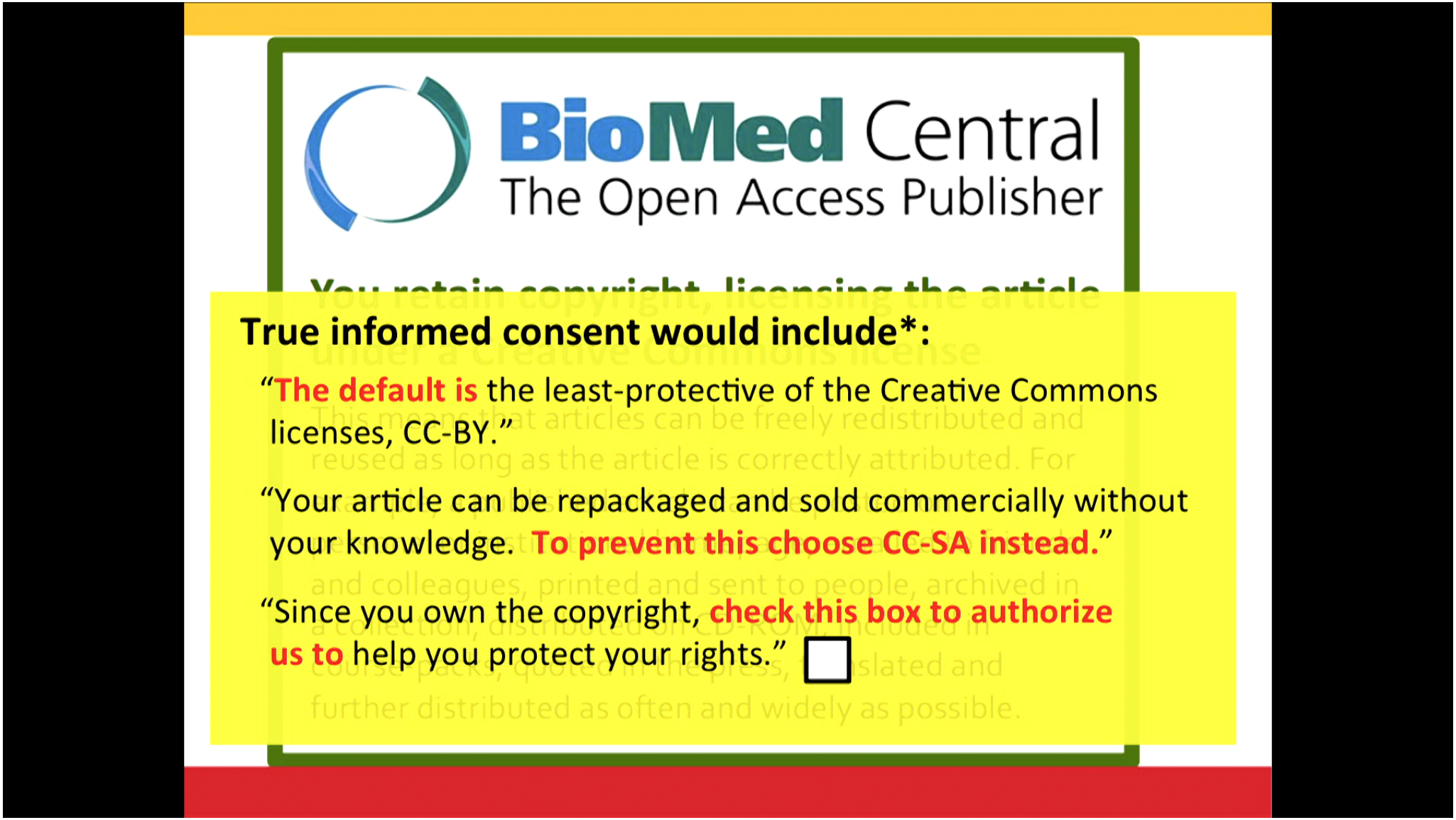
True informed consent would include*:

"You must accept the least-protective of the Creative Commons licenses, CC-BY."

"Your article can be repackaged and sold commercially without your knowledge."

"Since you own the copyright, we will not help you protect your rights."

***at the start of the submission process, not after final acceptance**


BioMed Central
The Open Access Publisher
True informed consent would include*:
"The default is the least-protective of the Creative Commons licenses, CC-BY."
"Your article can be repackaged and sold commercially without your knowledge. To prevent this choose CC-SA instead."
"Since you own the copyright, check this box to authorize us to help you protect your rights."

Evolution teaches us

- Cooperation is not easy to evolve
- Immediate self-interest trumps altruism
- If we want scientists to act cooperatively, we need to build structures that:
  - Make it easy
  - Reward it
  - Reduce its costs and risks

Kinds of problems/obstacles:

- What should I post (this is a big issue)? What's optional and what's required by journals or funding agencies, or just expected of responsible scientists? How has this changed since the last time I did this?
- Where should I post each type of information?
- What format does each type of information need to be useful?
- How much work will gathering and formatting the information be? How many complicated decisions will I need to make?
- Should/must what I post be copyrighted in some way?
- Who might find the posted information useful?
- What's the probability that nobody ever finds it useful?
- Might the information be used in ways that harm my reputation or the field? Who can I trust to tell me this?

Open access publishing succeeded because:

1. **What we wanted was clear:** Research papers free for all to read; copyrights held by authors, not journals.
2. **A way to get this was clear:** Start new journals whose expenses are supported by publication charges, not reader subscriptions.
3. **The cost to authors seemed clear.**

The goals of open science are worthy …

"… doing science on a public platform that facilitates collaboration, feedback, and the spread of ideas …"

… but not specific enough to guide action.