



UNIVERSITY OF GOTHENBURG
CENTRE FOR MARINE EVOLUTIONARY BIOLOGY

SCIENCE EDUCATION IN A CHANGING WORLD


Creation of digital resources for science education


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Why does science education matter?





Human Development
Report 2007/2008

Fighting climate change:
Human solidarity in a divided world

Human Development Report Office
OCCASIONAL PAPER

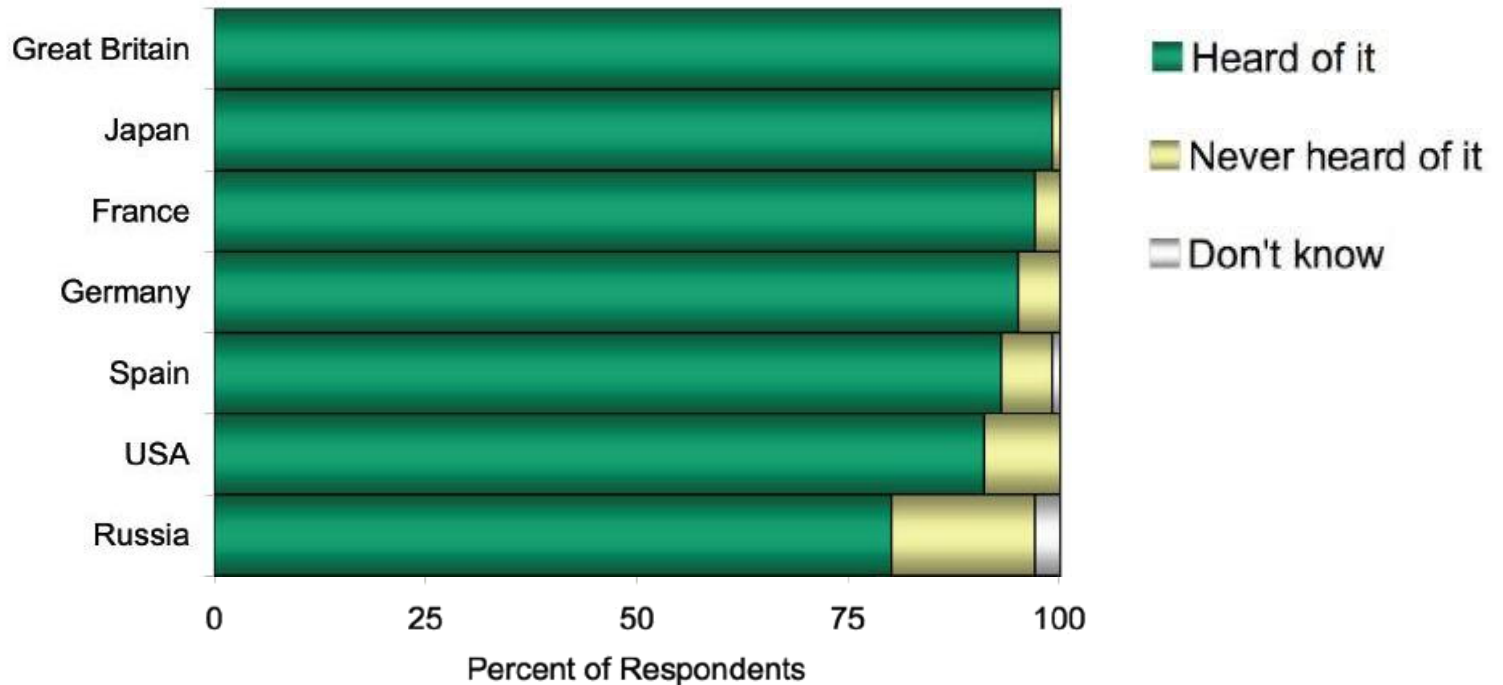
**International Public Opinion, Perception, and
Understanding of Global Climate Change**

Anthony Leiserowitz

2007/31

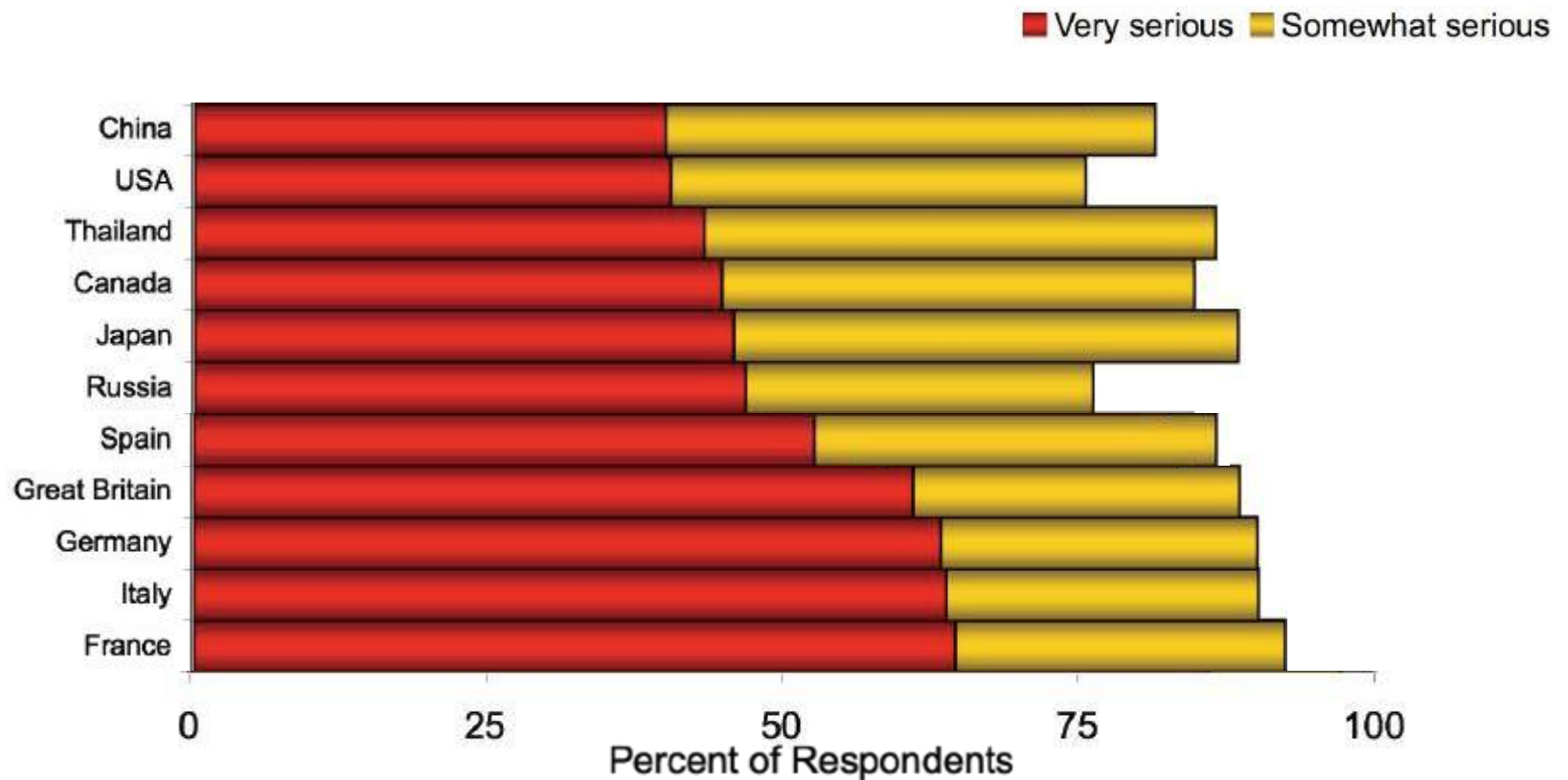
Why does science education matter?

“Have you ever heard of the environmental problem of global warming?” (Pew 2006)



Why does science education matter?

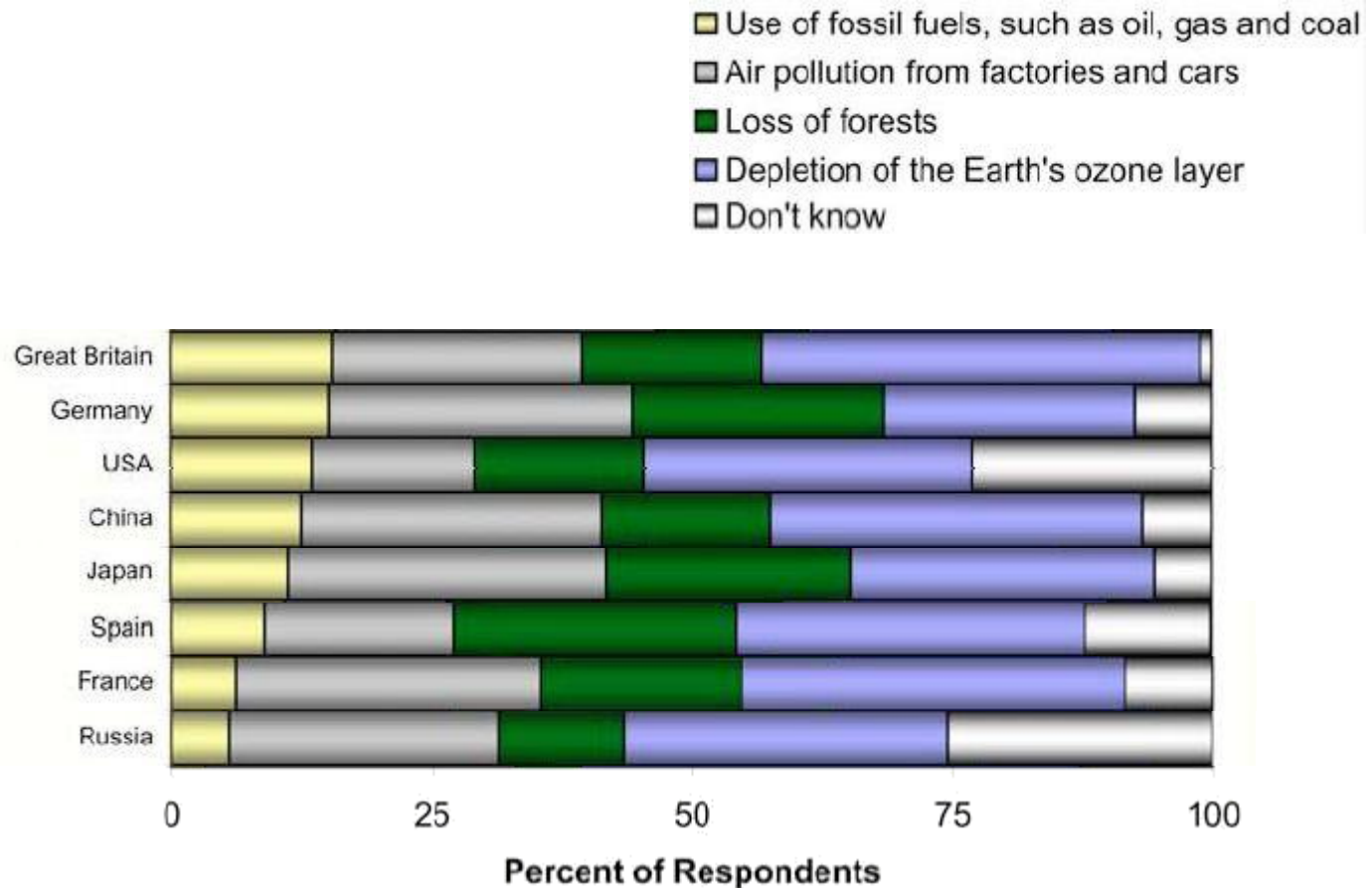
Perceived Seriousness of Global Warming (GlobeScan, 2000)



Why does science education matter?

Which of the following is the main cause of the greenhouse effect?

(GlobeScan, 1999)



Why does science education matter?

Early report

Ileal-lymphoid-nodular hyperplasia, non-specific colitis, and pervasive developmental disorder in children

A J Wakefield, S H Murch, A Anthony, J Linnell, D M Casson, M Malik, M Berelowitz, A P Dhillon, M A Thomson, P Harvey, A Valentine, S E Davies, J A Walker-Smith

Lancet. 1998 Feb 28;351(9103):637-41.



MMR (measles, mumps & rubella) vaccine

Why does science education matter?

% of MMR vaccination in UK

91 %	1997-1998
80%	2003-2004
85%	2008-2009

Measles cases in UK

56 cases	1998
1000 cases	2007

Science 8 August 2003:

Vol. 301 no. 5634 p. 804

DOI: 10.1126/science.1086726

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BREVIA

Measles Outbreaks in a Population with Declining Vaccine Uptake

V. A. A. Jansen^{1,*}, N. Stollenwerk¹, H. J. Jensen², M. E. Ramsay³, W. J. Edmunds³ and C. J. Rhodes¹

Why does science education matter?

What we have:

*Poor understanding of scientific method
Poor scientific knowledge*

SCIENCE  **EDUCATION**

What we need :

Scientifically literate citizens

What we do

- ✓ bring up-to-date and relevant science into the classrooms
- ✓ Understand main environmental issues
- ✓ Reflect upon their own responsibilities
- ✓ Develop critical thinking
- ✓ Discover the world of Science

Our methodology

Collaboration
with scientists

Design
of digital tools

Implementation
in the classroom

Evaluation
of the outcomes

Design of digital tools
with scientists
Offer learning experience
English literacy for non-native English speakers .
Impossible idea to be relevant
Scientific literacy schools in
and up-to-date
Environmental awareness
Scientific literacy
Feedback from students & leaders to fine-tune
our resources North America, Asia
Online, free, English



A 3 step curriculum

Step 1: What is OA and its impact on marine ecosystems? Virtual lab on OA

Step 2: How does OA impact us? Interactive discussion on OA

Step 3: What can we do? Carbon footprint calculator

Step 1

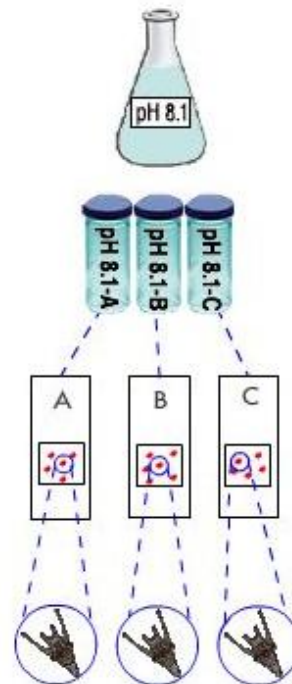
The virtual lab

✓ Lesson on OA

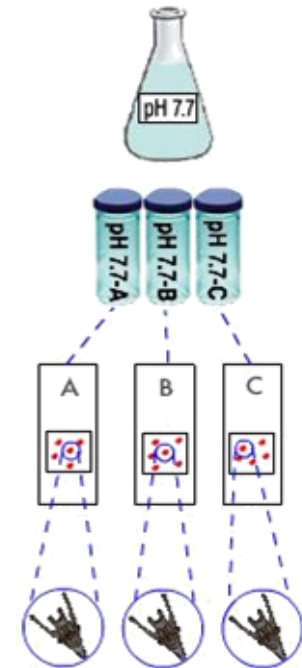
✓ Run experiment on sea urchin larvae

✓ Impact of seawater pH on sea urchin larvae development rate

pH 8,1: TODAY



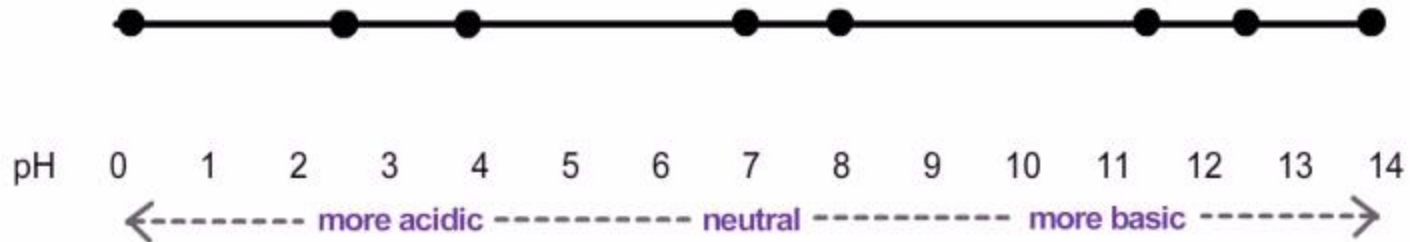
pH 7,7: END CENTURY



pH of liquids

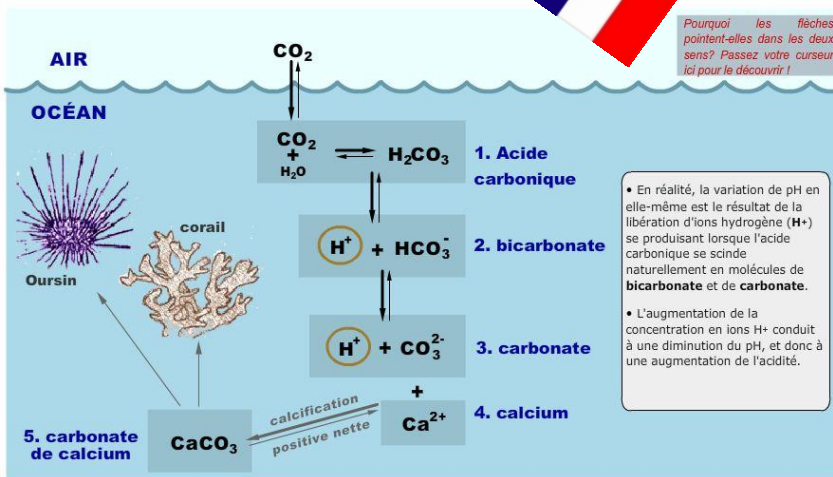
The acidity of liquids can be measured by pH, on a logarithmic scale from 0 to 14. Where do common liquids fall on this scale?

Drag the liquids below to their proper relative position in the pH scale at the bottom. The eight dots on the scale indicate the drop positions. Good luck!

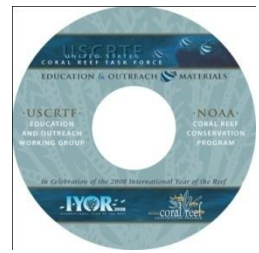
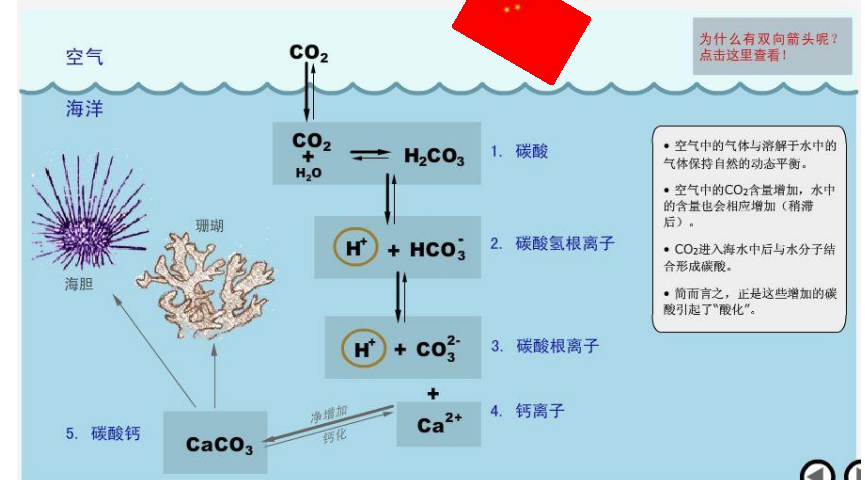


A success...

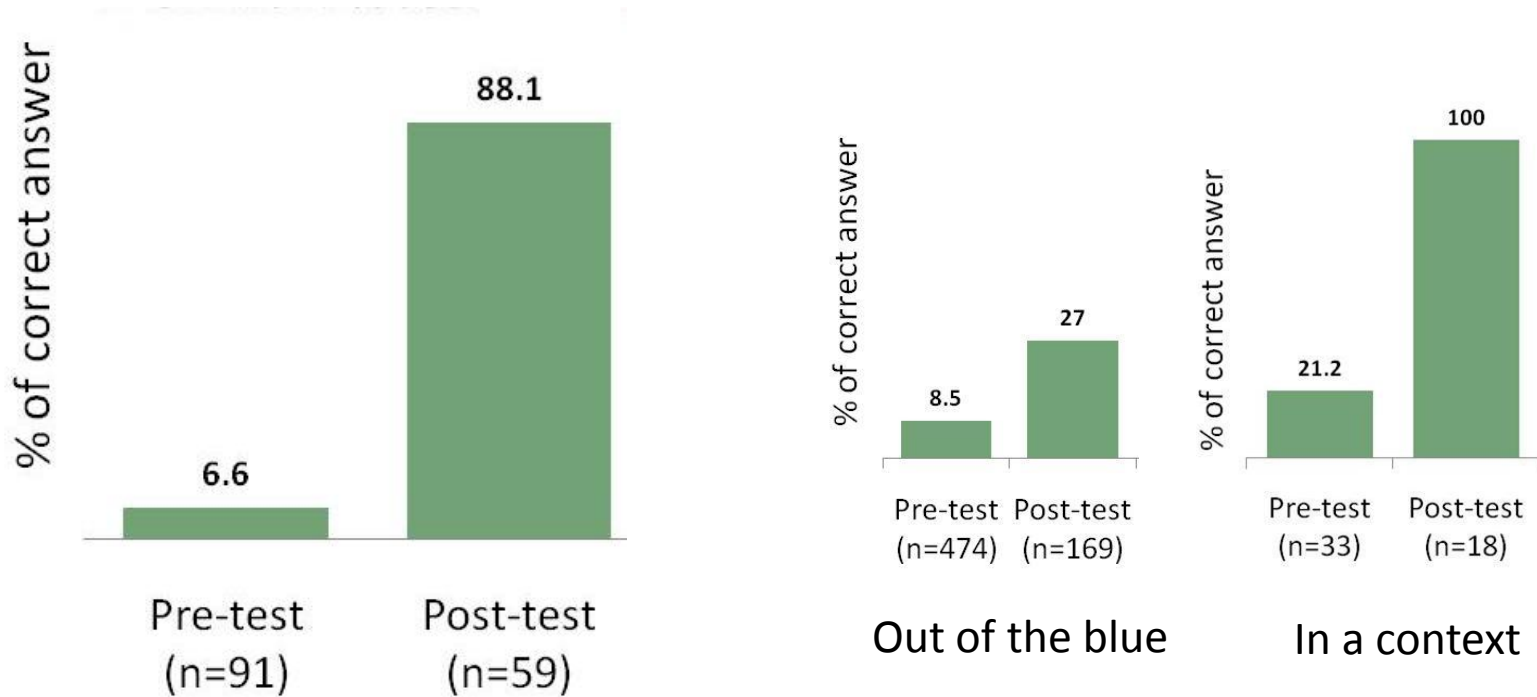
Carbone dans l'eau



水中的碳



... and it works

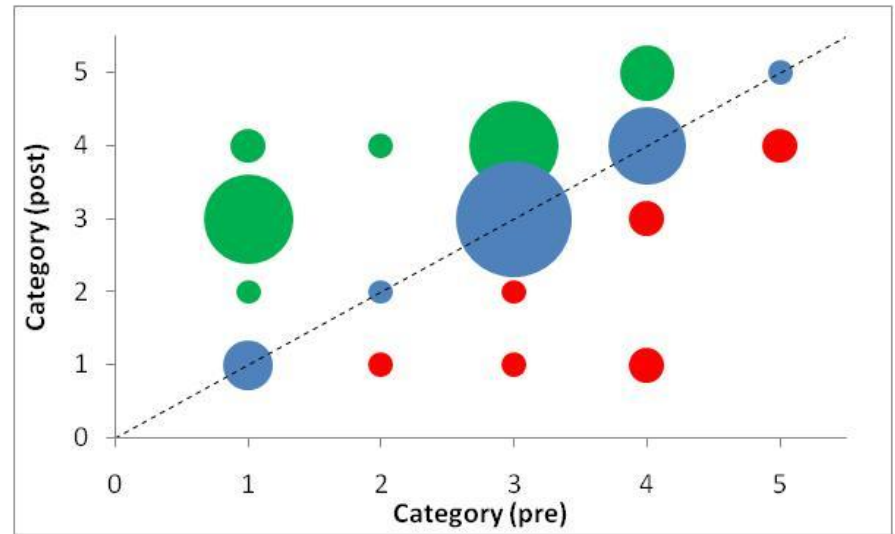
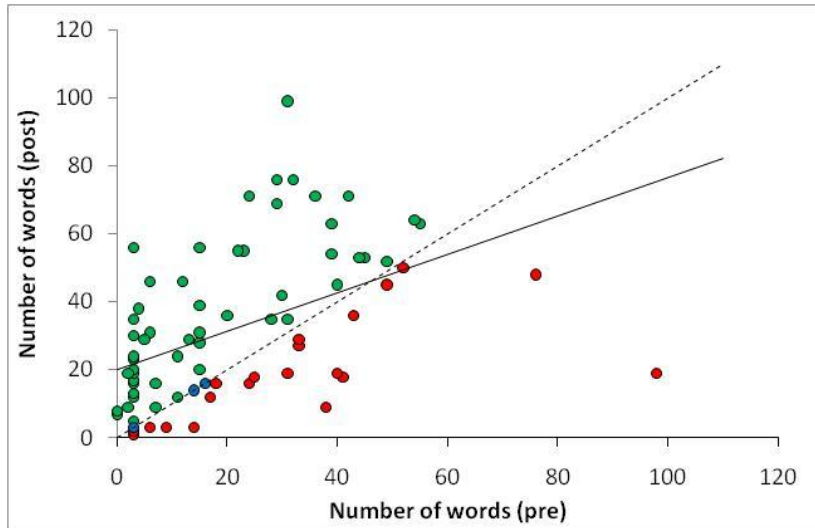


Increased knowledge on ocean acidification

BUT

You need a context

... and it works



Increased scientific thinking

Step 2

voicethread

Sea urchin larvae are smaller in low pH water

SO WHAT???

- ✓ Students can browse at their own pace
- ✓ Students can leave comment and question



menu

Public: Ocean acidification and animal early ...



Impact of CO₂-driven ocean acidification on early life-history – what we know and what we need to know



Sam Dupont & Mike Thorndyke

[sam.dupont@marecol.gu.se]



UNIVERSITY

The Sven Lovén Ocean Acidification Facilities
Kristineberg



comment





Impact of ocean acidification on marine species and ecosystems

Smaller sea urchin larvae?
So what???

Sam Dupont

[sam.dupont@marecol.gu.se]

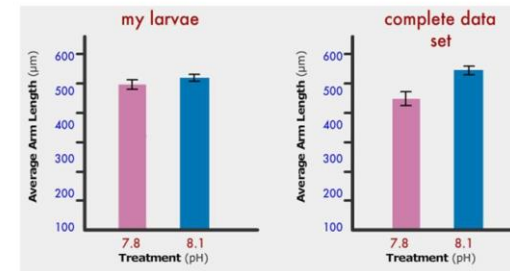


Marine Ecology – Gothenburg University
The Sven Lovén Marine Research Centre
Kristineberg

PART 1 – Summary of the Virtual Lab

The virtual results

	my larvae		complete data set	
	pH 7.8	pH 8.1	pH 7.8	pH 8.1
number of larvae	3	3	15	15
average	500 μm	523 μm	451.2 μm	533.6 μm
standard deviation	34.6 μm	25.2 μm	48.2 μm	29.2 μm



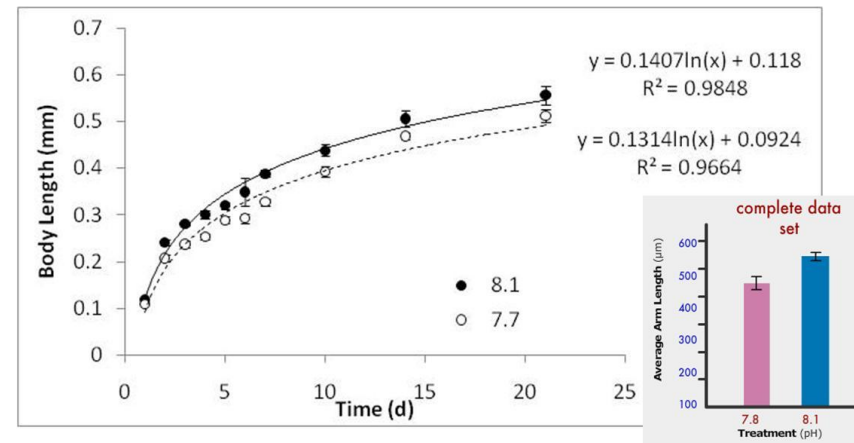
OA lab: <http://i2i.stanford.edu/carbonlab/co2lab.swf>

PART 2 – How the data were collected & the full dataset

The real laboratory and experiment



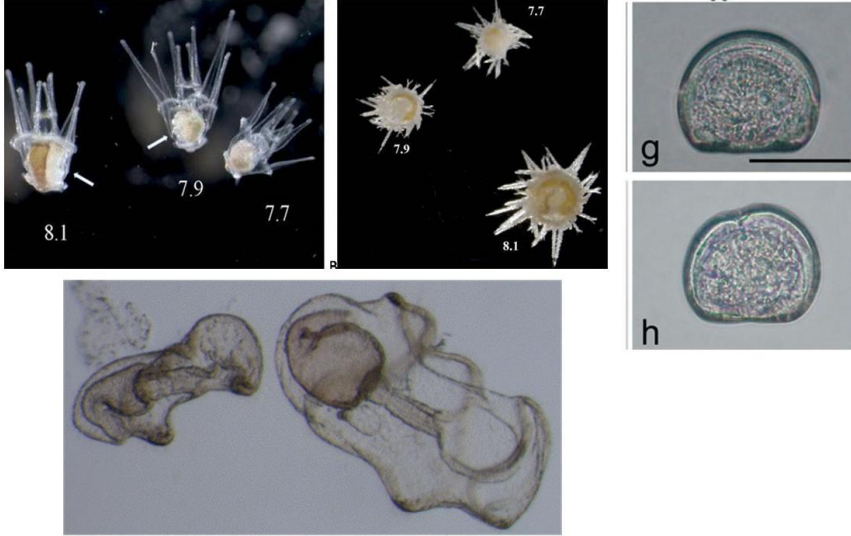
The real results



Same conclusion: Delay in development

PART 3 – Other species & SO WHAT?

Other species



Same trend in many other species

The facts

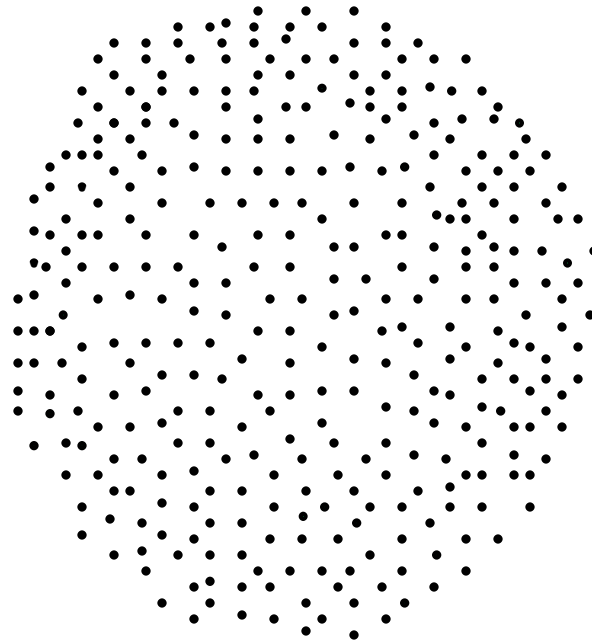
*Ocean acidification will induce a delay
in development in many marine species*

**SO
WHAT?**

Larvae into the wild...



Predators – 15% mortality EVERY DAY

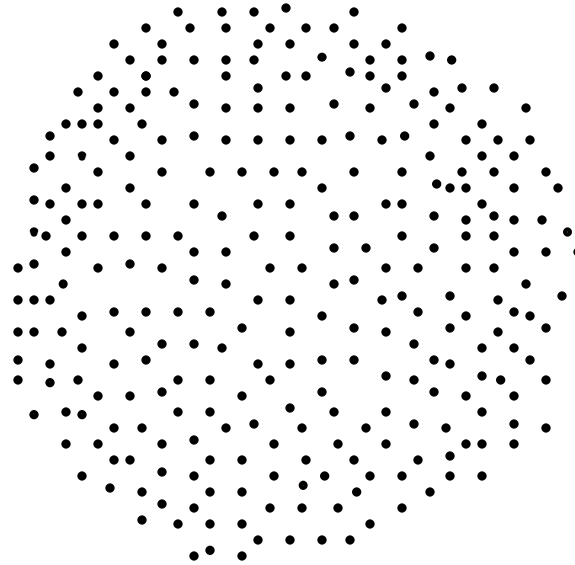


Day 0 – 350 eggs

Larvae into the wild...

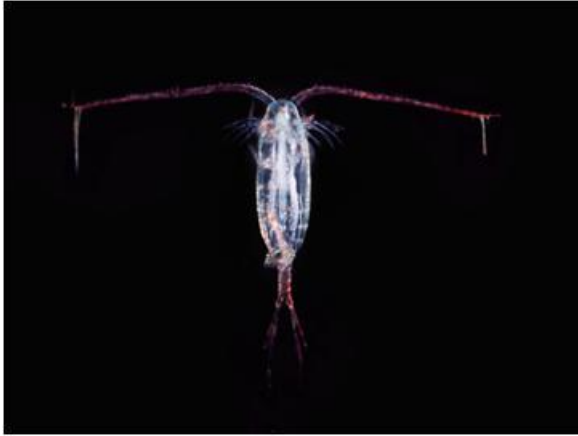


Predators – 15% mortality EVERY DAY

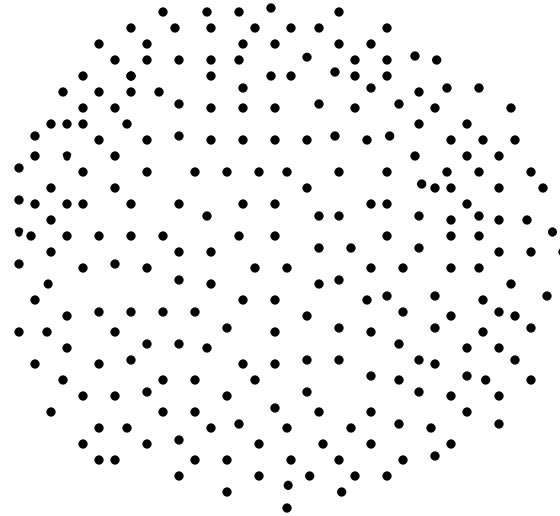


Day 1 – 306 embryos

Larvae into the wild...

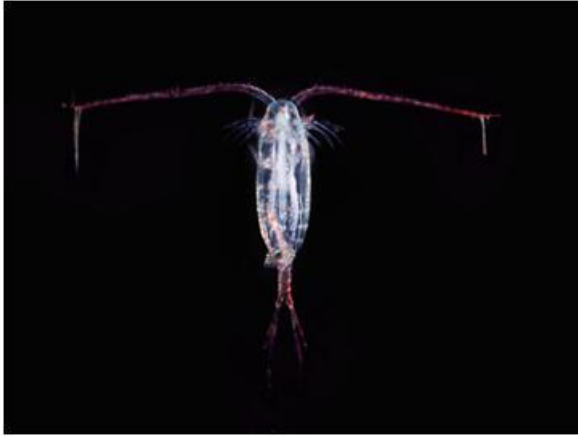


Predators – 15% mortality EVERY DAY

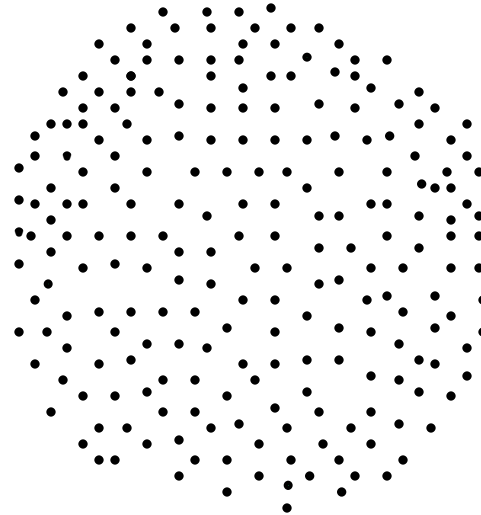


Day 2 – 266 larvae

Larvae into the wild...



Predators – 15% mortality EVERY DAY

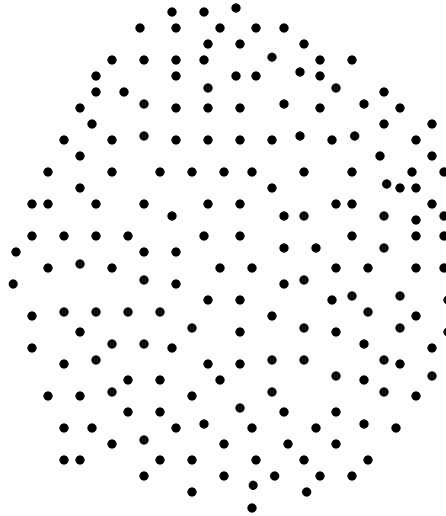


Day 3 – 231 larvae

Larvae into the wild...

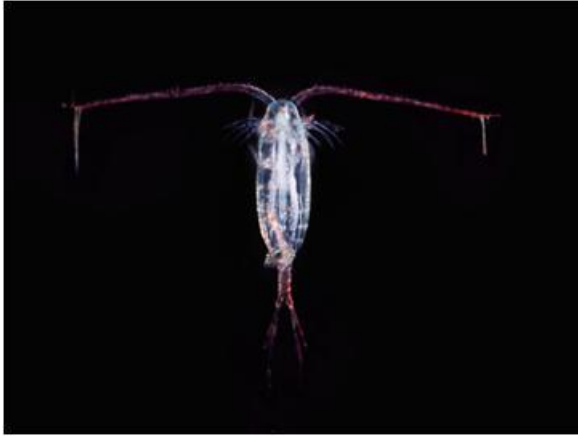


Predators – 15% mortality EVERY DAY

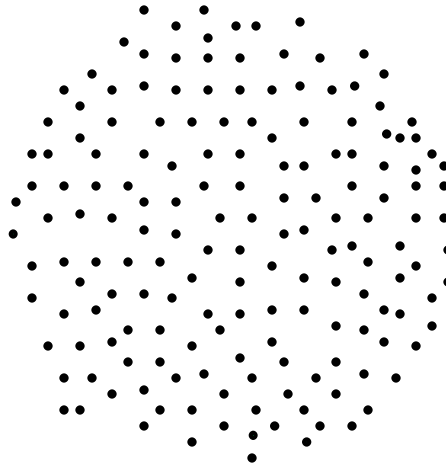


Day 4 – 201 larvae

Larvae into the wild...



Predators – 15% mortality EVERY DAY

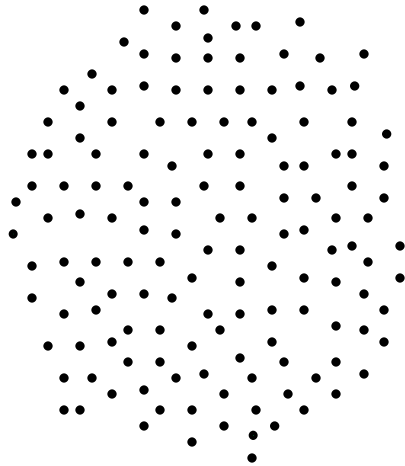


Day 5 – 175 larvae

Larvae into the wild...

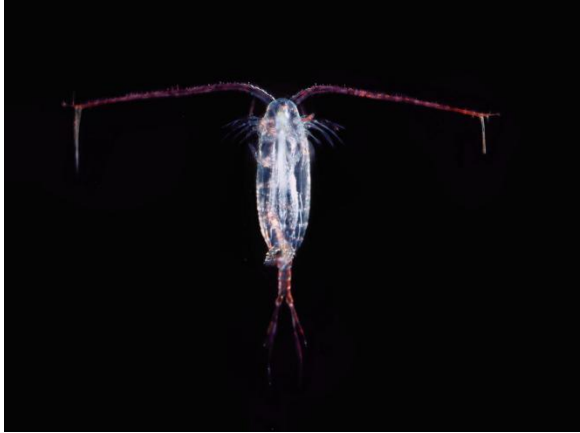


Predators – 15% mortality EVERY DAY

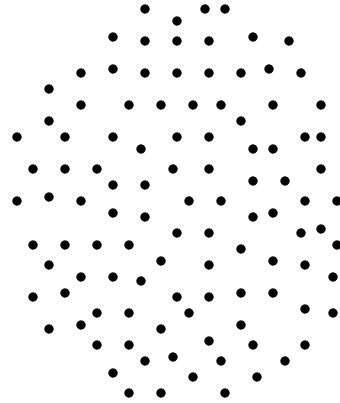


Day 6 – 152 larvae

Larvae into the wild...

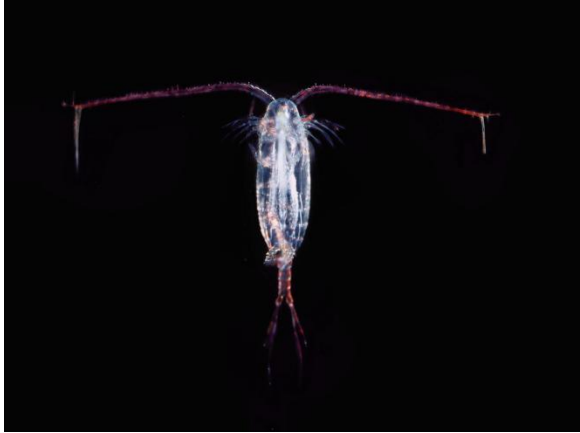


Predators – 15% mortality EVERY DAY

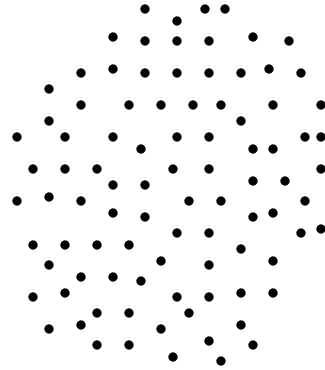


Day 7 – 132 larvae

Larvae into the wild...



Predators – 15% mortality EVERY DAY

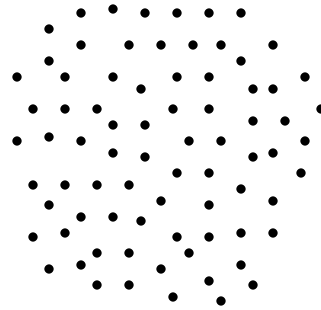


Day 8 – 115 larvae

Larvae into the wild...

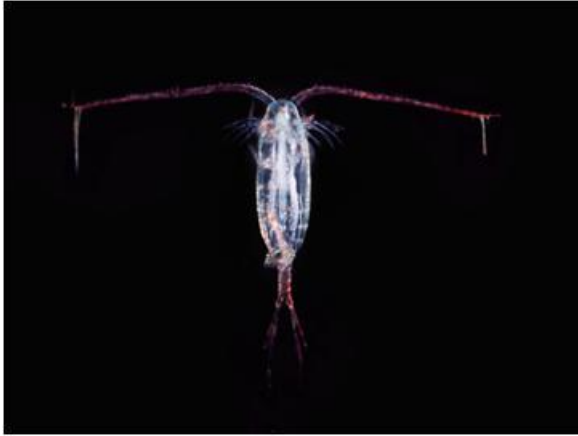


Predators – 15% mortality EVERY DAY

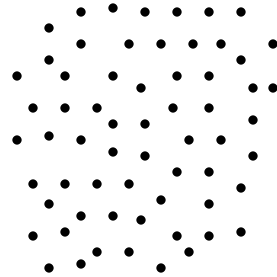


Day 9 – 100 larvae

Larvae into the wild...

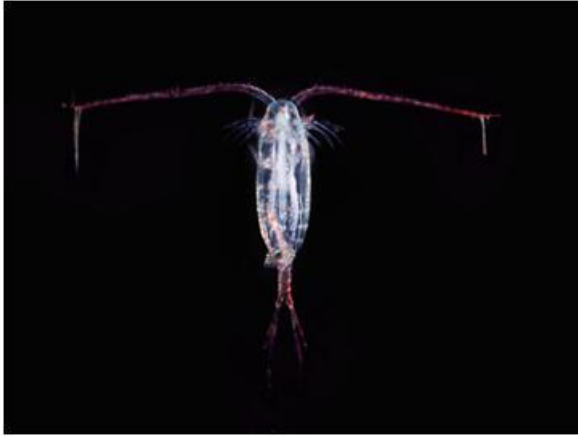


Predators – 15% mortality EVERY DAY



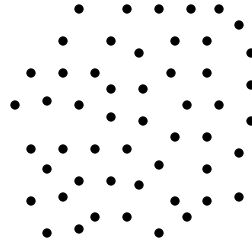
Day 10 – 85 larvae

Larvae into the wild...



Predators – 15% mortality EVERY DAY

Day 11 – 72 larvae

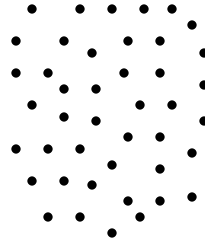


Larvae into the wild...

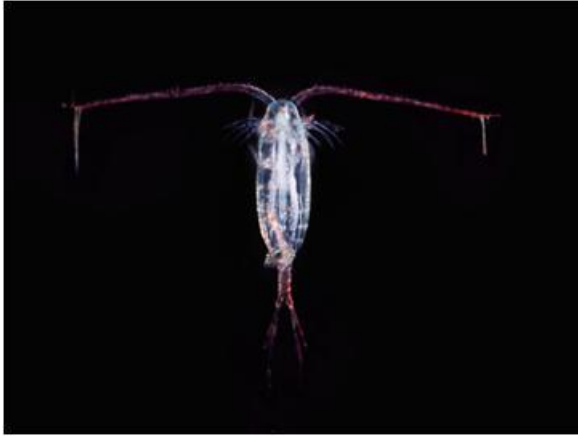


Predators – 15% mortality EVERY DAY

Day 12 – 61 larvae

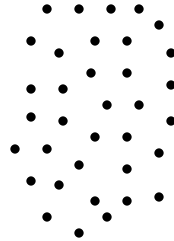


Larvae into the wild...



Predators – 15% mortality EVERY DAY

Day 13 – 52 larvae

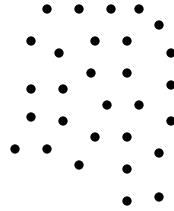


Larvae into the wild...



Predators – 15% mortality EVERY DAY

Day 14 – 44 larvae

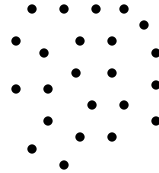


Larvae into the wild...



Predators – 15% mortality EVERY DAY

Day 15 – 38 larvae

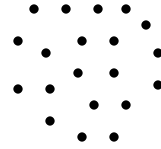


Larvae into the wild...

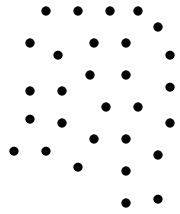


Predators – 15% mortality EVERY DAY

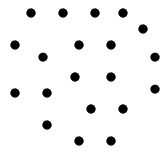
Day 16 – 32 larvae



Larvae into the wild...



Day 14



Day 16

2 days of delay

=

1/3 less larvae reach juvenile stage

For 1 female = 1000 juveniles (on 3700)



PART 4 – Economical significance

Direct economic cost



Paracentrotus lividus

Today (8.1) vs. Future (7.7)



indirect economic cost

Source of food



Conclusions

Ocean acidification WILL have impacts on marine species and ecosystems

This can be dramatic (species extinction)

It is complicated and we need more data

BUT WE NEED TO ACT NOW

**WHAT CAN YOU
DO?**

PART 6 – Human and CO₂ emissions

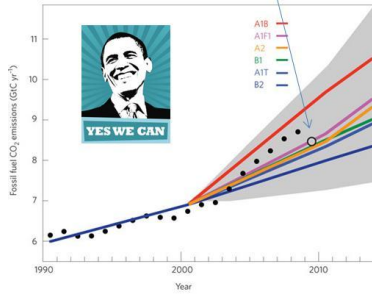
Economy drives CO₂ emissions



2009 Financial crisis

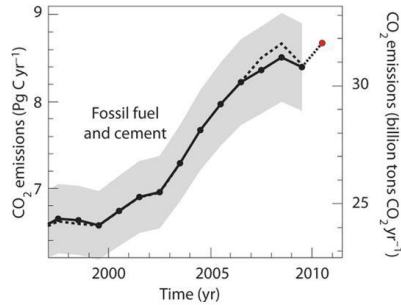
2010
New world record

03 June



Manning et al. 2010 Nat Geosc

21 November

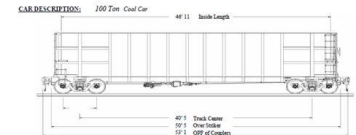


Friedlingstein et al. 2010 Nat Geosc

Humans release CO₂



1 car = 100 Tons of coal (80% C)

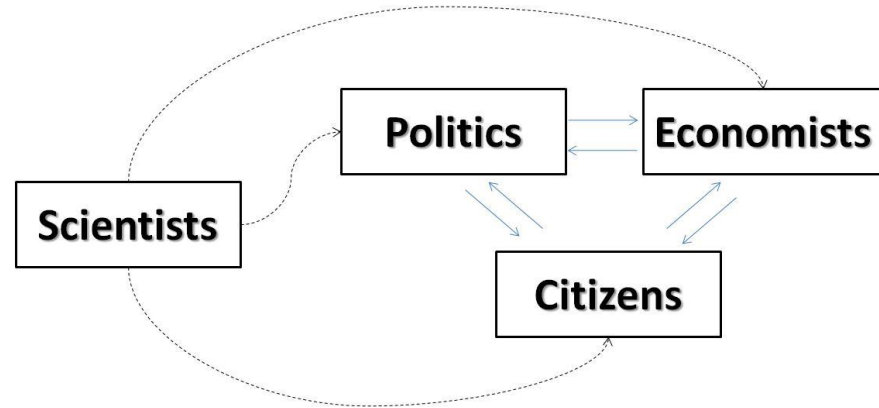


How long is the
“emission” train ???



What can we do? = decrease CO₂ emissions

- Spread the word



- Change our behaviours

Introduction

Where do you live? ?

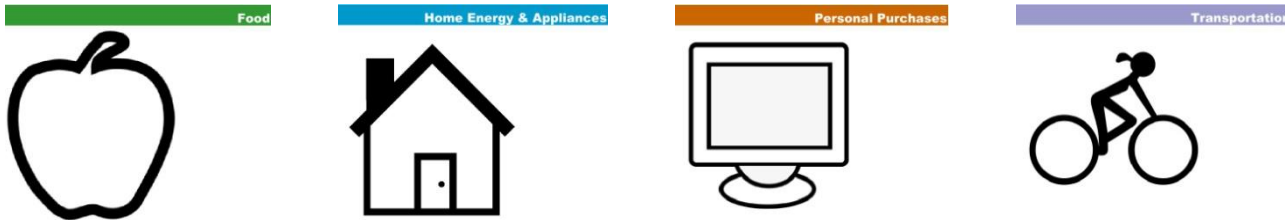
-- choose your country --

Enter Your Name

Please note that this carbon footprint calculator is currently under development. If you encounter any problems or mistakes, we apologize, but would love your feedback! Please email us at gester@stanford.edu ... thanks for trying it out!

Step 3

Carbon footprinting



- ✓ students' life style
- ✓ Takes into account user's location
- ✓ Synchronization behavior - emission

Introduction

Where do you live?



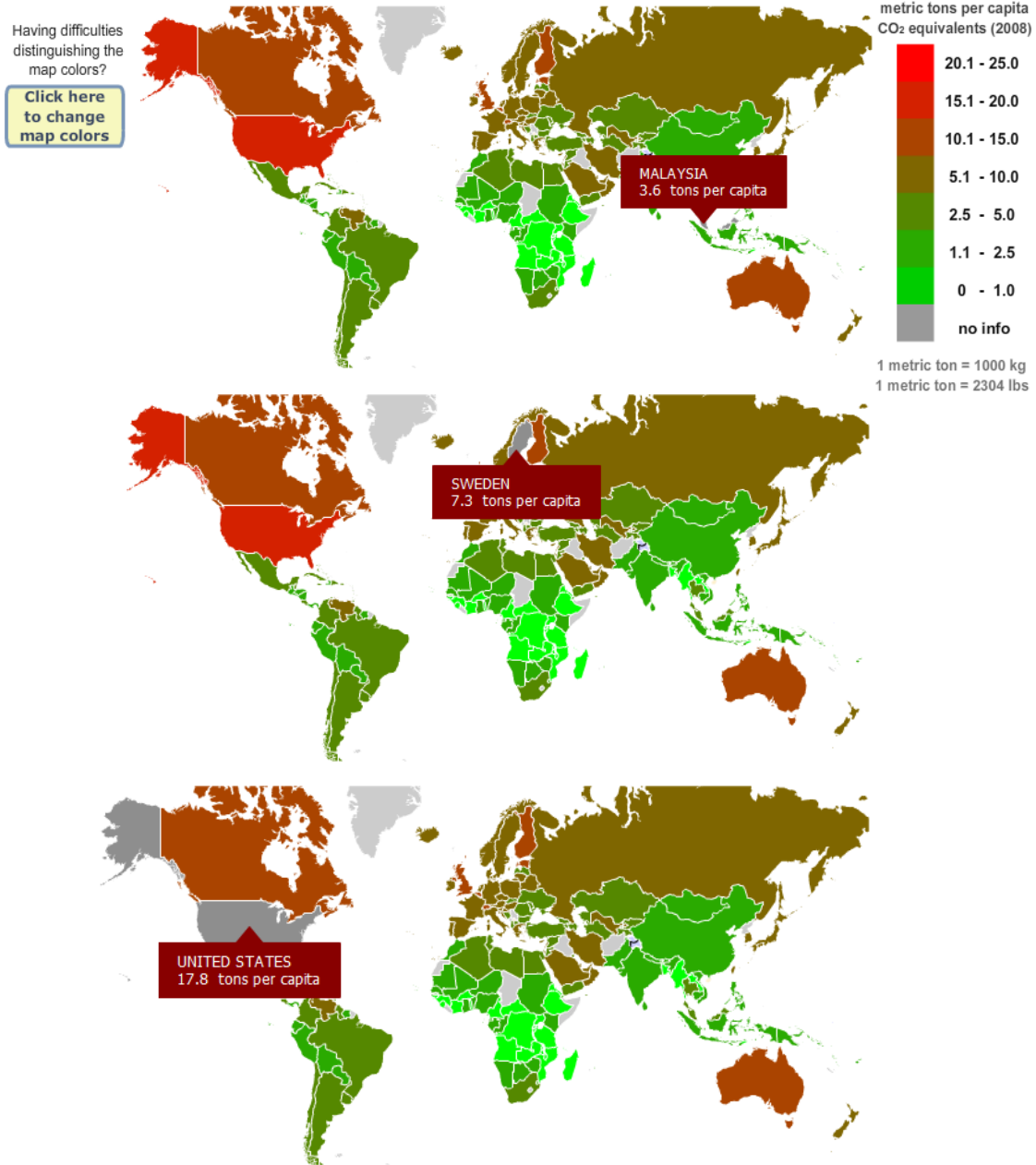
-- choose your country --

Enter Your Name:



Please note that this carbon footprint calculator is currently under development
If you encounter any problems or mistakes, we apologize, but would love your feedback!
Please email us at seastar@stanford.edu ... thanks for trying it out!

Compare your country's average carbon footprint



Average:



15286 pounds CO2 per year

Your total:



10311 pounds CO2 per year 4.7 T



Average:



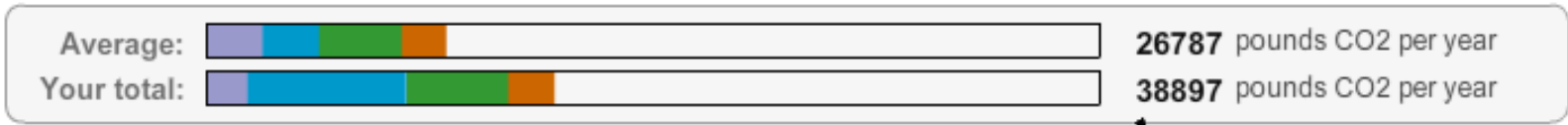
15286 pounds CO2 per year

Your total:



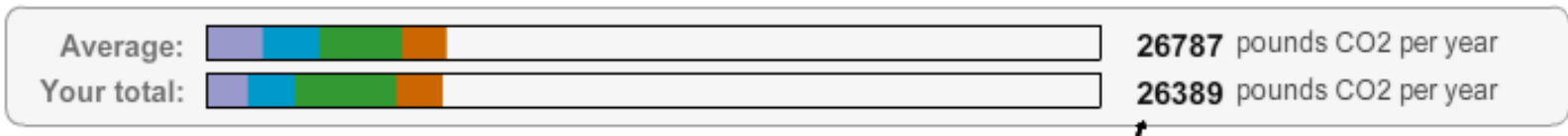
90877 pounds CO2 per year

Take a “bad” citizen



Teach him/her how to save energy

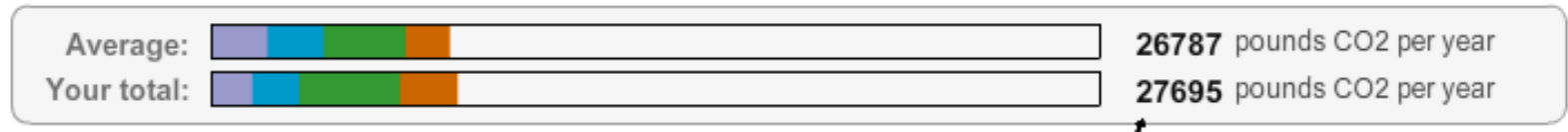
[e.g. turn off computers and electric equipment when not in use]



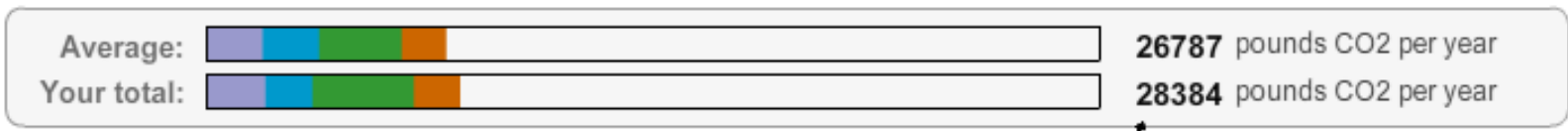
Save energy AND save money

Spend it for...

1) i-phone, computer, etc.



2) A city trip with Ryan Air



International Student Challenge



Get an international view on CO₂ footprint

Learn from each other

Envision solution together




International Students Carbon Footprint Challenge

20 classrooms in 13 countries:

- | | | |
|-------------|----------|-----------|
| USA | France | Sweden |
| Canada | Italy | Lithuania |
| Maldives | Slovenia | Poland |
| South Korea | Greece | |
| Belgium | Germany | |

Other resources

Education resources on OA

Type of resources	Evaluation
Passive information	
Movies	✗
Document, fact sheet	✗
Interactive information	
ask a scientist	✗
Blogs	✗
Voicethread	
Inquiry-based Learning	
Hands-on experiments	↑
Global Learning	✗
Creation of resources	✗
Virtual hands-on exp.	↑

NEXT: Step in Scientist shoes

Department of
Marine Ecology

STIFTELSEN
MARCUS OCH AMALIA
WALLENBERGS
MINNESFOND

Department of education,
communication & Learning

Virtual lab on OA:

- Run an experiment designed by someone else
- Short time activity

Scientist role play:

- Go through the whole scientific process
- Longer time activity

NEXT: Step in Scientist's shoes

Virtual world

Step 1: virtual lab on OA

Step 2: scenario of role play, choose the scientific field

Step 3: what parameters to measure, what variables to test with limitations (number of measure, of animal...)

Physical world

Step 4: raw data to interpret

Step 5: classroom discussion about the results

Step 6: give a talk

Please, join us !!!!

- ✓ I2I homepage: <http://i2i.loven.gu.se/>
- ✓ Carbon Footprint calculator: <http://i2i.loven.gu.se/NewFootprint/footprint.html>
- ✓ Ocean acidification virtual lab: <http://i2i.loven.gu.se/AcidOcean/AcidOcean.htm>
- ✓ Ocean acidification virtual talk: <http://voicethread.com/share/1978581/>



To contact me:
geraldine.fauville@loven.gu.se

