

Human Population 2018

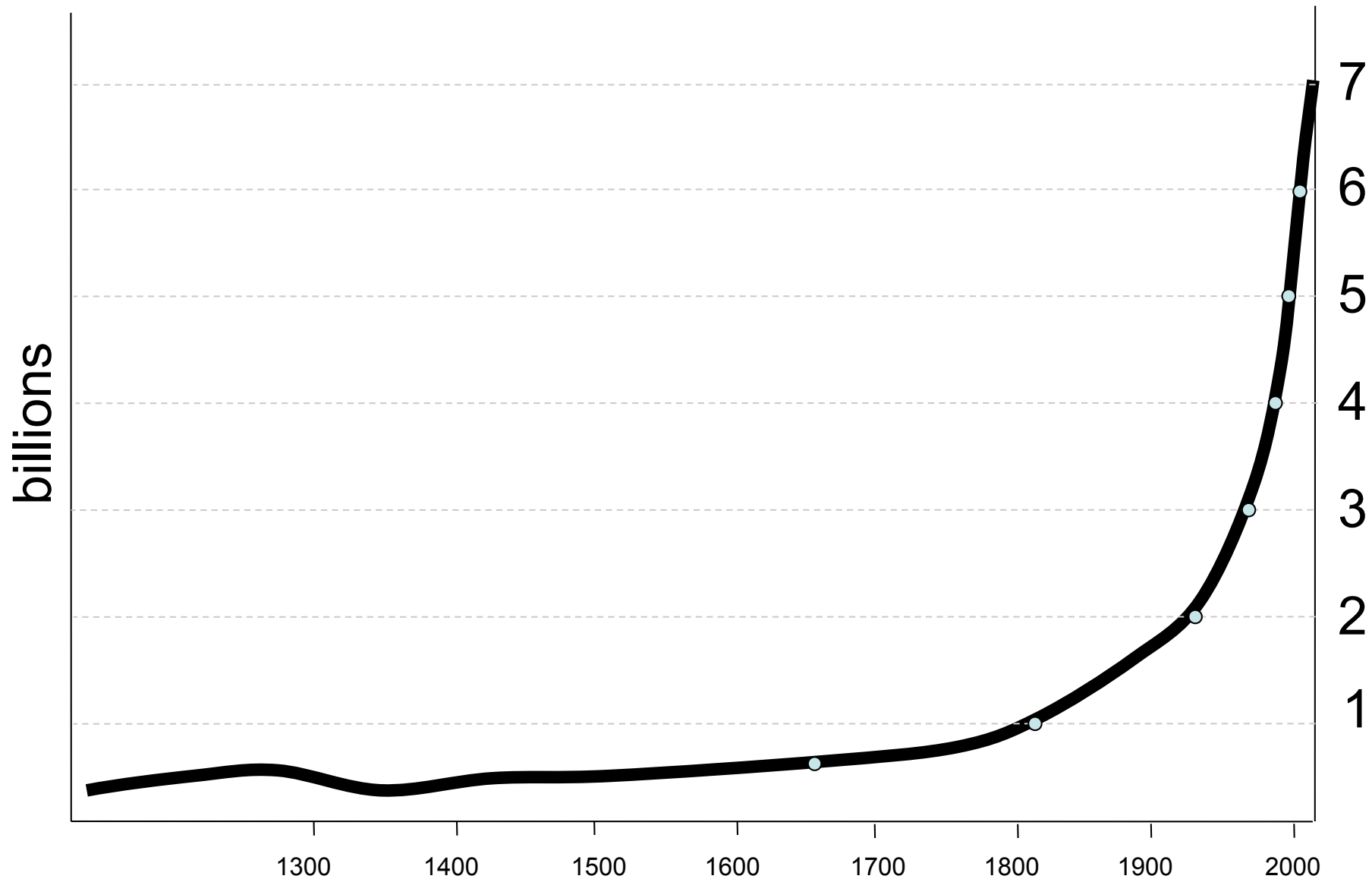
Lecture 1

My Worldview

Imagine a stranger strikes up a conversation with you. They say:

“Consider the following...”





**Global population is growing exponentially!**





**Cities are overcrowded**





**Oceans are overfished**

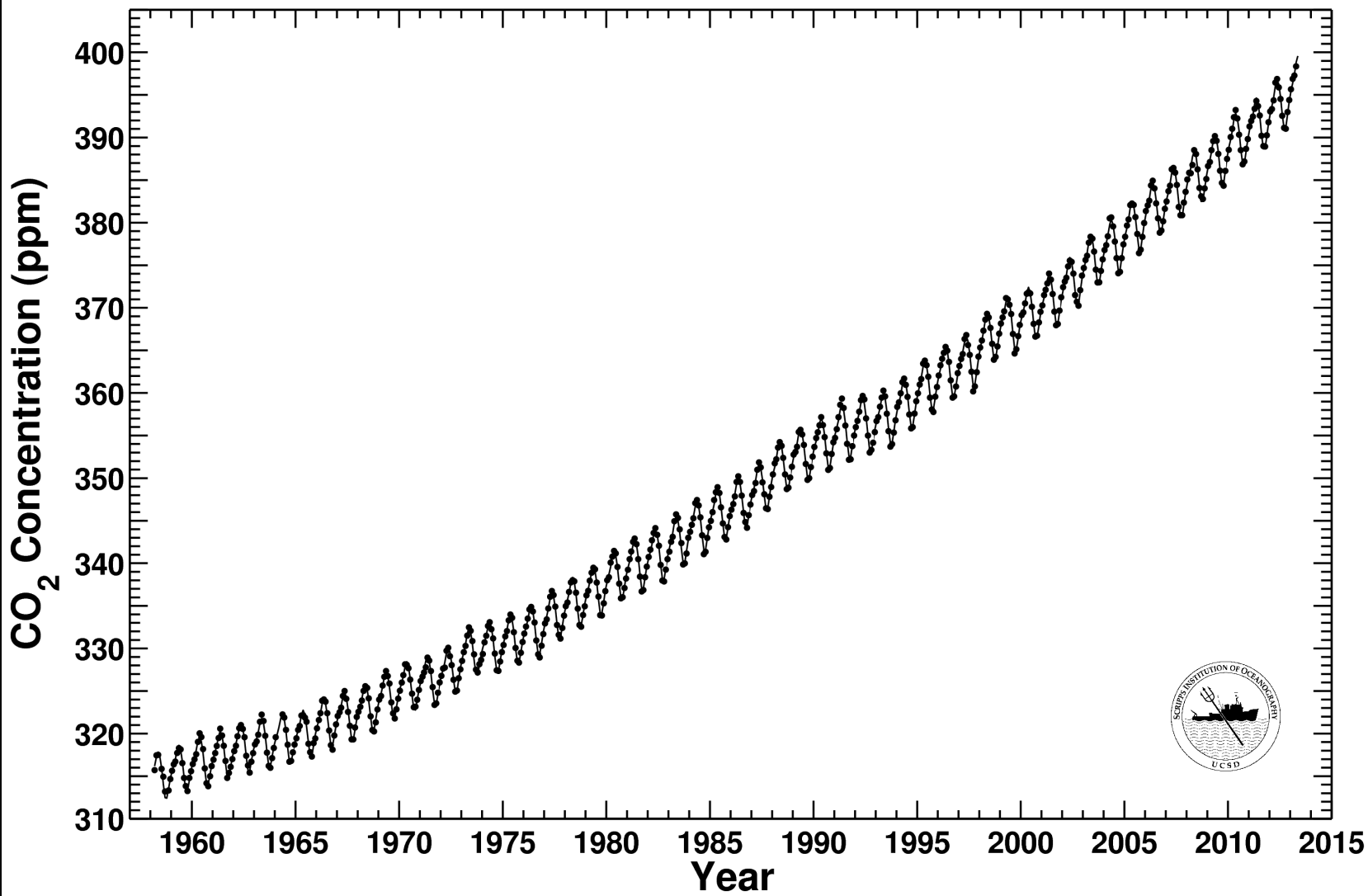




**Fertile farmland is disappearing**

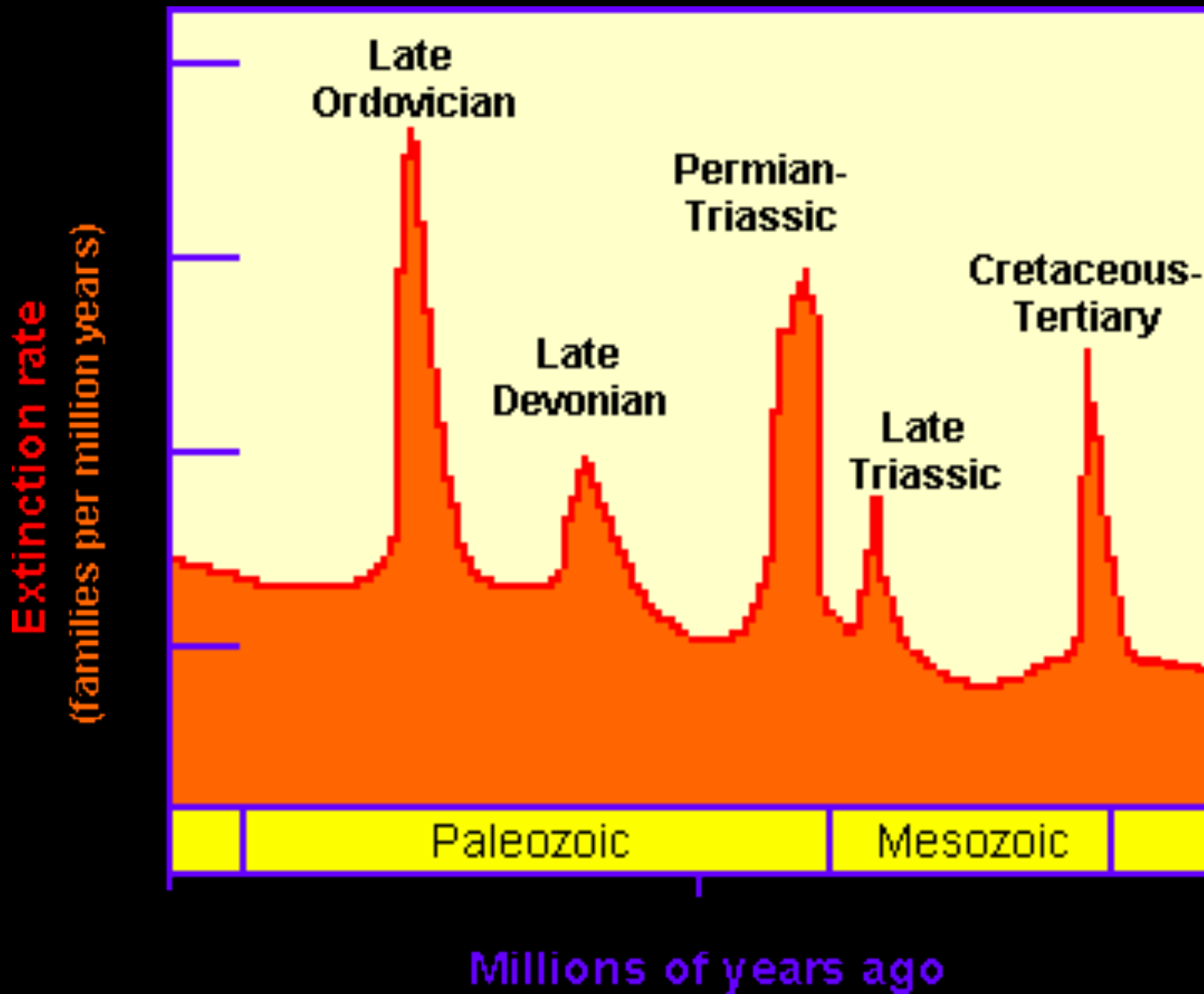
# Mauna Loa Observatory, Hawaii Monthly Average Carbon Dioxide Concentration

Data from Scripps CO<sub>2</sub> Program Last updated May 2013

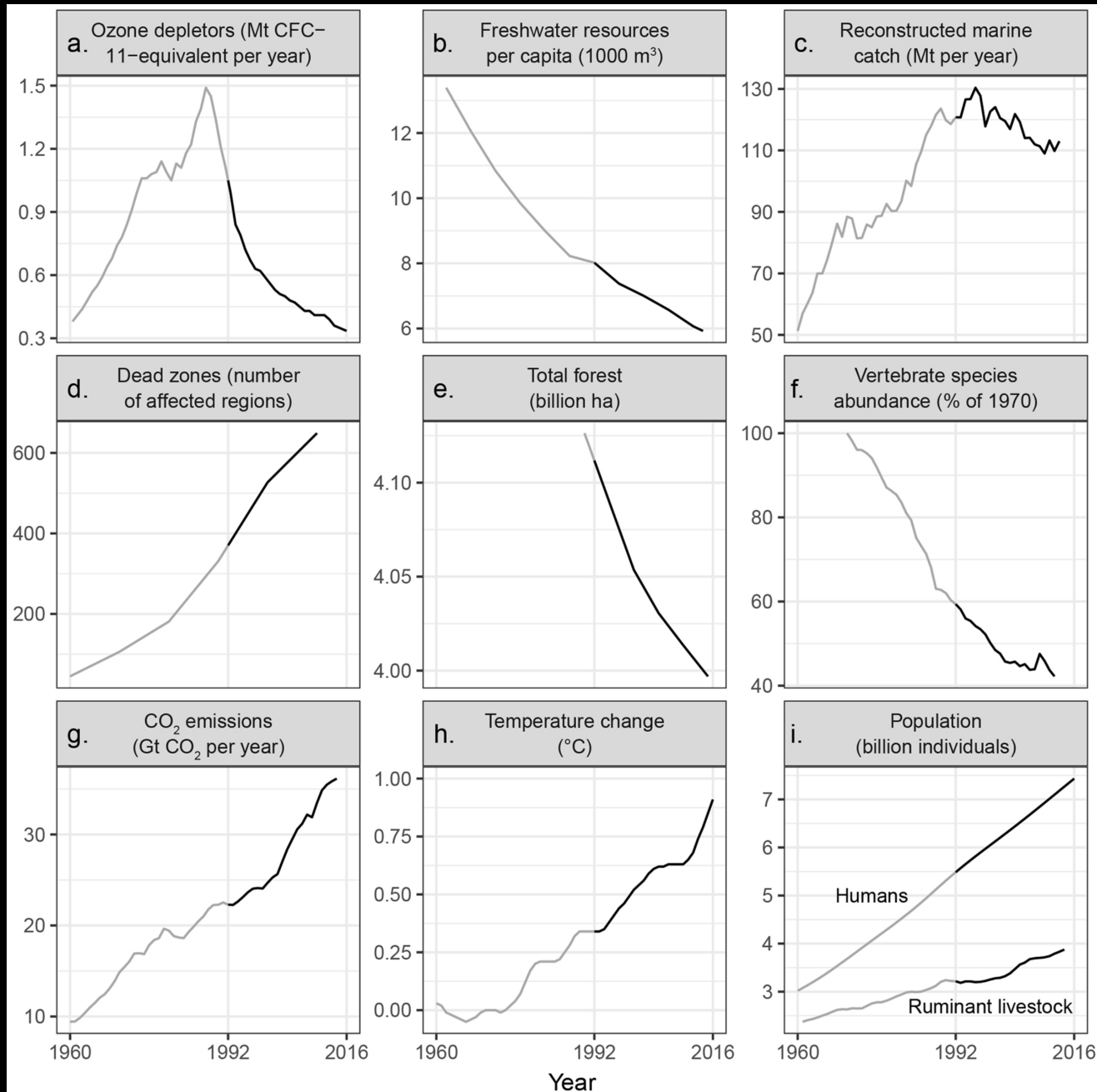


**the climate is changing**





**we are in a mass extinction event**



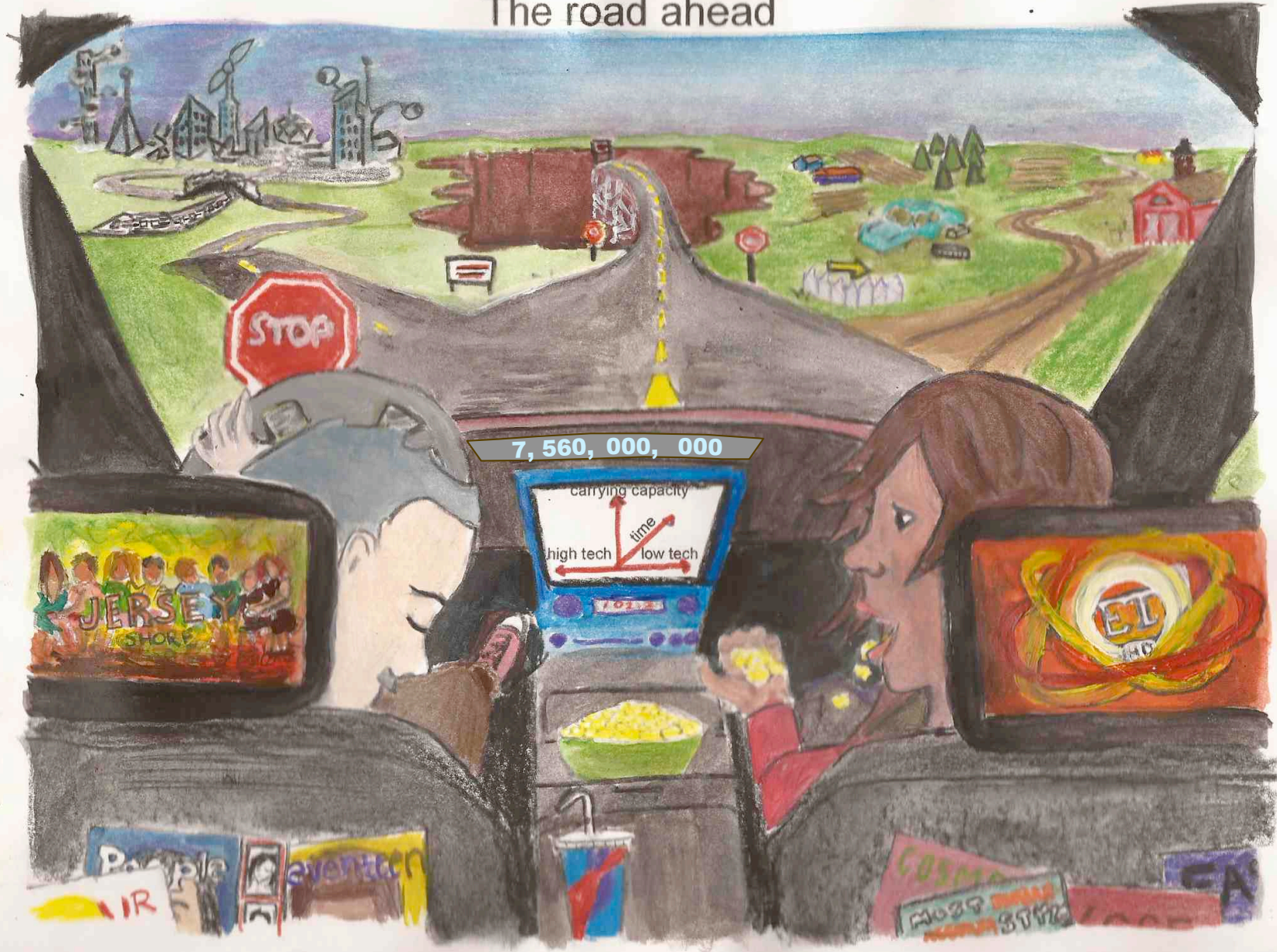
# everything points to disaster

From: World Scientists' Warning to Humanity: A Second Notice

BioScience. Published online November 13, 2017. doi:10.1093/biosci/bix125

BioScience | © The Author(s) 2017. Published by Oxford University Press on behalf of the American Institute of Biological Sciences. All rights reserved. For permissions, please e-mail: journals.permissions@oup.com

# The road ahead



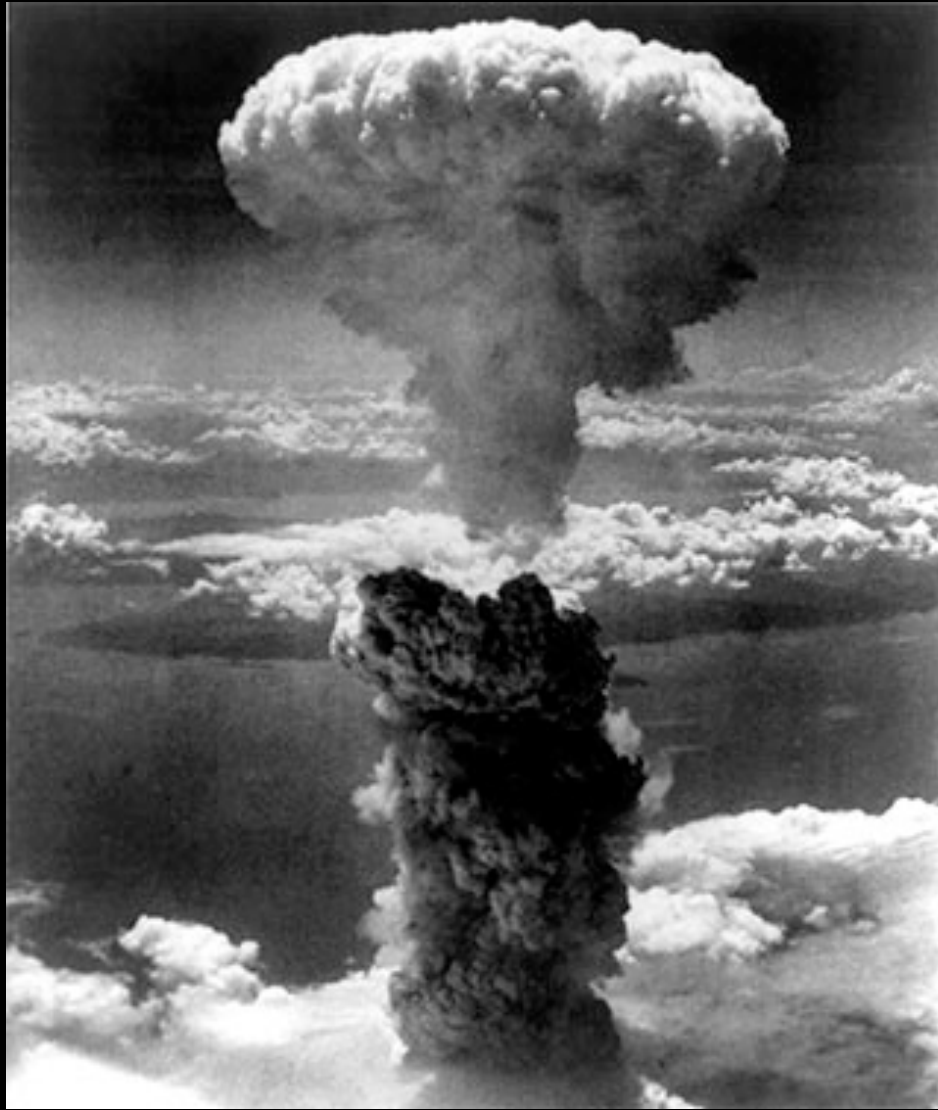
And, no one seems to be paying attention!



Anybody still listening?



How will it all end? Disease?



War?



Famine?



# How do you react?



## Choose one.

1. Continue eating and ignore him.
2. Look at watch. Make excuse. Get out of there as fast as possible.
3. Reassure them politely that population is not a problem.
4. Engage in an animated conversation about the-end-of-life-as-we-know-it.

# Is discussing population taboo?

- Absent in news.
- Absent in education.
- Absent in scientific research.
- Absent in policy making.
- Absent or misrepresented in economics.

Discuss discussing population



# Lecture 1

## My Worldview

# What is a worldview?

- Science
- Engineering
- Social
  - Political
  - Economic
- Local
- Global
- Religious

Description

Modeling

Needs

Peace

Leadership

Peace

Justice

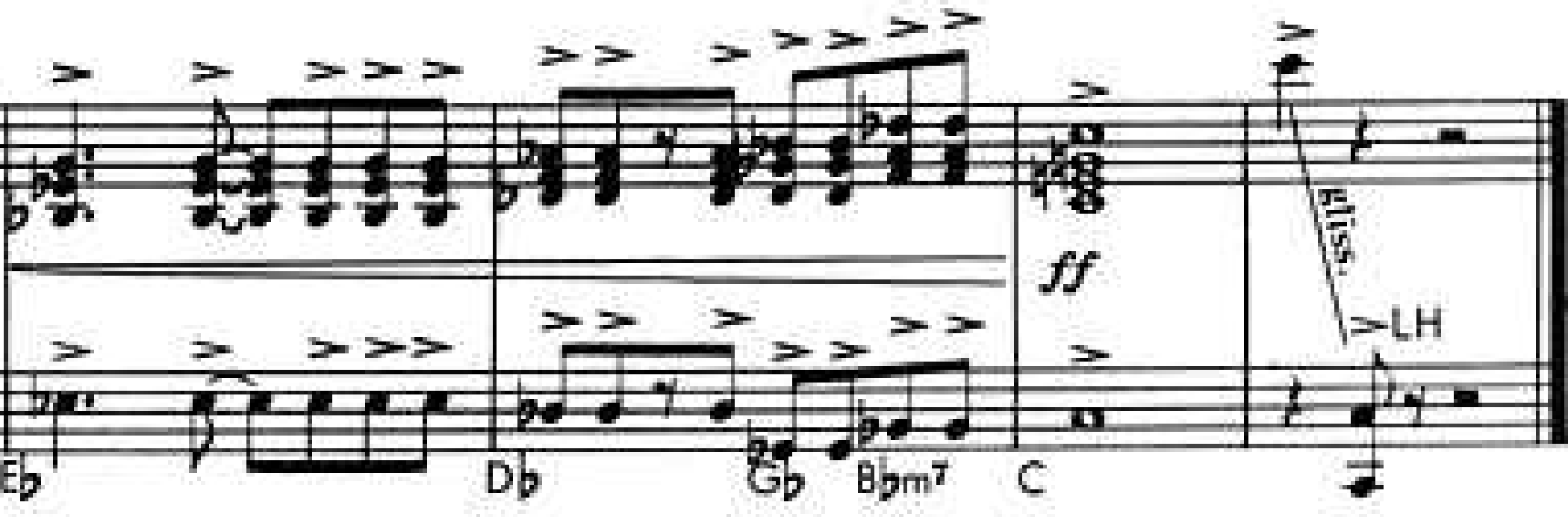
Family

Friends

Ethics

# My psychological worldview

***Musical Dissonance*** -- an uncomfortable feeling when notes or rhythms do not fall neatly into the current tonality.



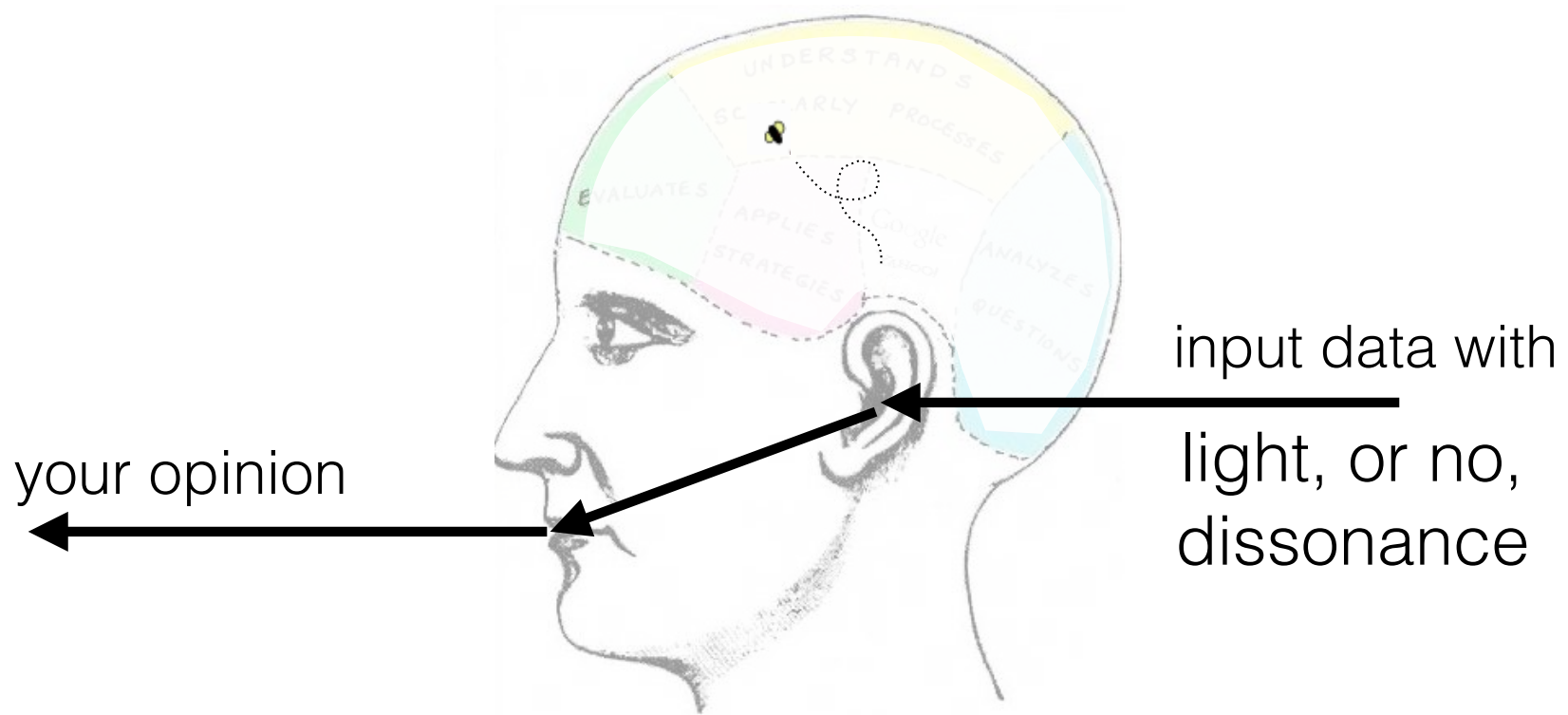
The image shows a musical score with two staves. The top staff contains a melodic line with various notes and rests. The bottom staff contains a bass line with notes and rests. The score is divided into measures by vertical bar lines. The notes are written in a standard musical notation style. The bass line includes chord symbols: Eb, Db, Gb, Bbm7, and C. The top staff has some notes that are not clearly defined, but they appear to be a sequence of notes that do not fit neatly into the tonality of the bass line, illustrating the concept of musical dissonance.

***Cognitive Dissonance*** -- an uncomfortable feeling when discussing data that does not fall neatly into current beliefs.

# Is there a psychology of dissonance?

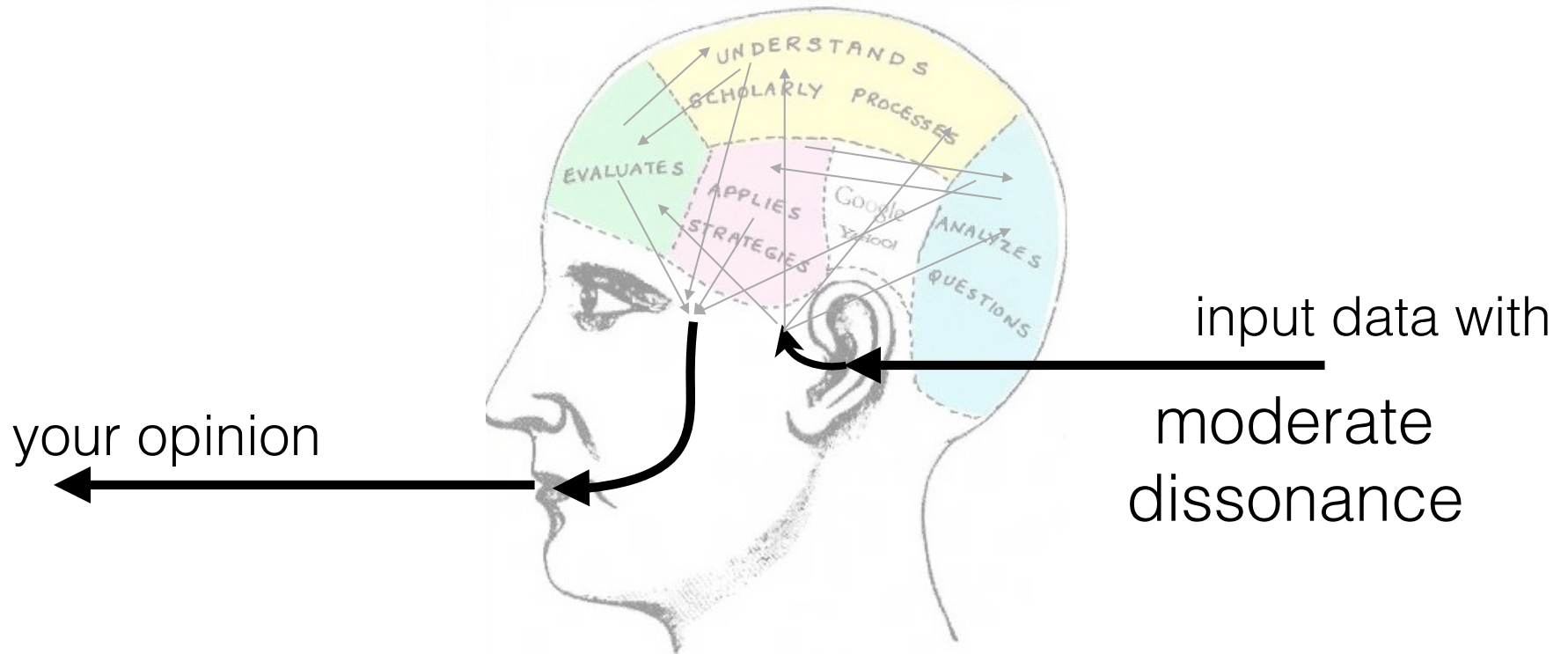
Level of Dissonance	...in Music	...in Science	Reaction...
low	row row row your boat	what is $2 + 2$ ?	just accept it.
medium	Bach tocatta	how does calcium cross the cell membrane?	study it.
high	Schönberg 12- tone row "music"	how do we solve the overpopulation problem?	flee.

# Repeating

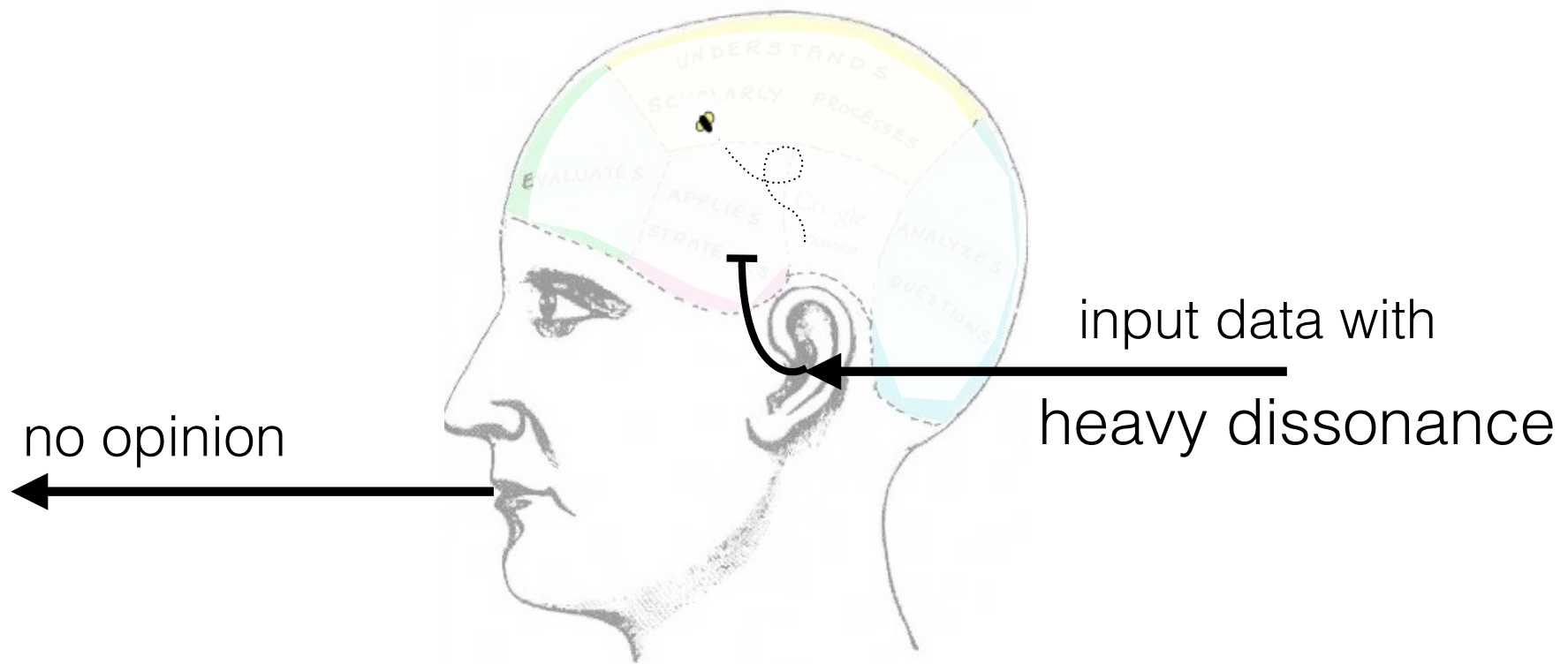




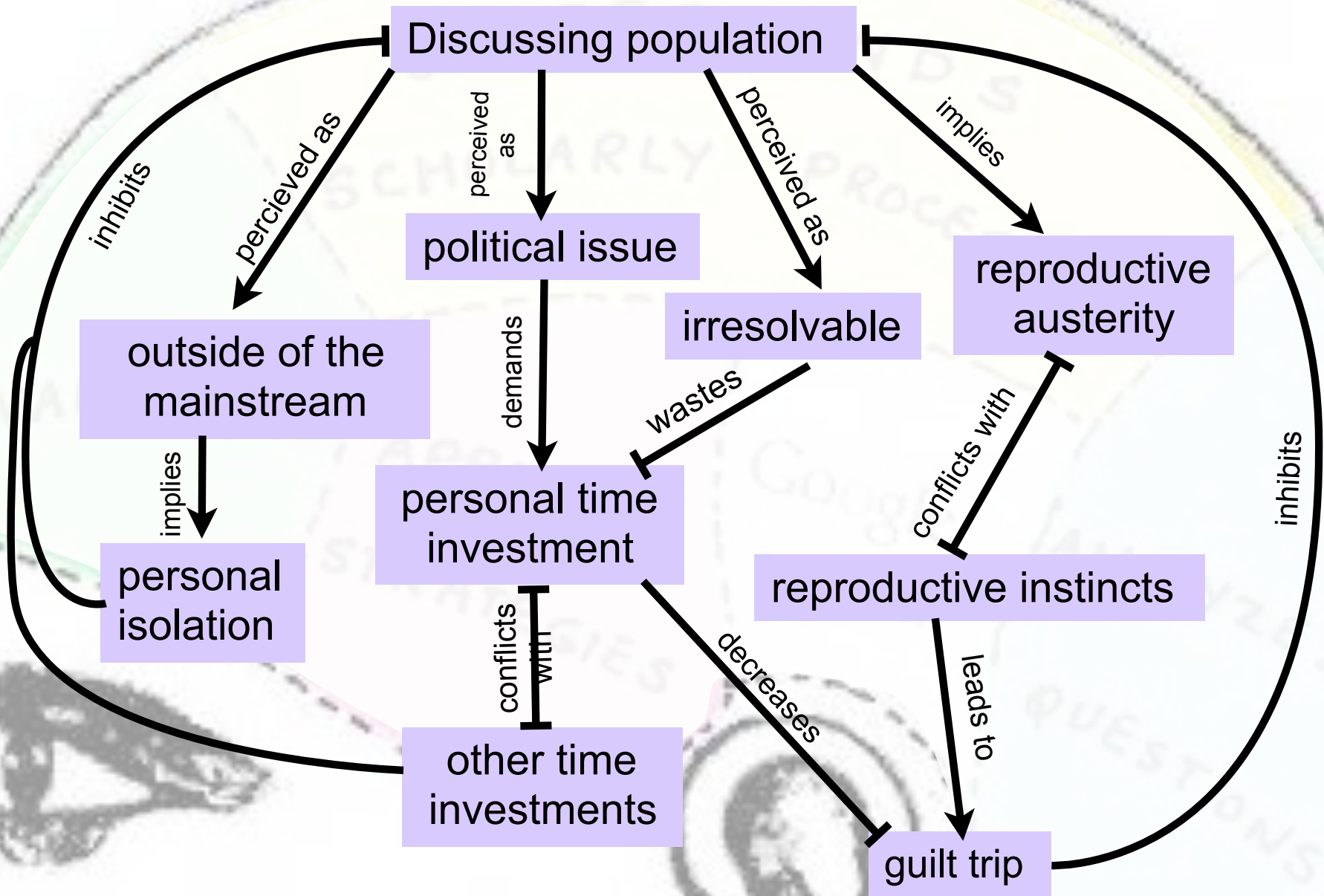
# Reasoning



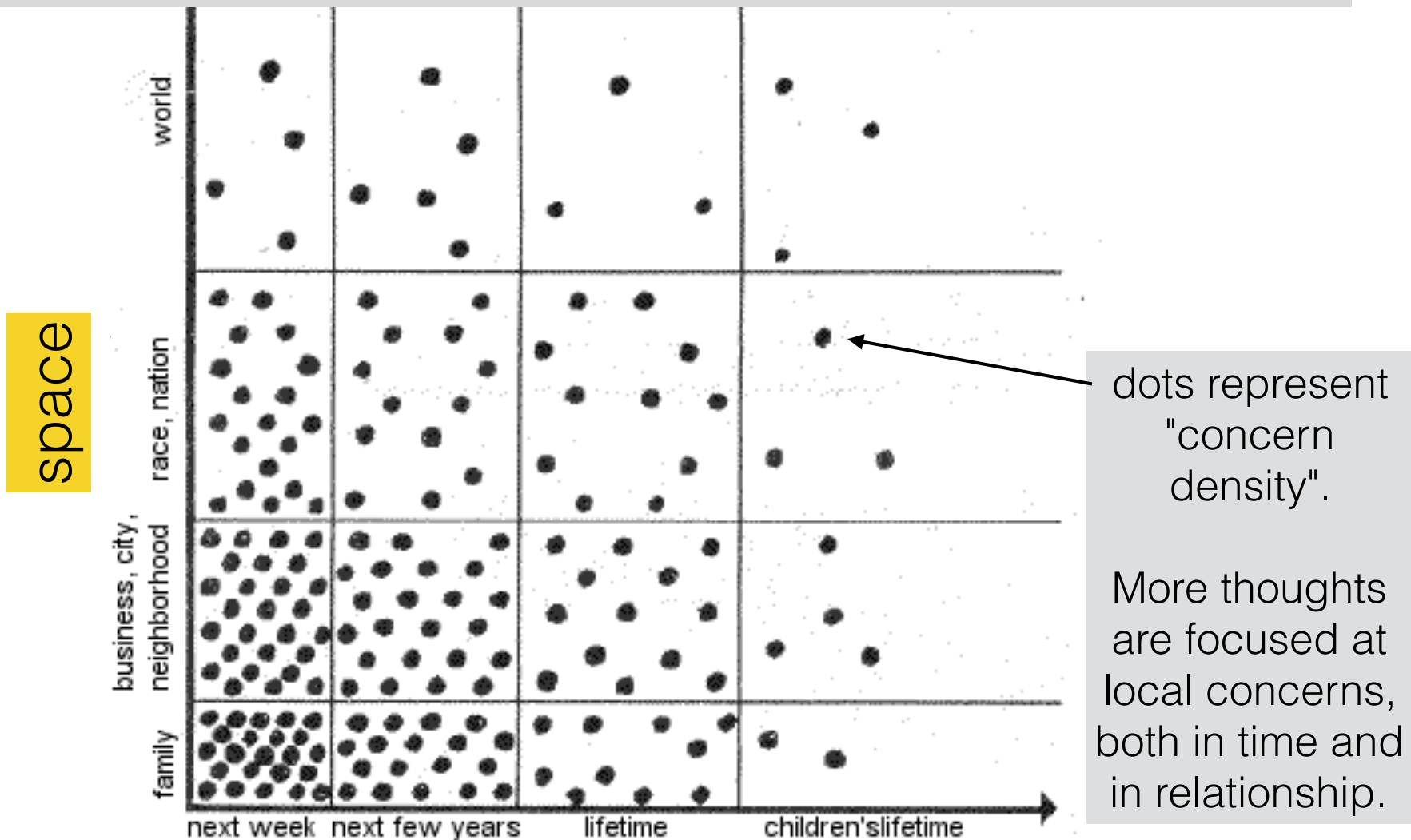
# Blocking



Careful consideration of population may lead to blocking!



# What do we reason about?





More psychological worldview

# Reasoning makes opinions convergence



C.S. Peirce

“the father of pragmatism”

If a proposition is true, then anyone who inquires ‘into the nature **of** reality’ (well enough and long enough) is fated to believe it.

And of a proposition is *false*, then anyone who inquires.. is fated to *disbelieve* it.

Given that knowledge is "*justified, true belief*" [Plato],  
then science leads to *common* knowledge.  
Common knowledge is a form of agreement.  
Agreement leads to peace.

## My process worldview

**What is science?**

# My process worldview

completeness

science is a process

- **Science** (from Latin *scientia*, meaning "knowledge") is a systematic enterprise that builds and organizes knowledge in the form of testable explanations and predictions about *the universe*.

hypothesis driven

science applies to anything, anywhere

science results in models

# My process worldview

## DIPA

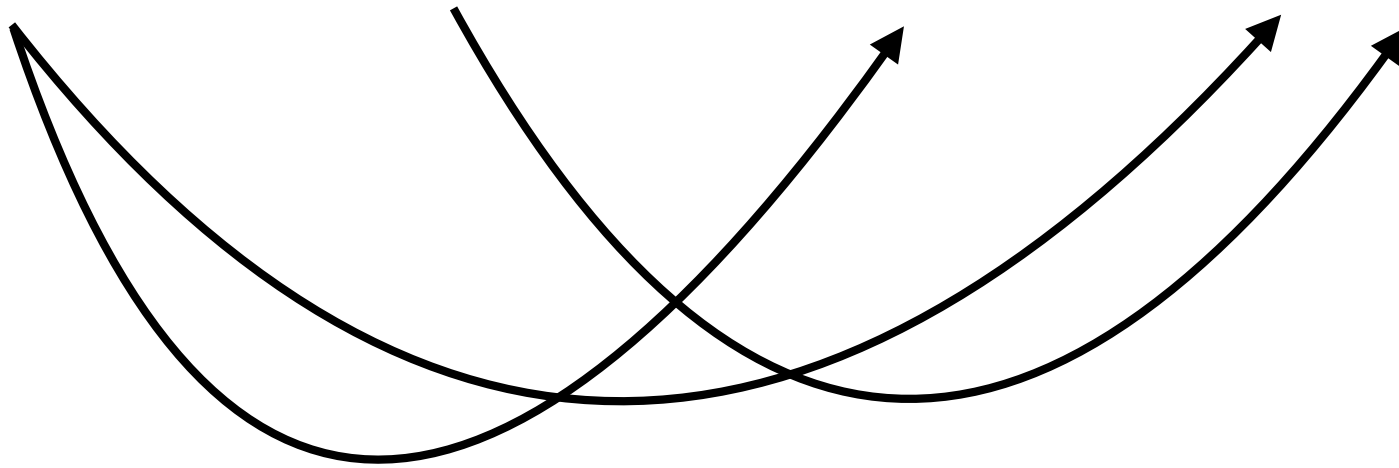
- Descriptive Data, information (or cited sources).
- Interpretive Models, explanations, analysis.
- Predictive Projections given *status quo*.
- Active Recommendations. Actions.

Note: A given statement may mix tasks. For example, “there are 7-billion people on the planet, so let’s stop breeding.” mixes Descriptive and Active tasks.



# Science is a stepwise process...

- Descriptive → Interpretive → Predictive → Active



Not proceeding methodically is called  
“Jumping to conclusions”

# Descriptive task

- Comprised of
  - data
  - and/or
  - *cited* data, model, or prediction.

e.g. If someone publishes a model, it is a **interpretive task** in the context of that publication, but it is considered data in the context of any publication that cites it.

- Marked by "is" statements. Tables. Graphs. Cited works.

- Descriptive → Interpretive

# Interpretive task

- Based on the data or descriptions of prior work.
- Result of Interpretive task is a "model".
- Models are simpler than data.
- Uses knowledge of system behavior (which is a type of data)
- In writing, marked by any kind of "what this means" statement.

- Descriptive → Interpretive → Predictive

# Predictive task

- based on the "model" (result of Interpretive task).
- predicts unseen data.
- results are "hypotheses."
- hypotheses may be validated by getting more data (i.e. by experimenting)
- Are generally future tense, "will" statements.



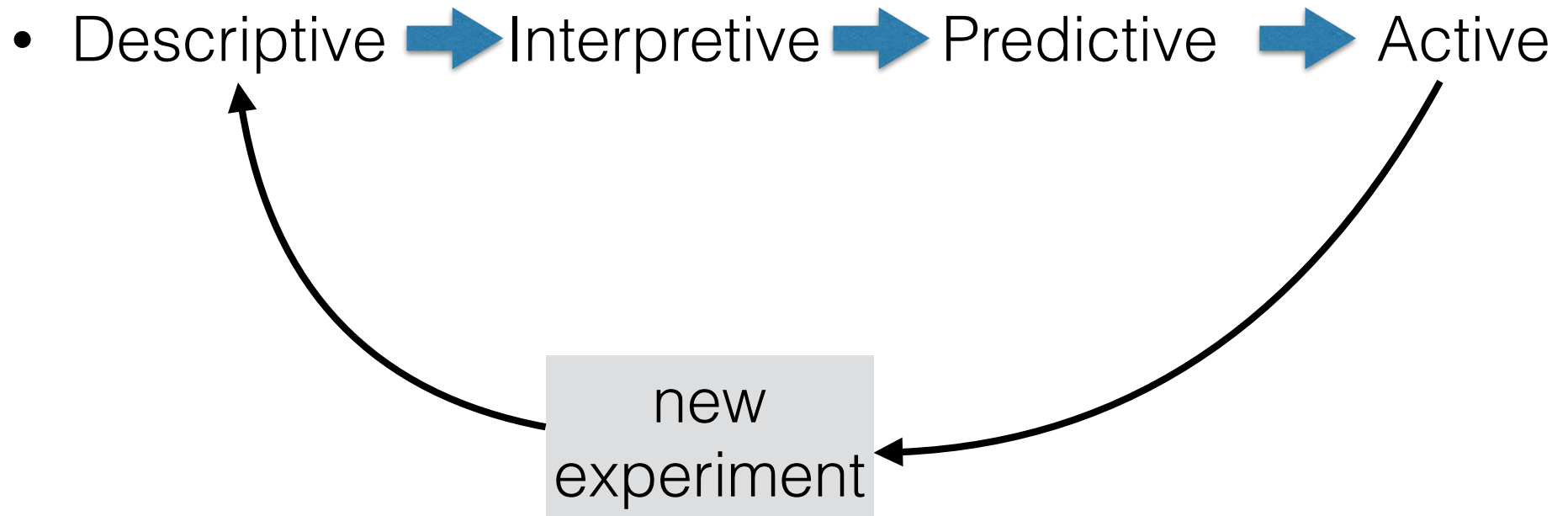
- Descriptive → Interpretive → Predictive → Active

# Active task

- based on predictions (results of Predictive task).
- invokes values, interests, desires.
- results are actions (i.e. experiments).
- may generate new data.
- Can be "would/should/could" statements.  
Recommendations for action.

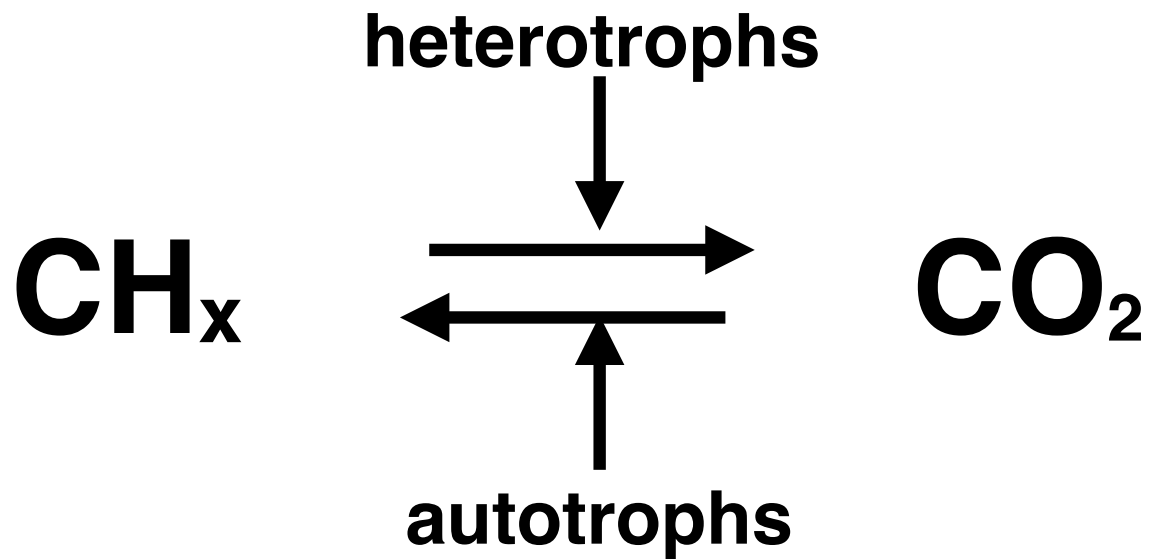
New cycle starts here!

# Science is a feedback process...



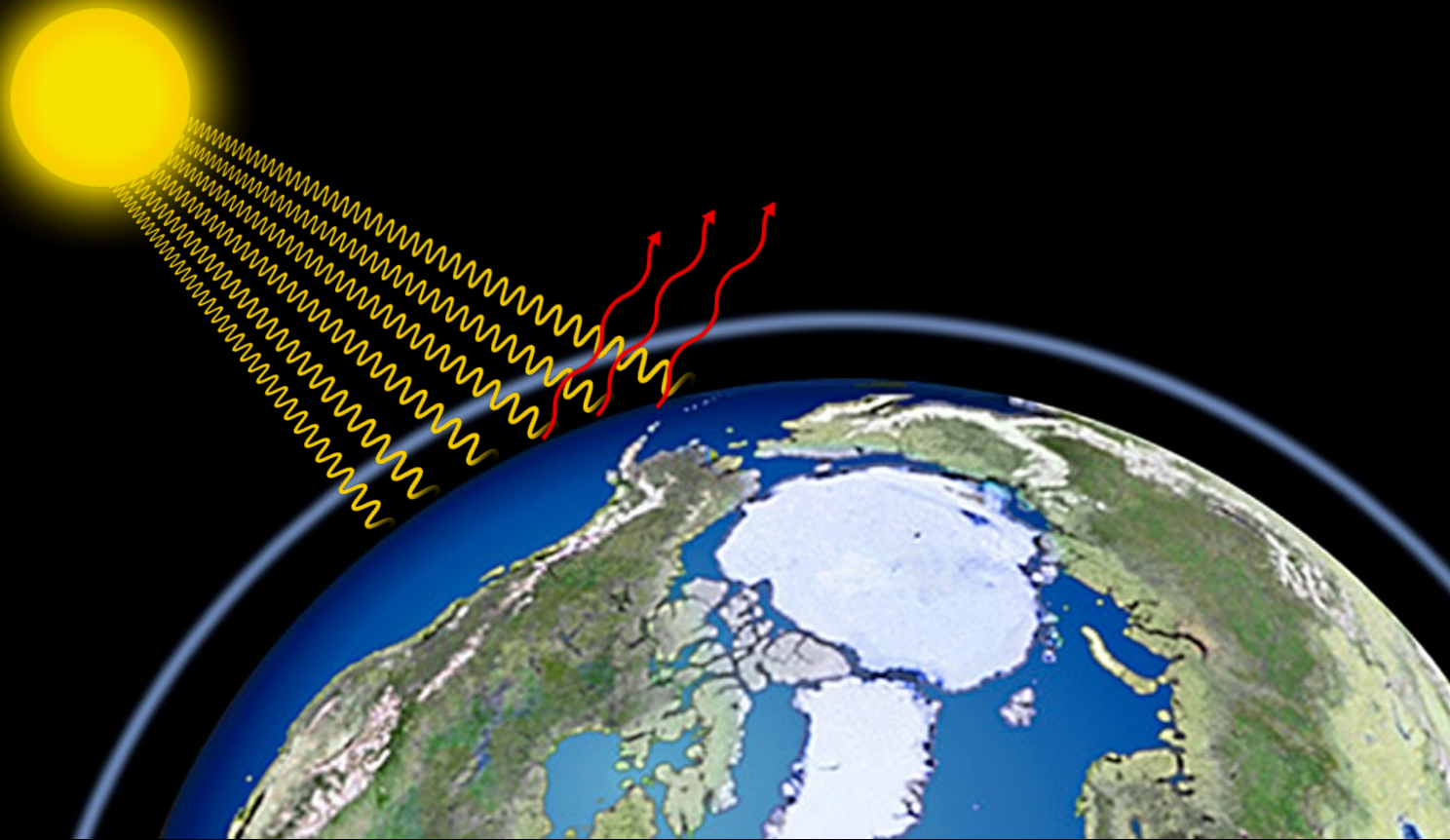
# My chemistry worldview

The global carbon cycle



Life catalyzes the oxidation/  
reduction of carbon.

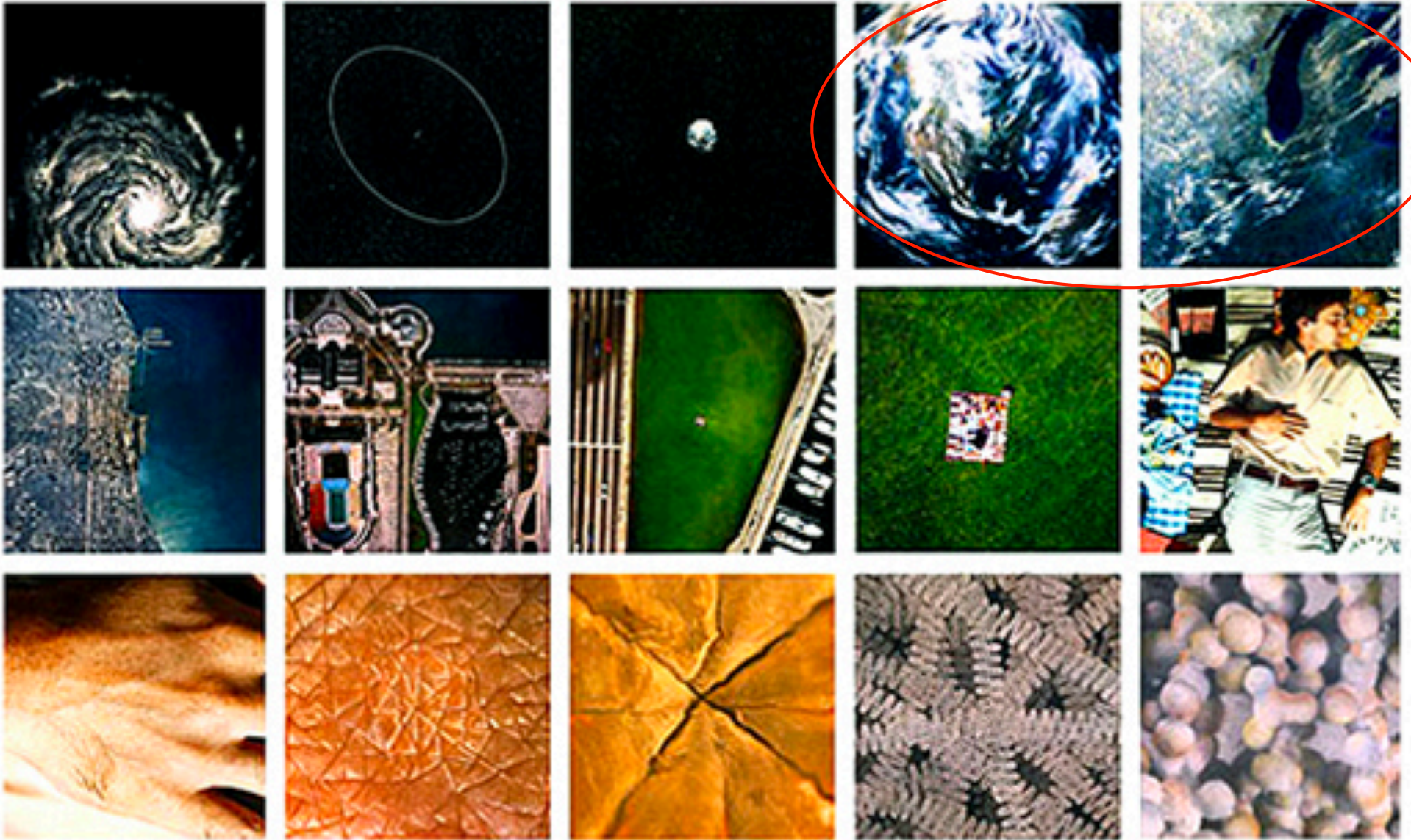
# My chemistry worldview



The Earth is a closed, non-adiabatic system.



Zoom out.



# Me

- **My psychological worldview** -- The brain is *not* wired for logic. (You have to train it to do that.)
- **My process worldview** -- Science is a step-wise cyclical process. (No jumping to conclusions.)
- **My chemistry worldview** -- The world is a closed non-adiabatic carbon cycle, catalyzed by life. (Zoom out to see the big picture.)

# Not my worldview:

- **Economics .**
- **Religion**
- **Politics**

# Course contents

- Here's what you signed up for...



Class meeting  
Lecture, date

# Syllabus

, Readings from *Limits to Growth*, *The 30-year Update*, unless otherwise specified. Read and submit questions. Homework due dates.  
Debate days (D),  
Presentations days (P),  
Modeling days (M)

1	My worldview	1/17			
2	Overshoot. InsightMaker: zombies	1/20	M	pp. 1-16	
3	Guest Lecture: Bram Van Heuveln: Logic and fallacy	1/24		vanHeuveln	HW1
4	Growth 1. linear, exponential, logistic	1/27	M	pp. 16-36	
5	Growth 2. hyperbolic. Debate prep	1/31	M	vonFoerster	
6	Debate 1: Doomsday.	2/3	D	pp 37-50	
7	video: How Many People Can Live on Planet Earth?	2/7		pp. 51-86	HW2
8	Ecological footprint. Sustainability.	2/10	M	Wackernagel	
9	Food webs, Food supply	2/14	M	Hopfenberg	
10	Non-renewables. Substitution. solar	2/17	M	pp. 87-107	
11	Guest lecture: Mimi Katz: Climate change.	2/24		NAS paper(s)	HW3
12	Debate 2. Pollution and sinks.	2/28	D	pp. 108-127	
13	World3. 1. Global systems	3/3	M	pp. 129-136	
14	World3. 2. Feedback	3/7	M	pp. 136-147	
15	World3. 3. Limits and Delays	3/10	P	pp. 147-162	
16	World3. 4. Oscillation and Collapse	3/21	P	pp. 163-179	HW4
17	Ethical dilemmas	3/24	P	Hardin	
18	Debate 3: Tragedy of the Commons	3/28	D	pp. 181-202	
19	Technology and Markets	3/31	M	pp. 203-234	
20	Predictions. Adaptations.	4/4	M	pp. 235-264	
21	Transitions. Messaging.	4/7	P	pp. 265-284	
22	video: Mother: Caring for 7 Billion	4/11	P	Uzochukwu	
23	Family planning	4/14	P	PamelaHerd	
24	Disavowal	4/18	M	Coole	
25	Millenium Development Goals	4/21	M	MDG	
26	Earth Week activity: TBD	4/25			
27	Term Projects 1	4/28	P		
28	Term Projects 2	5/2	P		
	Final exam				

# Grading

Essay/talk : 20%

Homework : 20%

Debates : 20%

Bring a question to class: 20%

Term project : 20%

## **Course web page**

[www.bioinfo.rpi.edu/bystrc/courses/biol4961](http://www.bioinfo.rpi.edu/bystrc/courses/biol4961)

# Debates

20%

Format: Karl Popper-style: Pro/Con

- 1 week prior : Get your assignment. Meet in groups, research the topic, come up with a strategy for defending your position.
- 3 days prior: Publish your arguments, one argument per debater. Work on cross-examination and rebuttals.
- Debate day: Present arguments. Present rebuttals. All are timed.
- Take questions from "Panel" (everyone else).
- Panel draws Argument Diagrams.



## Debates

20%

- *Sign up!*

BIOL 4961 Human Population

### Debates

Sign up for two (2) Debate Days. Select Affirmative for one date, Negative for the other. Topics and roles are to-be-determined. Look for the debate description on the course web page.

Created by:  Chris Bystroff 

Date (mm/dd/yyyy EST)	Available Slot	 Calendar View
02/02/2018 (Fri.)	Affirmative Team (4) Negative Team (4)	Sign Up <input type="checkbox"/> Sign Up <input type="checkbox"/>
02/16/2018 (Fri.)	Affirmative Team (3) Negative Team (3)	Sign Up <input type="checkbox"/> Sign Up <input type="checkbox"/>
03/06/2018 (Tue.)	Affirmative Team (3) Negative Team (3)	Sign Up <input type="checkbox"/> Sign Up <input type="checkbox"/>
03/27/2018 (Tue.)	Affirmative Team (3) Negative Team (3)	Sign Up <input type="checkbox"/> Sign Up <input type="checkbox"/>

# Course contents

# Reading

20%

Most class meetings have a reading, mostly from Limits to Growth.

**Set aside 1-2 hours for readings.**

When you have finished, write a question for class discussion.

Upload the question to the course web page.

	Slides	Title	When	How	Reading	Ask	HW
✓		Lecture <a href="#">1</a> My worldview	<a href="#">PDF</a>	1/17		<input type="radio"/>	
∅		Lecture <a href="#">2</a> Overshoot. InsightMaker: zombies	<a href="#">PDF</a>	1/20	M pp. 1-16	<input type="radio"/>	
∅		Lecture <a href="#">3</a> Guest Lecture: Bram Van Heuveln: Logic and fallacy	<a href="#">PDF</a>	1/24	<a href="#">VanHeuveln.</a>	<input type="radio"/>	<a href="#">HW1</a>
∅		Lecture <a href="#">4</a> Growth 1. linear, exponential, logistic	<a href="#">PDF</a>	1/27	M pp. 16-36	<input type="radio"/>	
∅		Lecture <a href="#">5</a> Growth 2. hyperbolic. Debate prep	<a href="#">PDF</a>	1/31	M <a href="#">VonFoerster</a>	<input type="radio"/>	

Select one of the readings and post a question or comment here

Type your email address

Enter a question on the checked reading

Submit your question Append

select

write

submit

If you submit again, it will append.  
Uncheck here to over-write. 47


# Bring a Question to Class

most days.

- If there is a reading for the day, ask a question.
- Question should be based on the reading.  
(If you don't submit a question, I assume you didn't read the assignment!)
- No need to make it a "hard" or "profound" question.
- Keep it a reasonable length.
- At the beginning of each class on Question days, read someone else's question and attempt to answer it.
- We will proceed pseudo-randomly until question time is exhausted.
- 20% of your grade is how many questions you upload.

# The Book

We will read the whole book! Get it.



**Meadows, D. "The Limits to Growth. The 30-year update" 2004.**

## Supplementary material (available on web site)

Diamond, J. (2005). Collapse: How societies choose to fail or succeed.

vanHeuveln: <http://www.cogsci.rpi.edu/~heuveb/Teaching/CriticalWisdom/Fallacies.htm>

Hardin, G. (1968). The tragedy of the commons. *Science*, 162(3859), 1243-1248.

Hardin, G. (1974). Commentary: Living on a Lifeboat. *BioScience*, 24(10), 561-568.

Hopfenberg, R., & Pimentel, D. (2001). Human population numbers as a function of food supply. *Environment, Development and Sustainability*, 3(1), 1-15.

Hardin, G. (1968). The tragedy of the commons. *Science*, 162(3859), 1243-1248.

Film: David Attenborough "How Many People Can Live on Planet Earth" (2011) (47 min)  
<https://www.youtube.com/watch?v=1oi9z1aZXBQ>

Von Foerster, H., Mora, P. M., & Amiot, L. W. (1960). Doomsday: Friday, 13 november, AD 2026. *Science*, 132(3436), 1291-1295.

Szekeres, D. (2012). United Nations Millennium Development Goals. Jura: A Pecs Tudományegyetem Állam-és Jogtudományi Karának tudományos lapja, 198.

# Essay/talk: Seven-minute science

20%

Sign up for **podium presentations** using Sign-up Genius (<http://www.signupgenius.com/>). No slides allowed. Talks should be 7 minutes with up to 5 minutes of questions/answers. Seven minutes is approximately 800 words or about three pages of text. Topics can be anything relating to human population. Present and attribute your data, construct an explanatory model, and predict future data, events or outcomes. Finish with a well-justified recommendation for future actions, such as studies, policies or experiments.

Essays will be graded on **clarity** and **content**. Clarity will be assessed by (1) correct **word usage**, (2) correct **sentence structure**, (3) correct **paragraph structure**, and (4) correct **essay structure**. Content will be assessed by (1) **logical progression** of statements, (2) **evidential support** of statements, (3) **correct attribution** of evidence, (4) **balance** of scientific "tasks".

Essays are text only, with citations and bibliography, in **Word** or **Pages** format.

Students are encouraged to visit the *Center for Communication Practices* in the Folsom Library to improve their skills in writing.

Sign-up for **two** 7-minute science presentations on Sign-up Genius (see email invite). One early, one late.





# Course contents

20%

## Homework: systems dynamics models

1. Insight1: Zombies. (Jan 23)
2. Insight2: Demographic transition theory (Feb 6)
3. Insight3: Human Development Index (Feb 23)
4. Insight4: Ecological Footprint (Mar 9)
5. Insight5: IPAT (Mar 30)



**\*Make InsightMaker account today!! Send me your username. You will be added to "Human Population at RPI" InsightMaker group**

# Term Projects

20%

Connect population to a specific current event using a systems dynamics model. Present your work with slides. Predict the future! Design experiments or propose actions.

Work in groups of 2.



# Course rules

# Academic honesty

Confirmed plagiarism, defined as unattributed use of published material, whether egregious or unintentional, will result in penalties as follows: First time "F" on assignment, 2nd time "F" in course.

*Dual submission:* Copying is a form of plagiarism. The first incidence of confirmed copying will result in a "F" on the assignment for both parties. A second incidence will result in an "F" in the course. (*Does not apply when working in groups and all authors names are on the paper.*)

## **Unexcused absences:**

This is a participatory course. Attendance is required. Each unexcused absence will result in a 3% grade reduction. Documentation for excused absences is processed by the Student Experience Office, 4th floor Academy Hall, x8022, [se@rpi.edu](mailto:se@rpi.edu).



# **Avoid semantic arguments**

Science requires that things be defined. We use words to define things. Words should have unique definitions to the extent possible. The alternative is confusion.

# **Treatment of student ideology in the classroom**

This course deals with a sensitive subject for some religions and other ideologies. Students will not be graded on their religious views, political leanings or opinions in general. Religion and politics may be discussed where it is relevant to the course, but every attempt should be made to ensure that religious topics and political views are treated with respect, objectivity and non-judgement. Any student who uses this course as an opportunity to judge any religious doctrine or ideology will be warned and possibly graded down. Any student who uses non-falsifiable statements tied to ideology will be gently warned and may be graded down.

# Office hours

- Fridays 10-12am
- J-Rowl 3c07
- or **by appointment**
- Send email! I always answer. Or call x3185.

## **For next time:**

- Read the assignment
- Submit a question
- Make an account on InsightMaker
- Bring a laptop computer to class.