



LUDWIG-  
MAXIMILIANS-  
UNIVERSITÄT  
MÜNCHEN

COOPERATION: HOW TO MODEL IT, HOW TO FOSTER IT, AND HOW IT MIGHT HAVE EMERGED

# COOPERATION IN THE FIELD

Adrian Haret

[a.haret@uva.nl](mailto:a.haret@uva.nl)

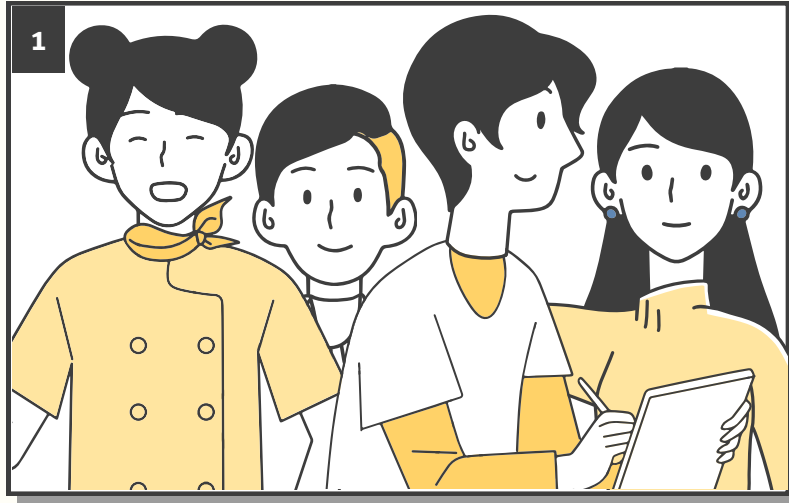
November 2-9, 2023

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A breakdown of what we'll be  
focusing on.

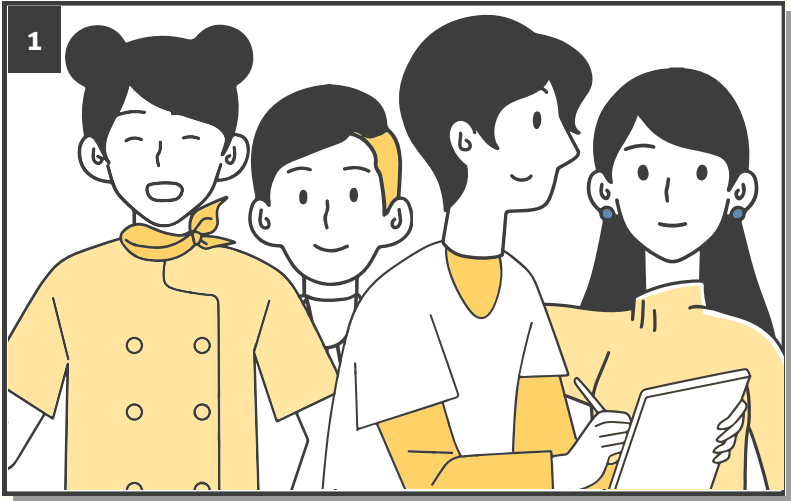
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# The Story of Cooperation

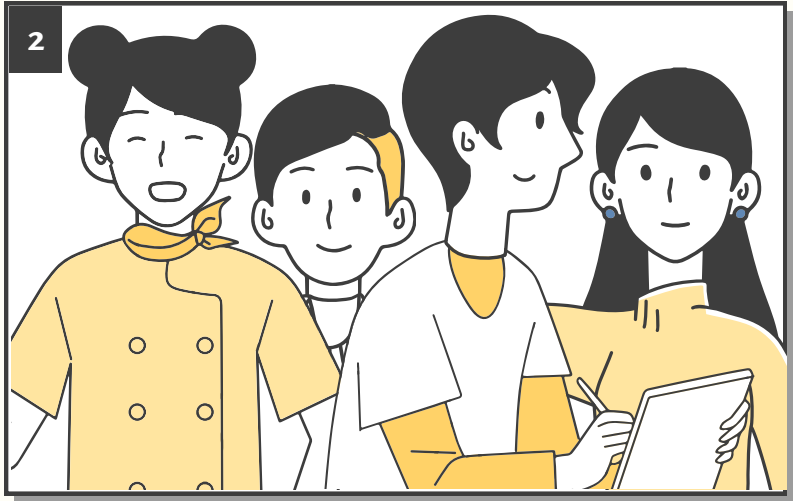


Cooperation is everywhere among living things.

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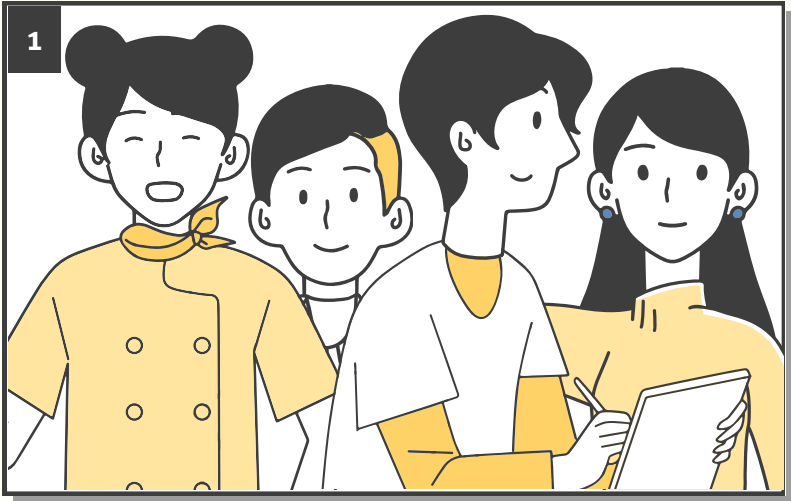
1  
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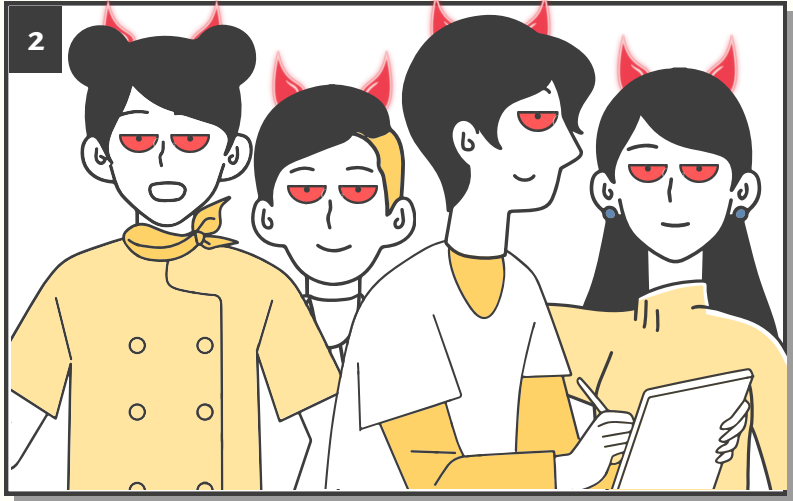
2  
???  
But how, when everyone is in it only for themselves?



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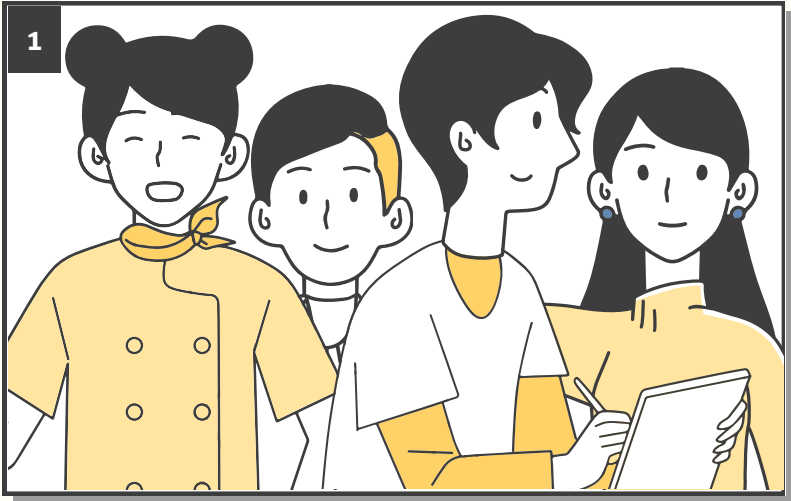


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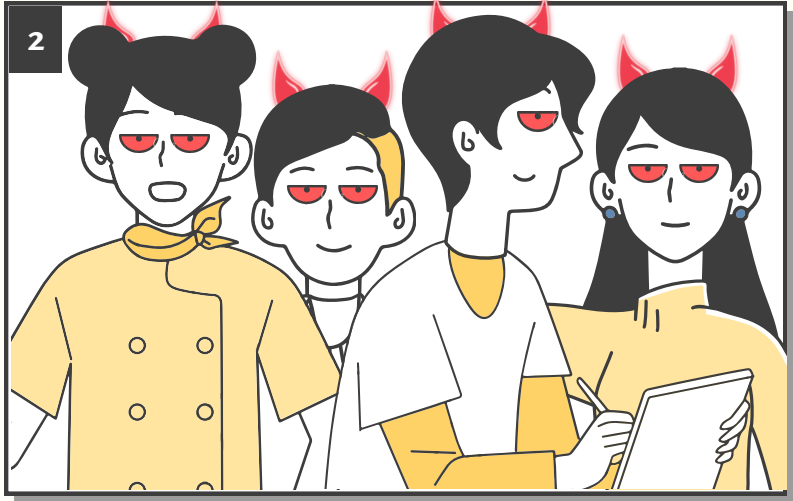


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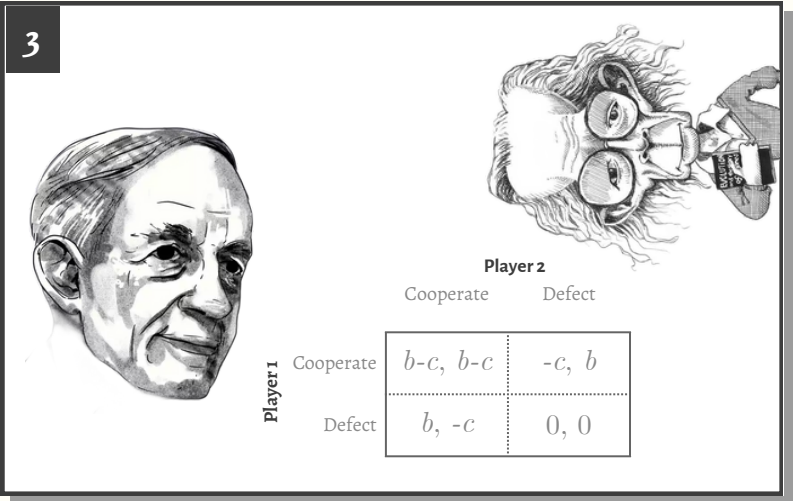
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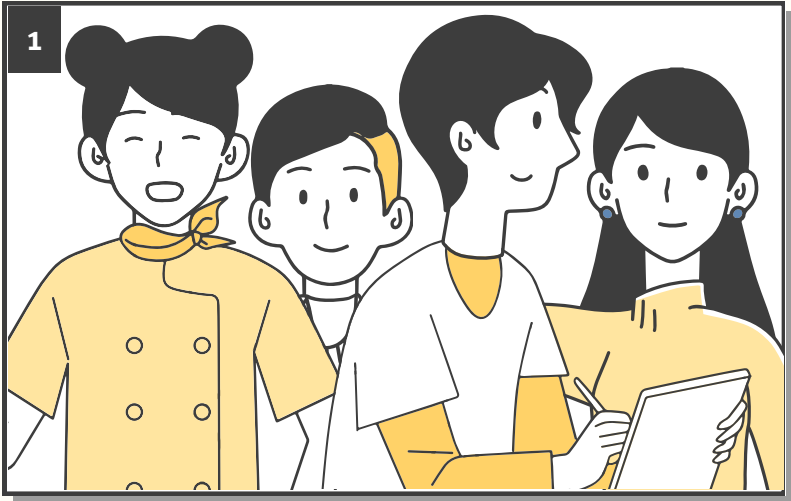


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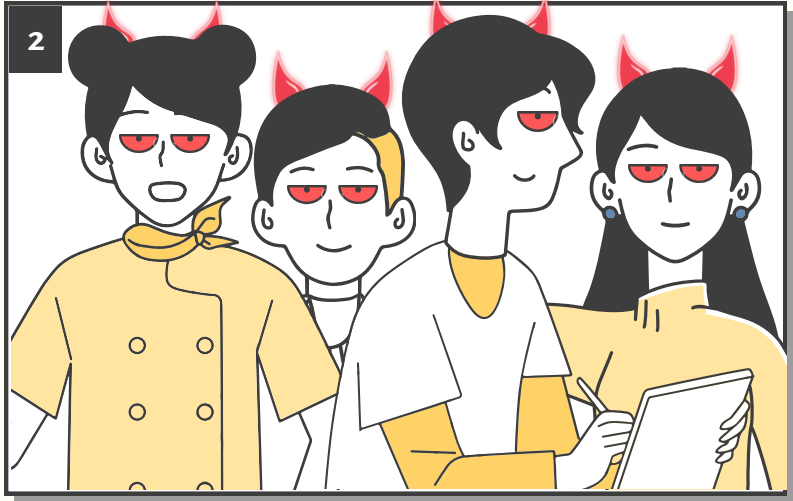


3 Game theory is the perfect tool to study the puzzle of cooperation.

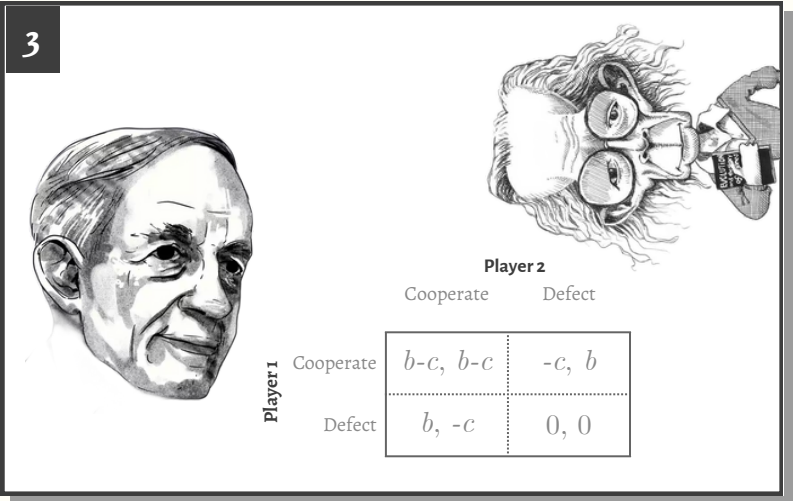
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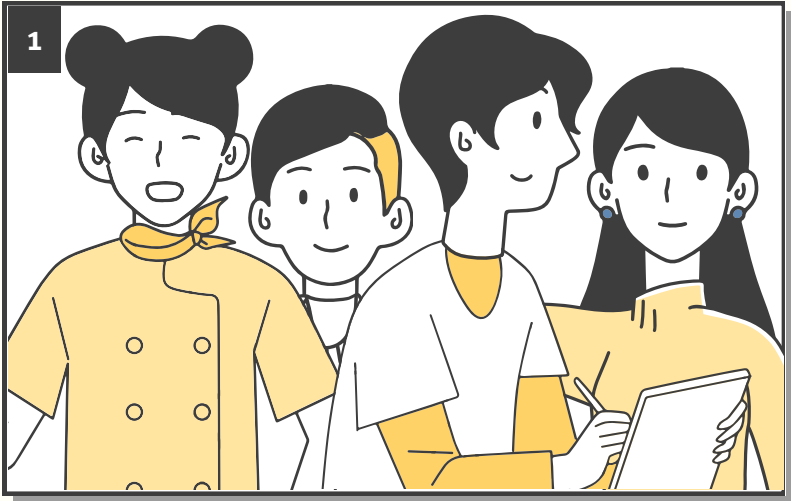


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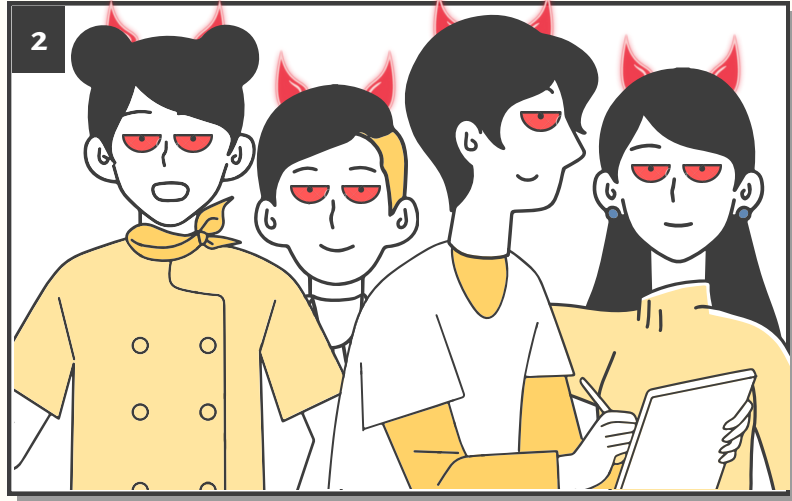


4 We'll look for plausible mechanisms capable of ensuring cooperation in a world of selfish individuals.

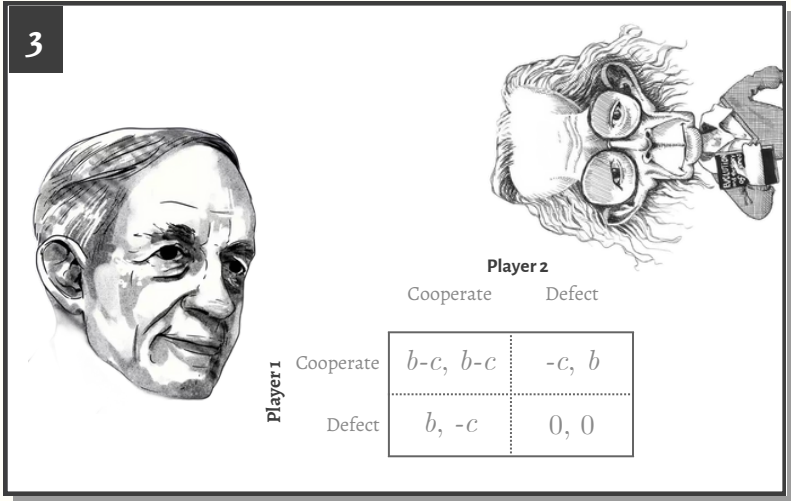
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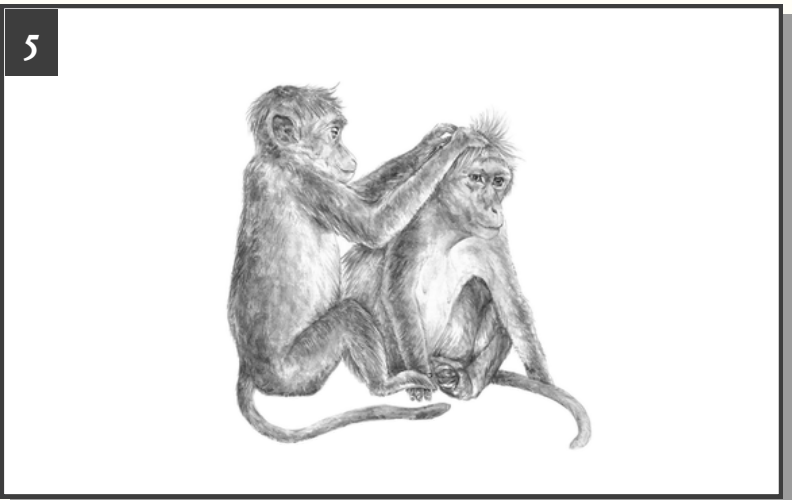
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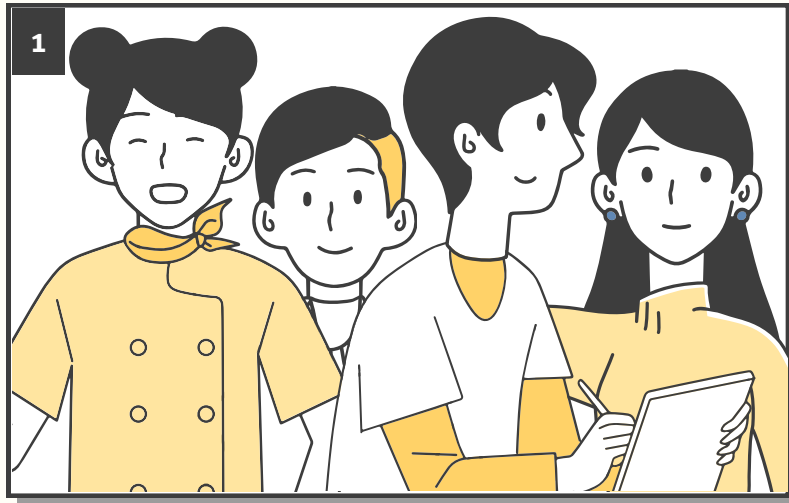


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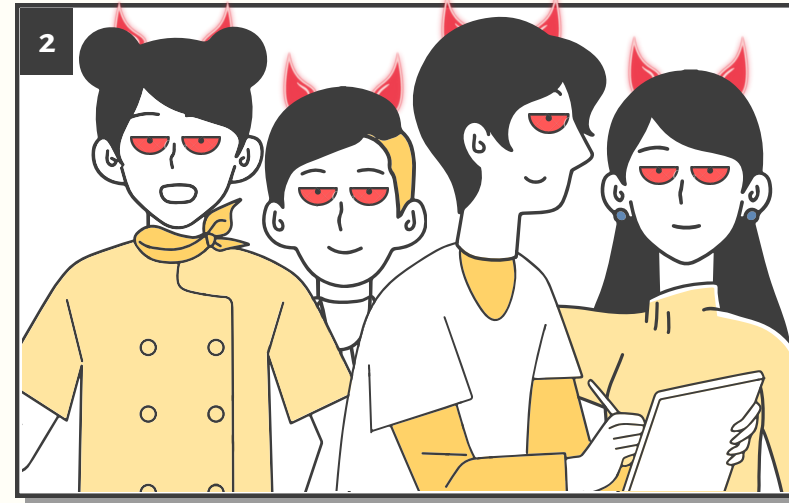


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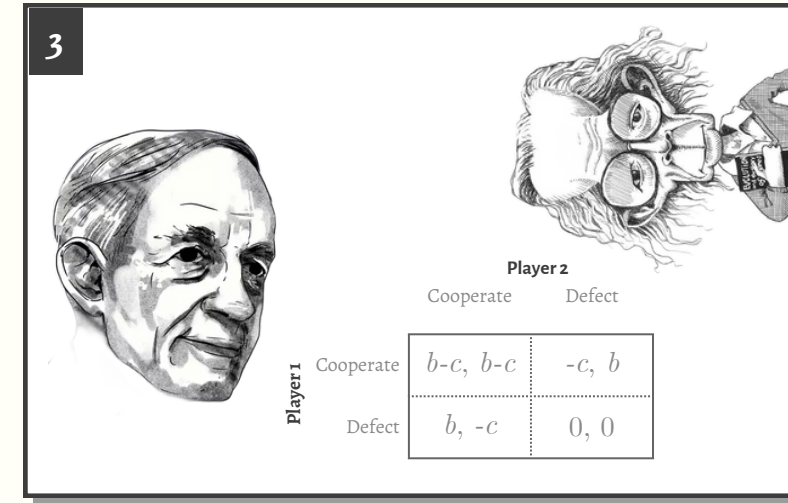
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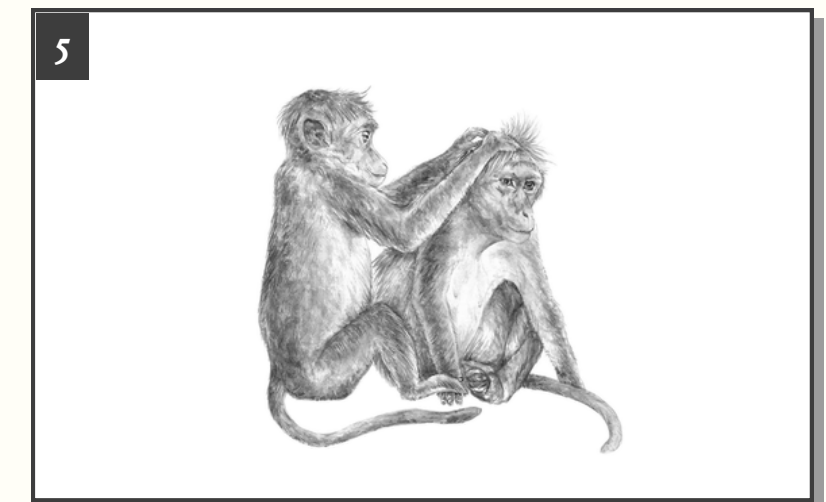
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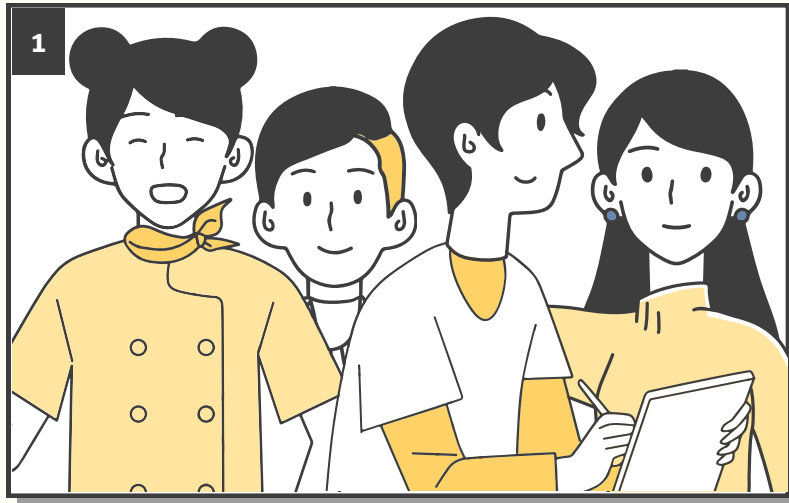
6 trust and reputation...



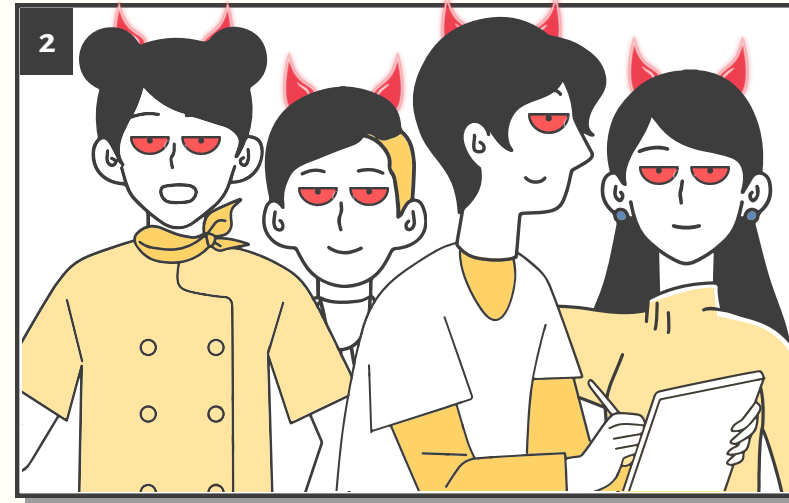
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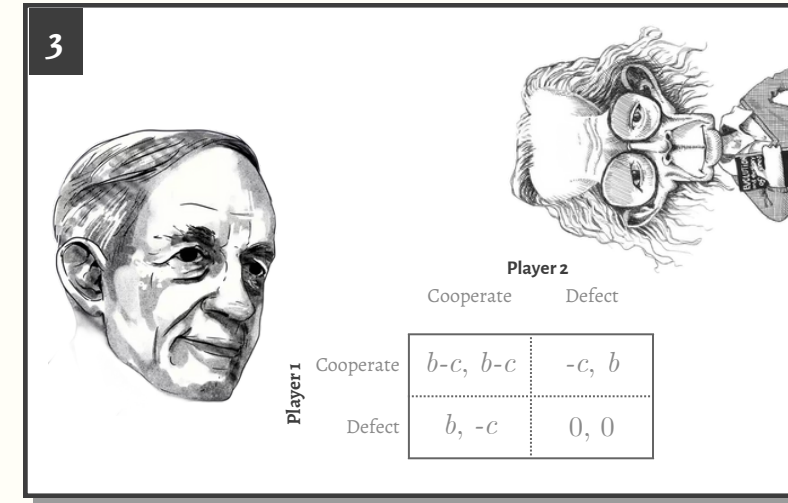
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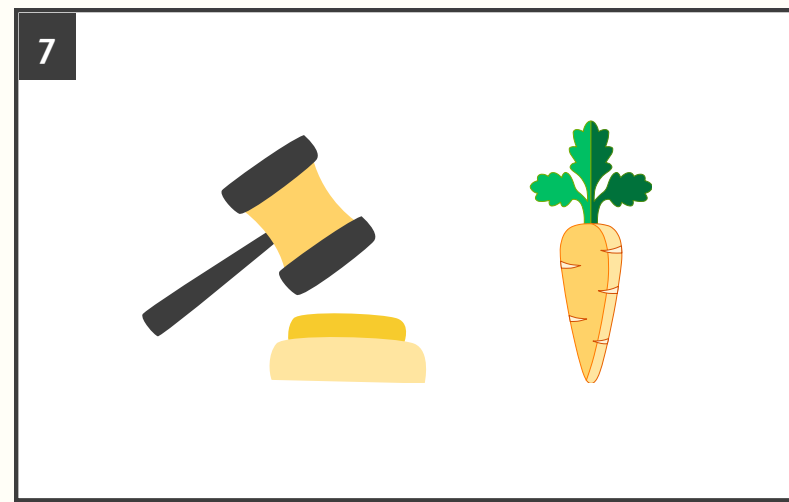
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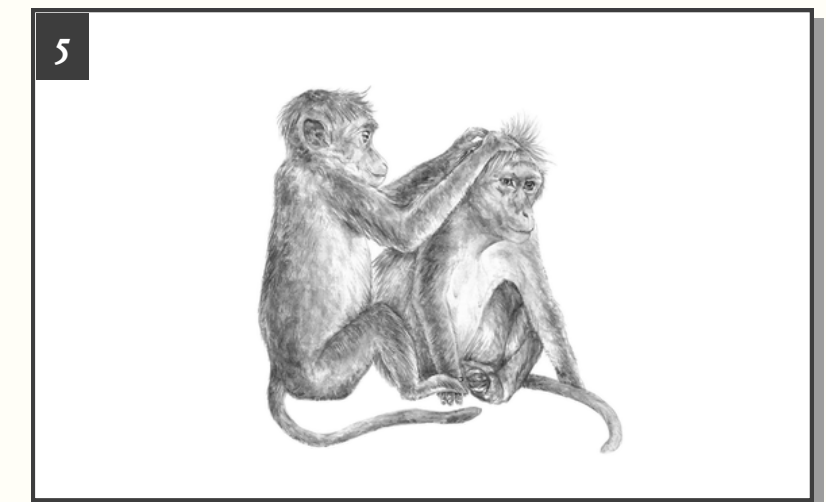
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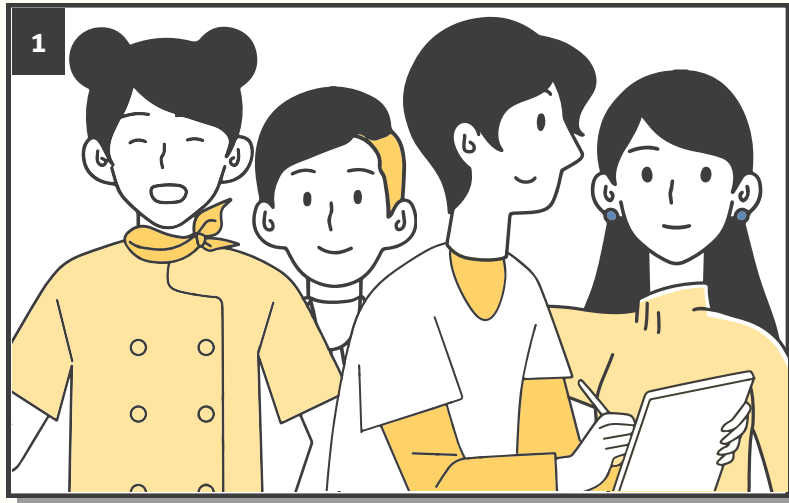


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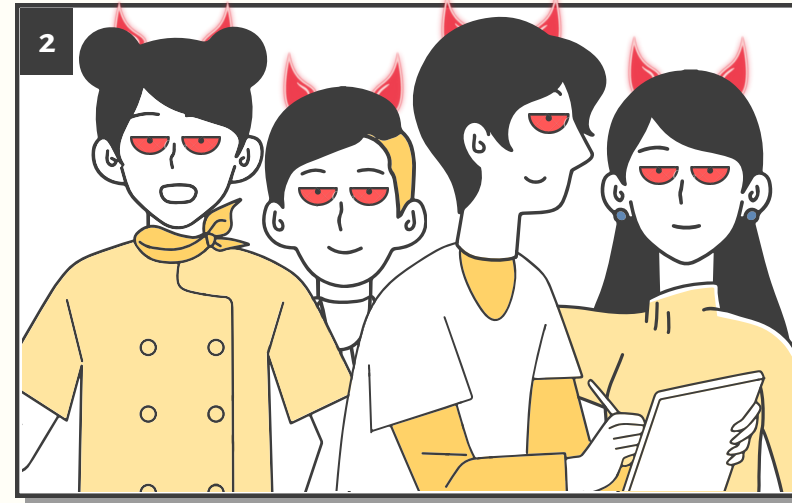


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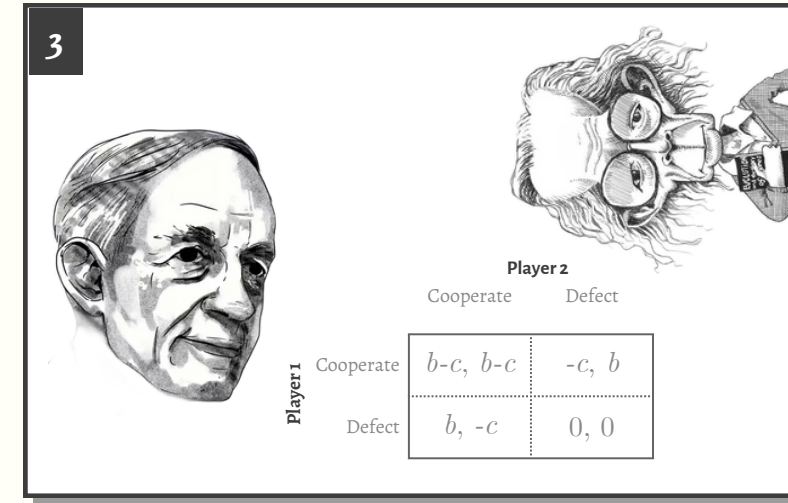
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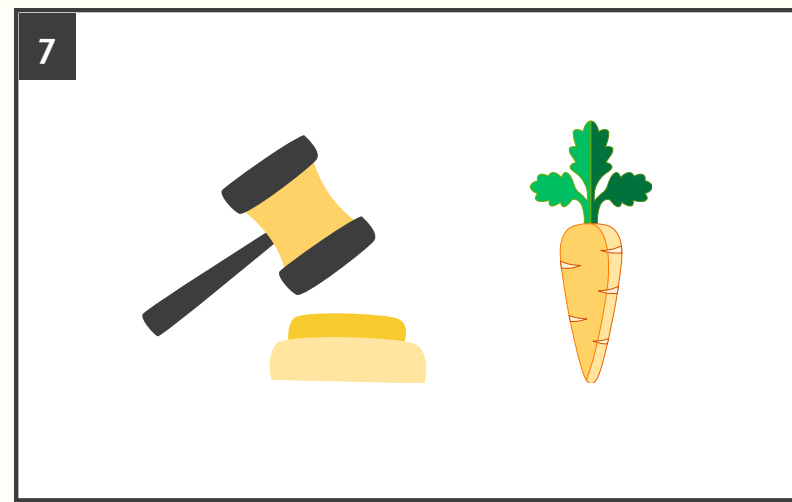
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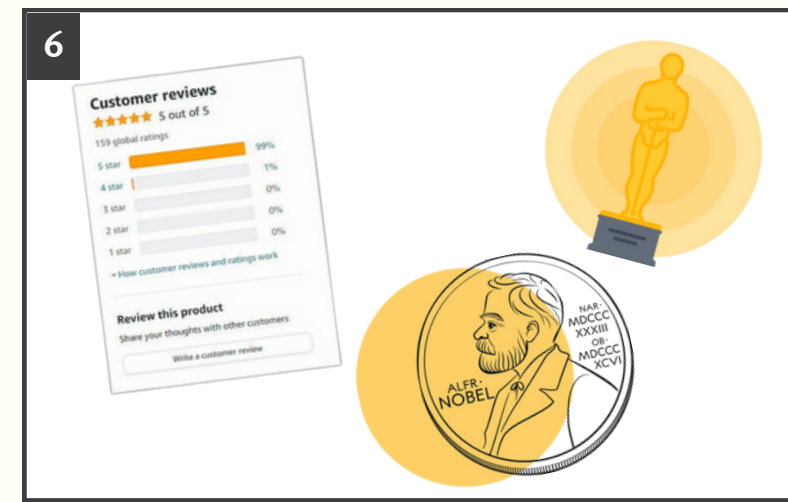
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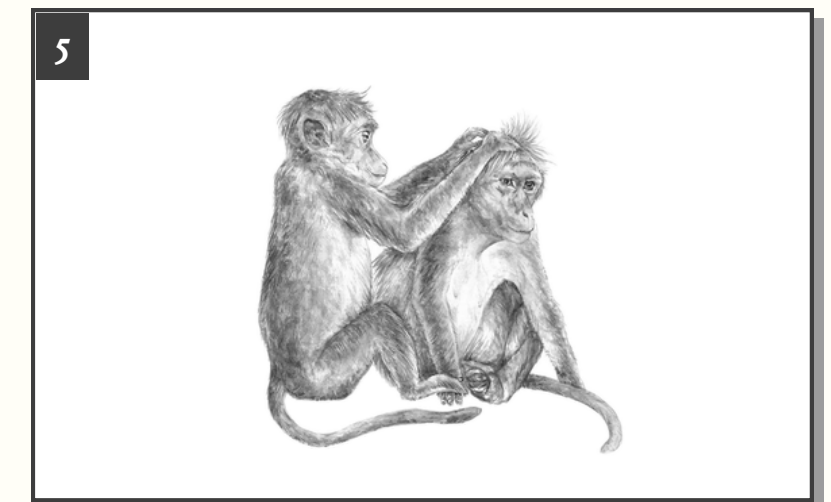
8 or selection based on kinship and group membership.



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Where does cooperation occur?

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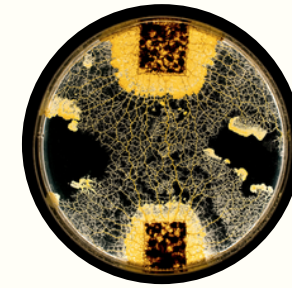
Where does cooperation occur?  
Let's see some examples.

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**SLIME MOLDS**

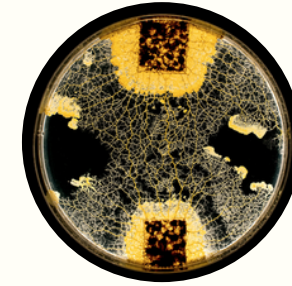
SLIME MOLD ELDER  
Slime molds are single-celled organisms, amoebas living in the  
ground.



Solman, P. (2012, April 5). [Slime Molds: No Brains, No Feet, No Problem](#). *PBS NewsHour*.

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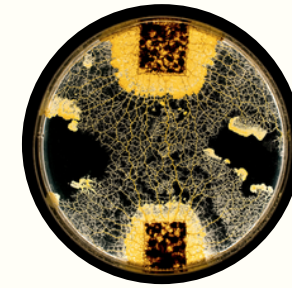
When resources are scarce, slime molds group together to form stalks with bulbs (fruiting bodies) at one end.

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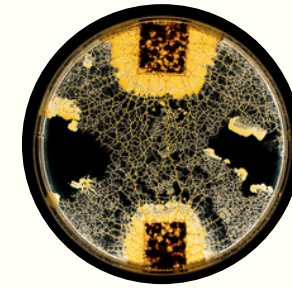
The fruiting body contains spores that end up producing other slime mold cells.

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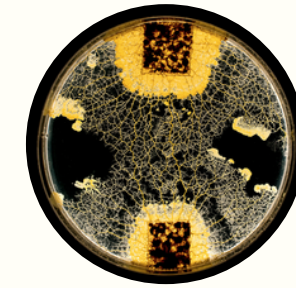
Meanwhile the cells in the stalk die, having 'sacrificed' themselves.

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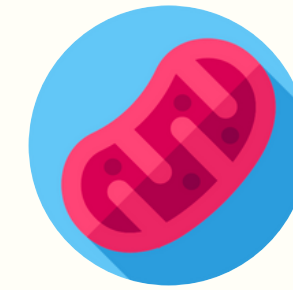


# MITOCHONDRIA & CELLS



## MITOCHONDRIA ELDER

Legend has it that about 1.8 billion years ago an early cell swallowed a bacterium—but instead of digesting it, it kept the bacterium around inside its body.



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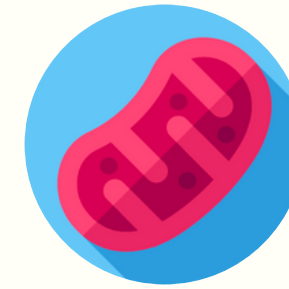
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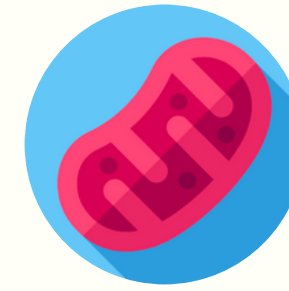
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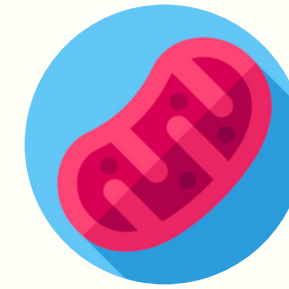
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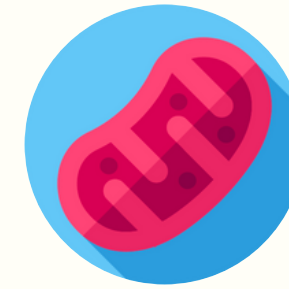
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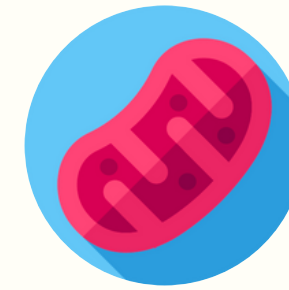
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LYNN MARGULIS

The details of this process are still subject to much debate. 🔍

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# LEAFCUTTER ANTS



E. O. WILSON

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*how does such specialization arise?*



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# VAMPIRE BATS

VAMPIRE BAT ELDER  
We live in crowded caves, but need to go out every night to  
procure food. 🩸



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Fortunately, luckier mates are willing to share food in case of need.

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VAMPIRE BAT ELDER

We live in crowded caves, but need to go out every night to procure food. 🩸



But sometimes we're unlucky, don't find any food, and return to the roost hungry.

If this happens three days in a row we starve.

Fortunately, luckier mates are willing to share food in case of need.



Wilkinson, G. S. (1984). Reciprocal food sharing in the vampire bat. *Nature*, 308(5955), 181–184.

Carter, G. G., Farine, D. R., Crisp, R. J., Vrtilik, J. K., Ripperger, S. P., & Page, R. A. (2020). Development of New Food-Sharing Relationships in Vampire Bats. *Current Biology*, 30(7), 1275–1279.e3.



**MEERKATS**

MEERKAT ELDER

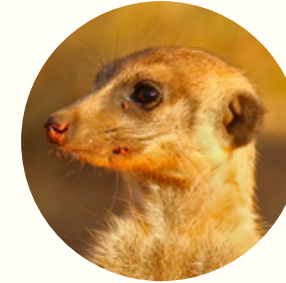
It is a truth widely acknowledged that in every group there must be a dominant male and female.



Griffin, A. S., Pemberton, J. M., Brotherton, P. N. M., McIlrath, G., Gaynor, D., Kinsky, R., & Clutton-Brock, T. H. (2003). A genetic analysis of breeding success in the cooperative meerkat (*Suricata suricatta*). *Behavioral Ecology*, 14(4), 472–480.

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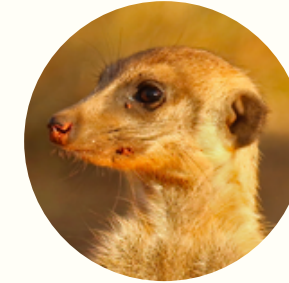
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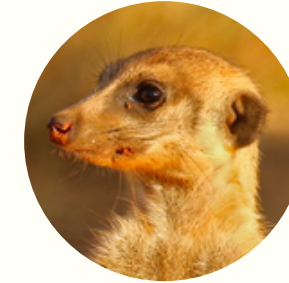


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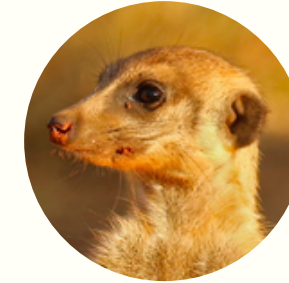


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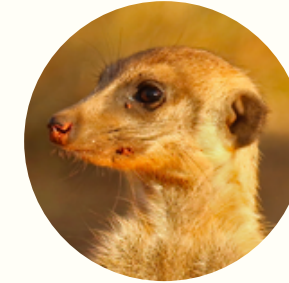
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why?!?





**PEOPLE**

GEORGE FREDERIC WATTS

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(that I set up)





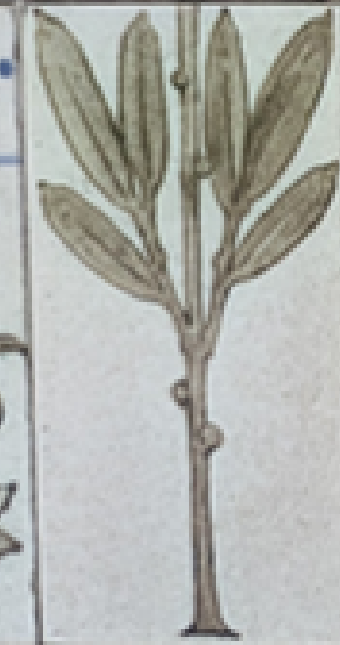
AMELIA KENNEDY

AGED 19

DIED IN TRYING TO

SAVE HER SISTER  
FROM THEIR BURNING HOUSE

IN EDWARD'S LANE STOKE  
NEWINGTON · OCT · 18 · 1871 ·







JOSEPH ANDREW FORD

AGED 30 · METROPOLITAN FIRE  
BRIGADE · [ SAVED SIX PERSONS

FROM FIRE IN GRAY'S INN ROAD ·

· BUT IN HIS LAST HEROIC ACT  
HE WAS SCORCHED TO DEATH ·

OCT · 7 · 1871 ·   

DOULTON  
LAMBETH



FREDERICK ALFRED CROFT

INSPECTOR · AGED 31

SAVED A LUNATIC WOMAN

FROM SUICIDE AT WOOLWICH  
ARSENAL STATION · BUT WAS  
HIMSELF RUN OVER BY THE TRAIN

JAN · 11 · 1878 ·



*is there anything in it for them?  
does that even matter?*

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(that I set up)

---

There are many example of humans being altruistic.

But these are anecdotes.

How altruistic are people *really*?

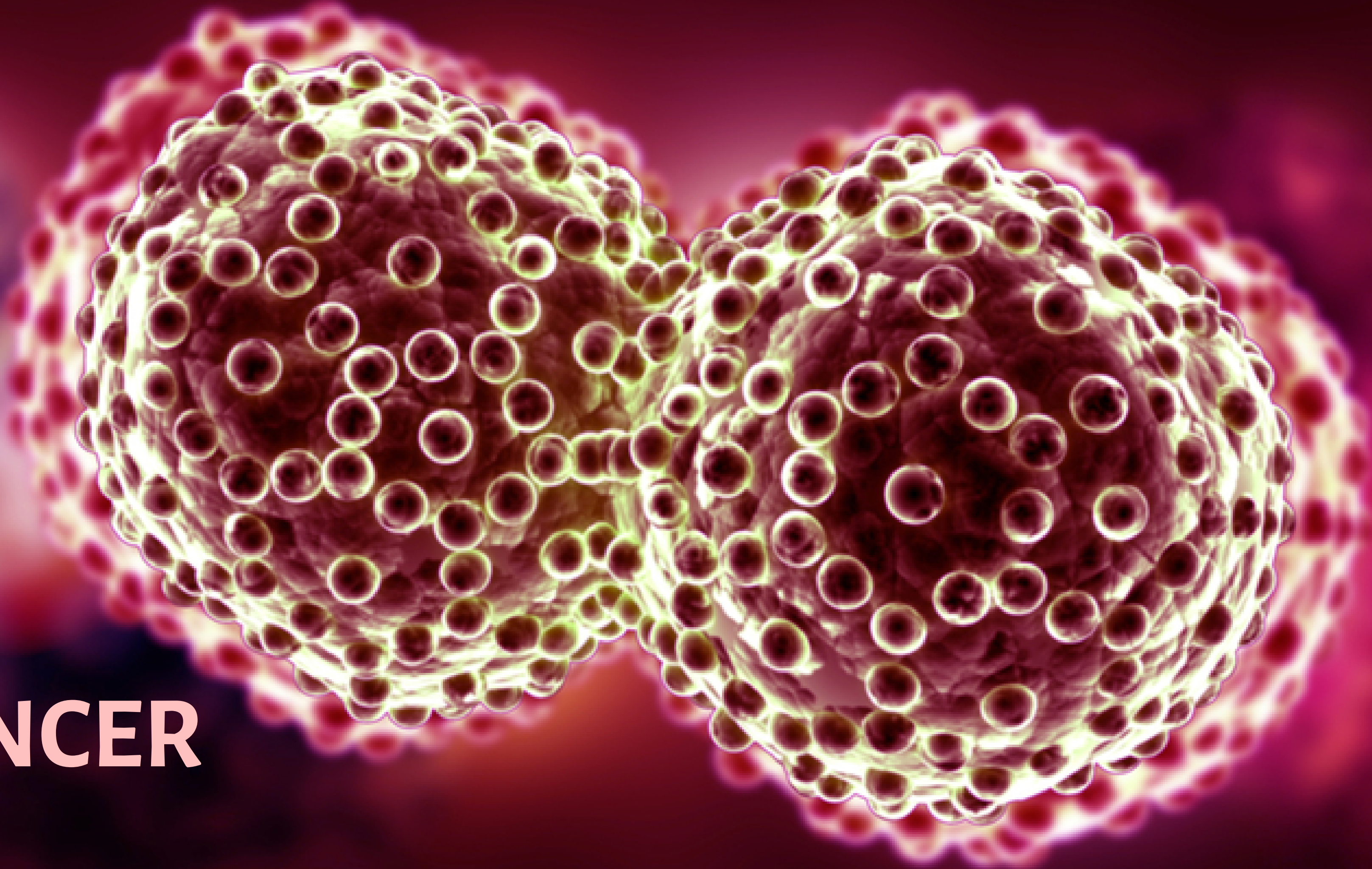


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Let's also look at some *failures* of  
cooperation.

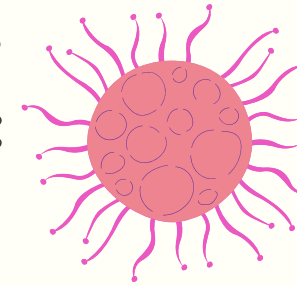
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**CANCER**



## CANCER CELL ELDERS

In a normally functioning organism, cells are cooperative:  
liver cells do liver stuff, skin cells do skin stuff.

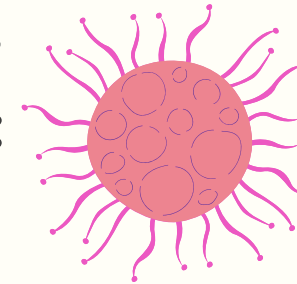


Aktipis, C. A., Boddy, A. M., Jansen, G., Hibner, U., Hochberg, M. E., Maley, C. C., & Wilkinson, G. S. (2015). Cancer across the tree of life: cooperation and cheating in multicellularity. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, 370(1673).9



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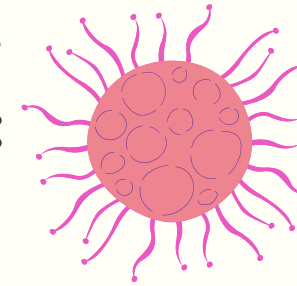


But sometimes, as result of mutation, cells go rogue and  
start multiplying uncontrolled, syphoning off resources from  
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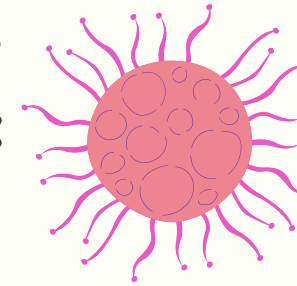
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what keeps 'normal' cells in  
check?



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# ANARCHIST BEES



BEE ELDER  
With our distant cousins the ants, workers are usually  
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Ratnieks, F. L. W., Foster, K. R., & Wenseleers, T. (2006). Conflict resolution in insect societies. *Annual Review of Entomology*, 51, 581–608.

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*ok, but why aren't all bees anarchists?*



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**CORRUPTION**



Corruption is an abuse of  
entrusted power for private gain.

Transparency International. *Long Methodological Brief*, p.2.

---

DON CORLEONE

The way I like to think about it is, you take things from this big pot lying around, and you put it into the pockets of your family.



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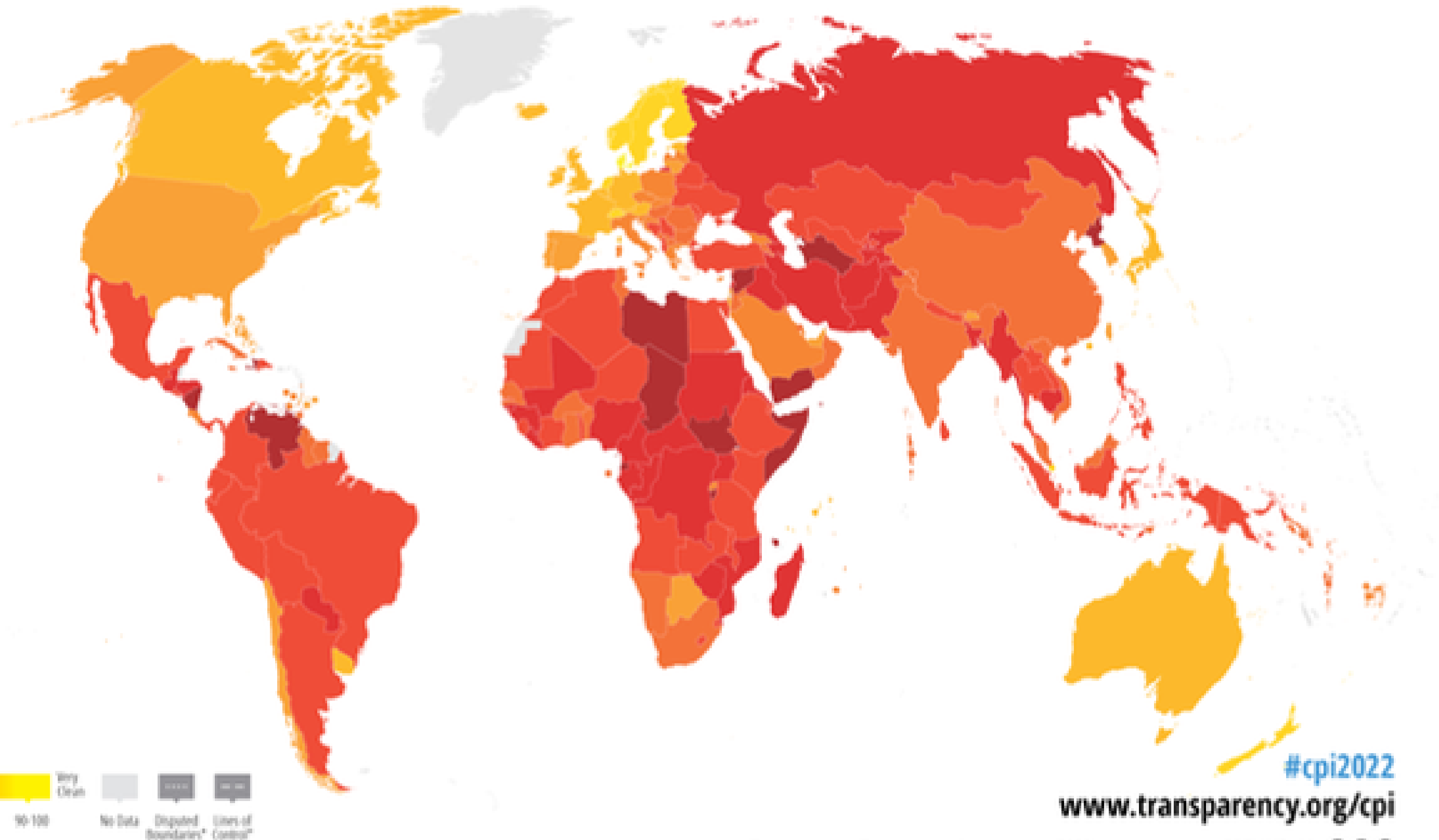


I don't see anything wrong with that.

*aren't we all supposed to look after our families?*

# CORRUPTION PERCEPTIONS INDEX 2022

The perceived levels of public sector corruption in 180 countries/territories around the world.



#cpi2022

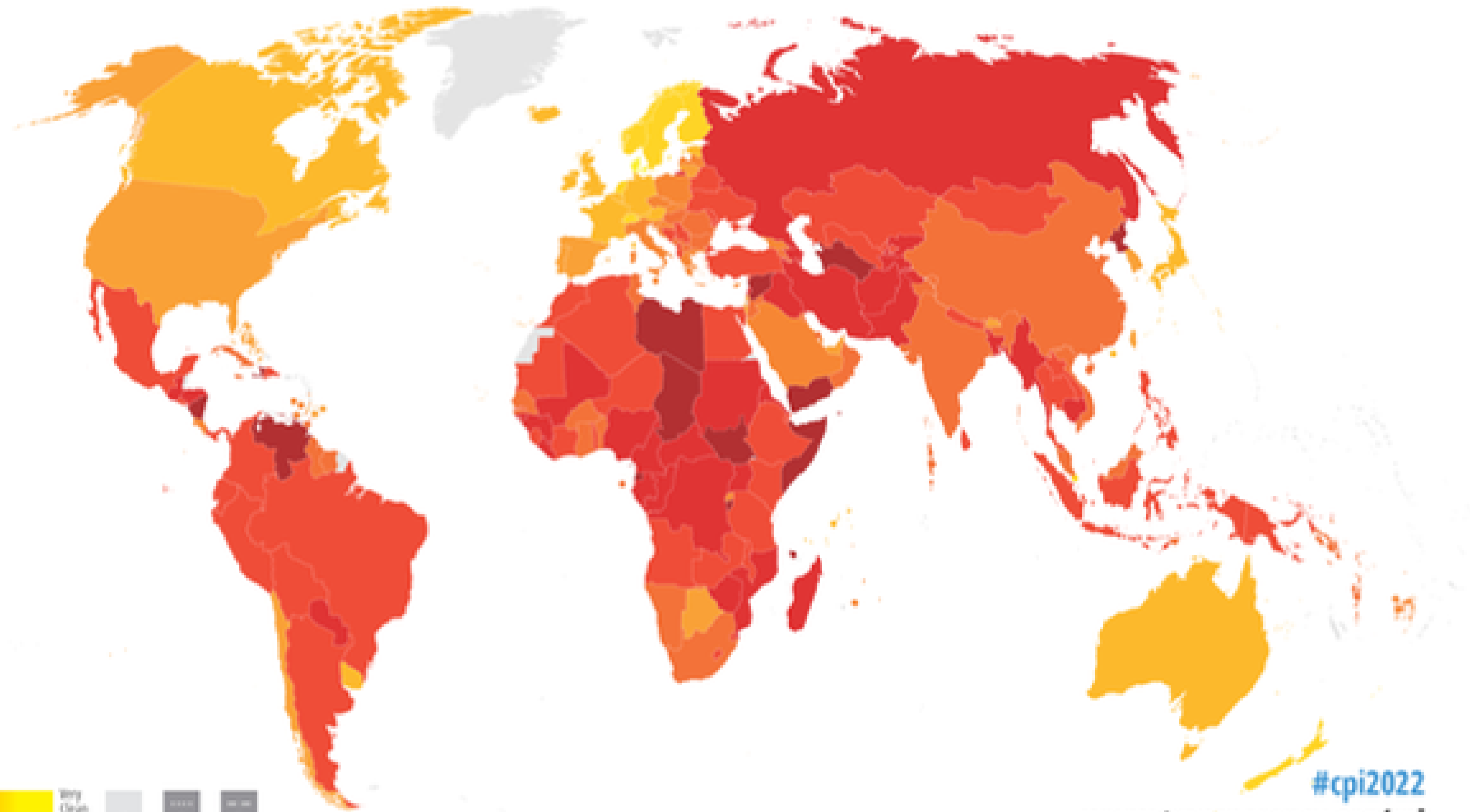
[www.transparency.org/cpi](http://www.transparency.org/cpi)

\*The designations employed and the presentation of material on this map follow the UN practice to the best of our knowledge and as of January 2022. They do not imply the expression of any opinion on the part of Transparency International concerning the legal status of any country, territory, city or area or of its authorities or concerning the delimitation of its frontiers or boundaries.

Notice anything about this map?



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#cpi2022  
[www.transparency.org/cpi](http://www.transparency.org/cpi)

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Most of the least corrupt countries seem to be WEIRD...



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*Western, Educated, Industrialized,  
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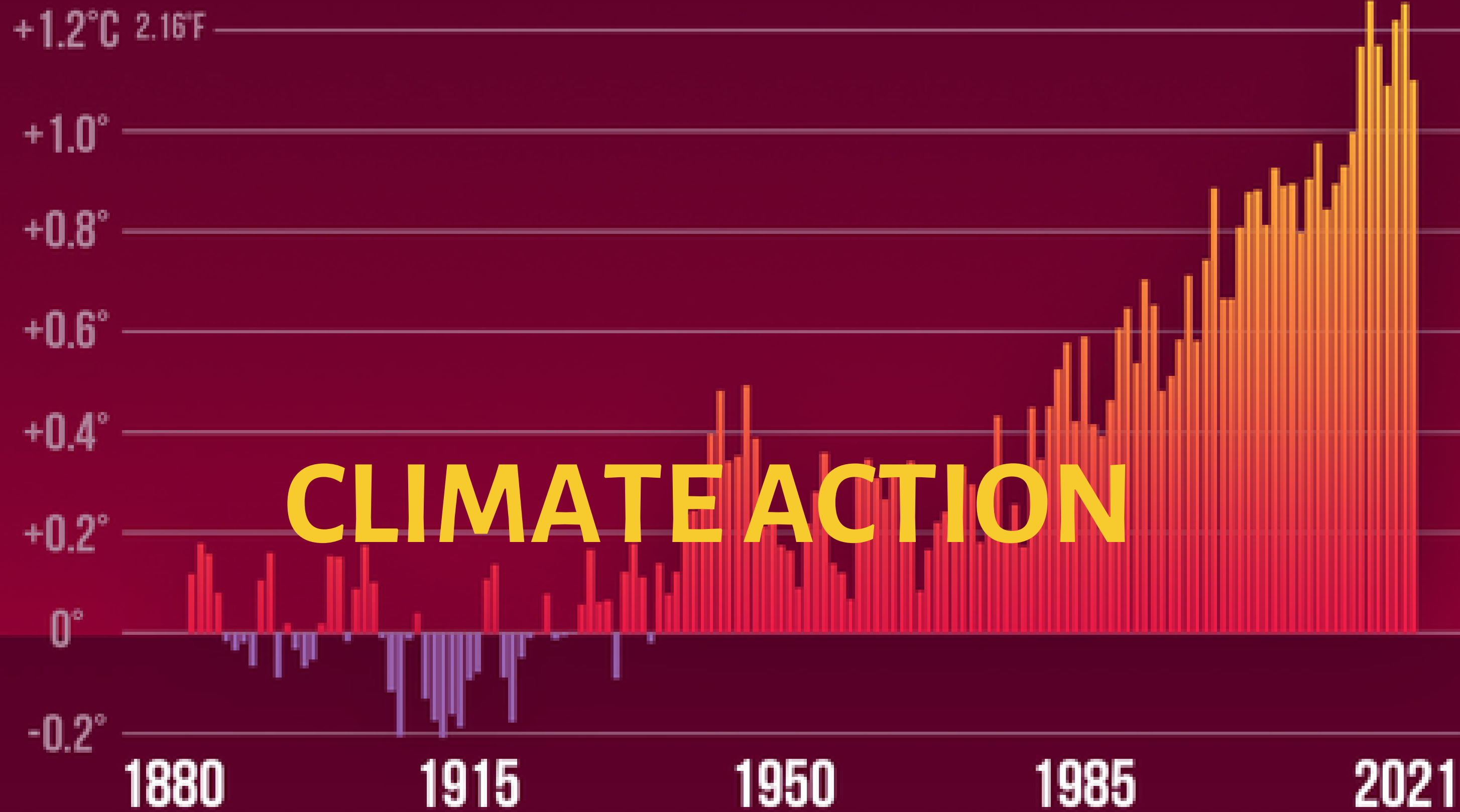
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Coincidence?

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Source: NASA GISS & NOAA NCEI global temperature anomalies averaged and adjusted to early industrial baseline (1881-1910). Data as of 1/13/2022.

CLIMATE  CENTRAL



# Cyclone Freddy

In 2023, around 500,000 people were estimated to have been affected by floods, mudslides and wind damage following the passage of Tropical Cyclone Freddy in southern Malawi.



JOSEPH STIGLITZ

Poor countries should be provided with \$300bn a year from the International Monetary Fund to finance their fight against the climate crisis.



Elliott, L. (2023, October 13). IMF should give poor countries \$300bn a year to fight climate crisis, says Joseph Stiglitz. *The Guardian*.

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*why wouldn't the US want to help poorer countries?*

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---

A cell, a worker bee, a person, a US  
congressman: why should they  
cooperate with others?

---

---

*Wait a minute. So what exactly do we mean by cooperation?*

---

## DEFINITION (PRELIMINARY)

A behavior is *cooperative* if it provides a benefit to another party, at a cost.



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*does not include situations where both parties are immediately better off (e.g., trade).*

---

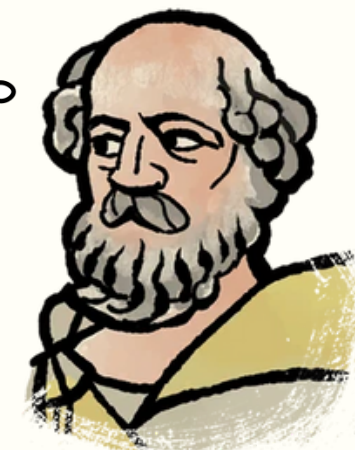
There should be a cost to  
cooperation... and there's the rub.

---

---

Cooperation: the age-old  
conflict between self-interest  
vs (some version of) the  
common good.

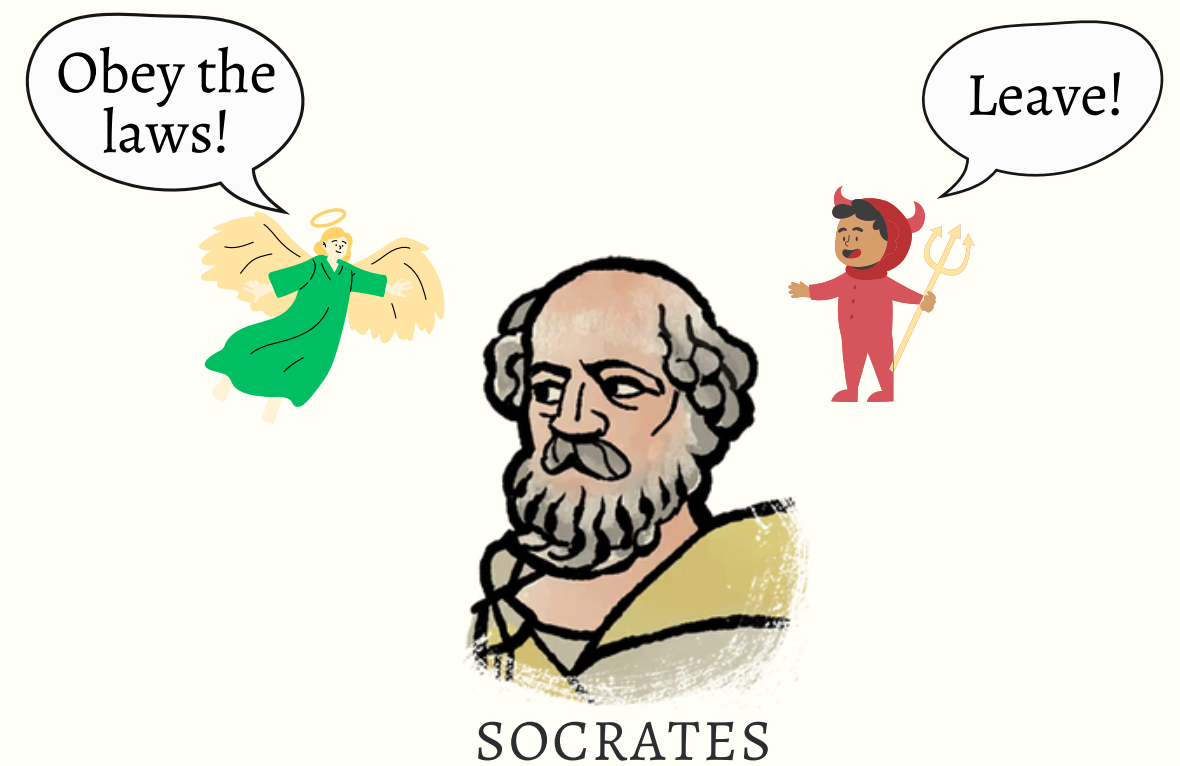
Uh oh, I've just  
been sentenced  
to death.



SOCRATES

---

Cooperation: the age-old  
conflict between self-interest  
vs (some version of) the  
common good.



---

We can make this drama more  
precise.

---

---

We can make this drama more  
precise.

With a little detour through...

---

# GAME THEORY