

Week 2: Couplings, Feedbacks, Energy

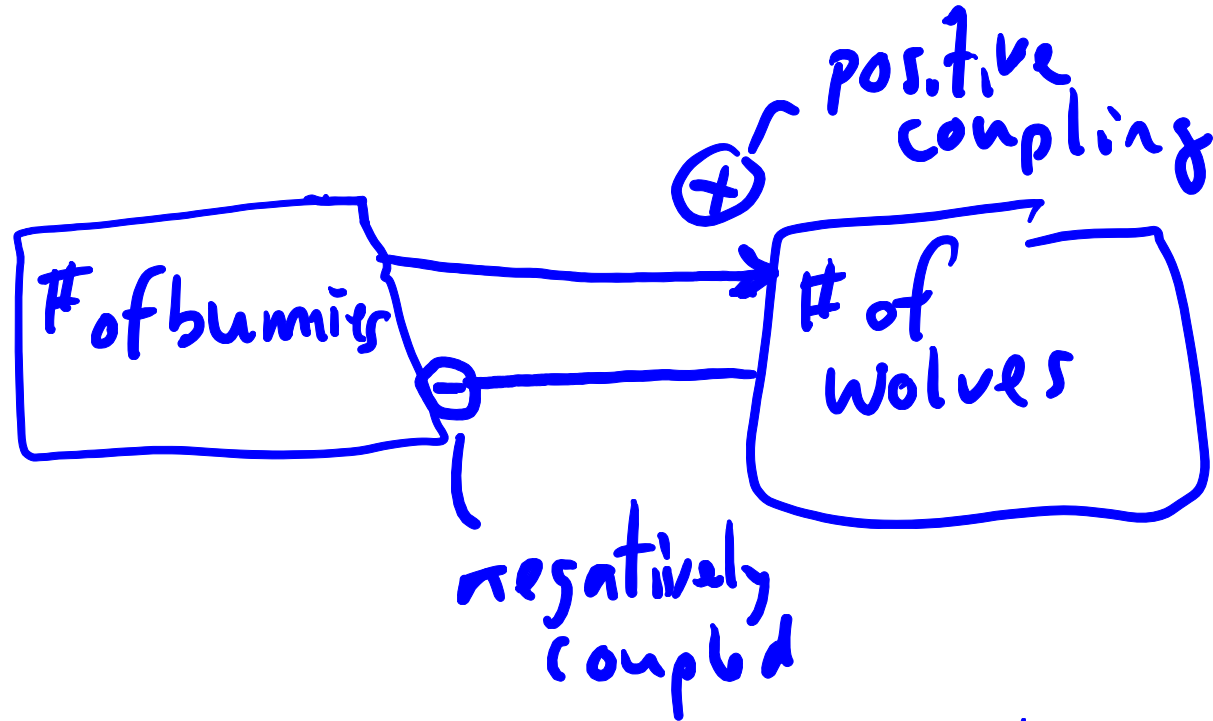
Couplings/Feedbacks

- Daisy World: a simple system
- Energy: Work, Heat, Radiation





Couplings Between Wolves and Bunnies



Forms a loop overall negative
(stabilizing) feedback

Poll Question

W

Interactions between wolves and bunnies
rise to

 **Poll locked.** Responses not accepted.

A positive feedback

A

A negative feedback

Positive couplings only

Negative couplings only

Visual settings 

Activate 

Show results 

Show correct 

Lock 

Clear results 

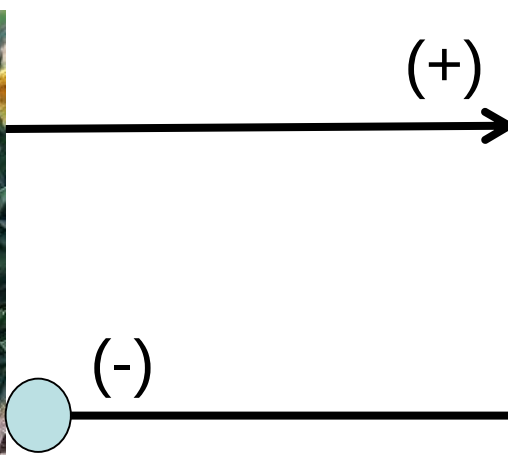
Fullscreen 

Next 

Previous 

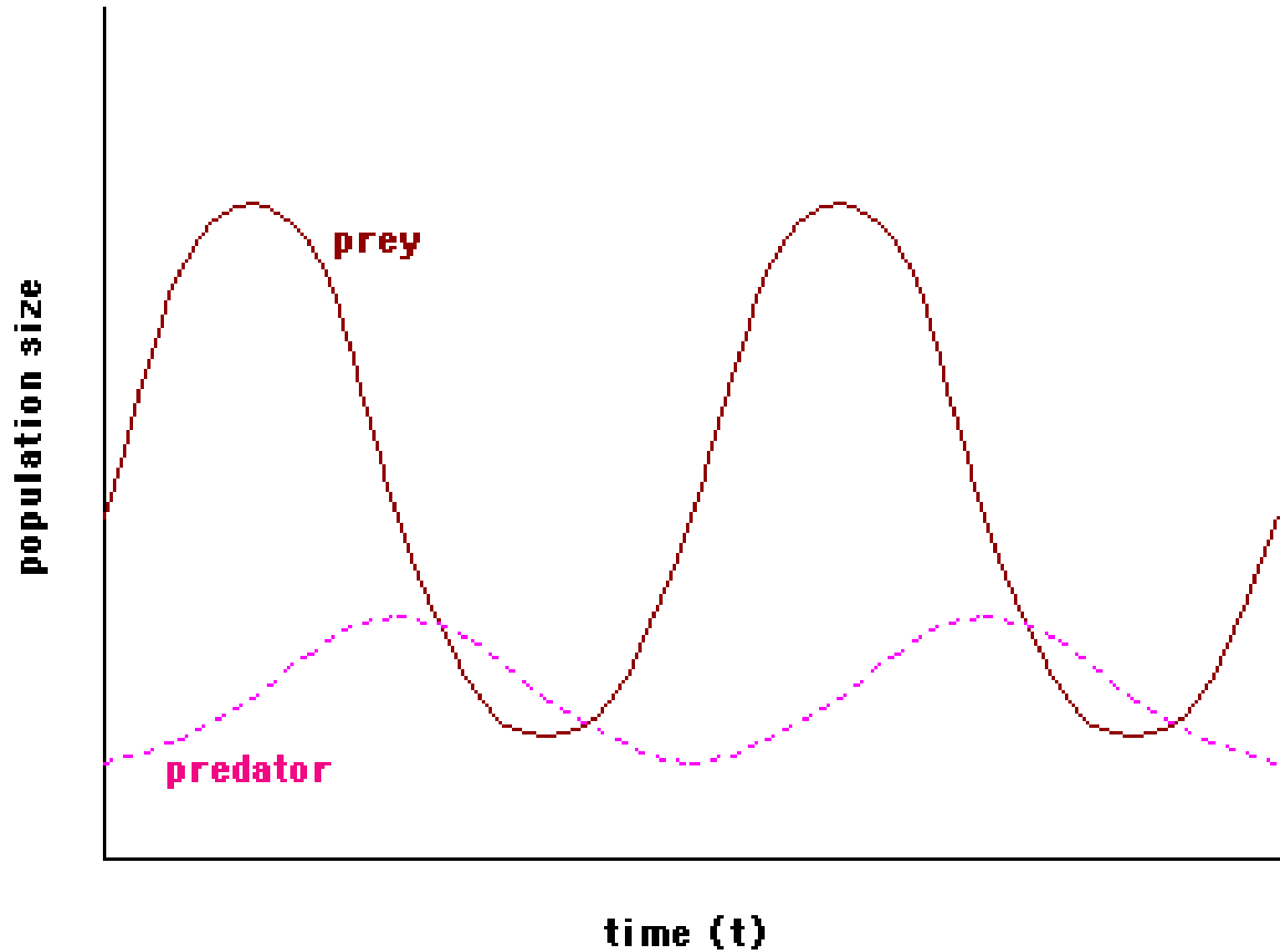
Total Results: 0

Wolves and Bunnies



Feedback loop overall negative (stabilizing)

Predator-Prey Model



Daisy World

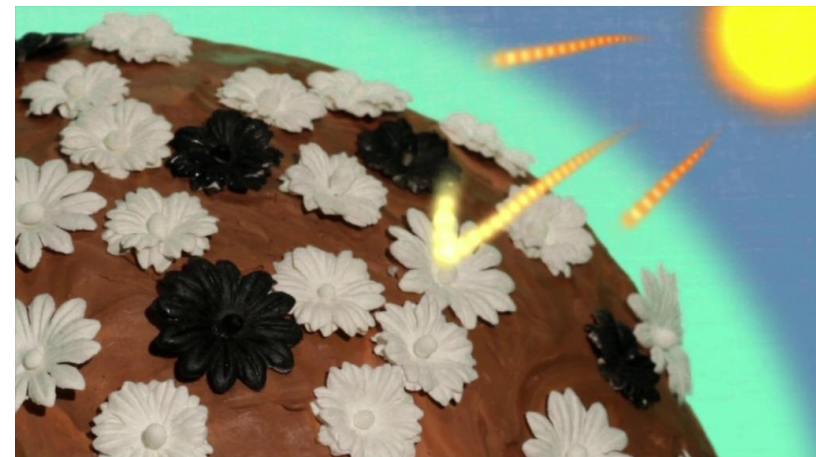
- Concept by James Lovelock
- Illustrates that biosphere can “regulate” climate without requiring intelligence
- Useful introduction to feedbacks in the climate system (especially those involving biosphere)

Useful Daisy World Concepts

- Life has “optimum conditions”



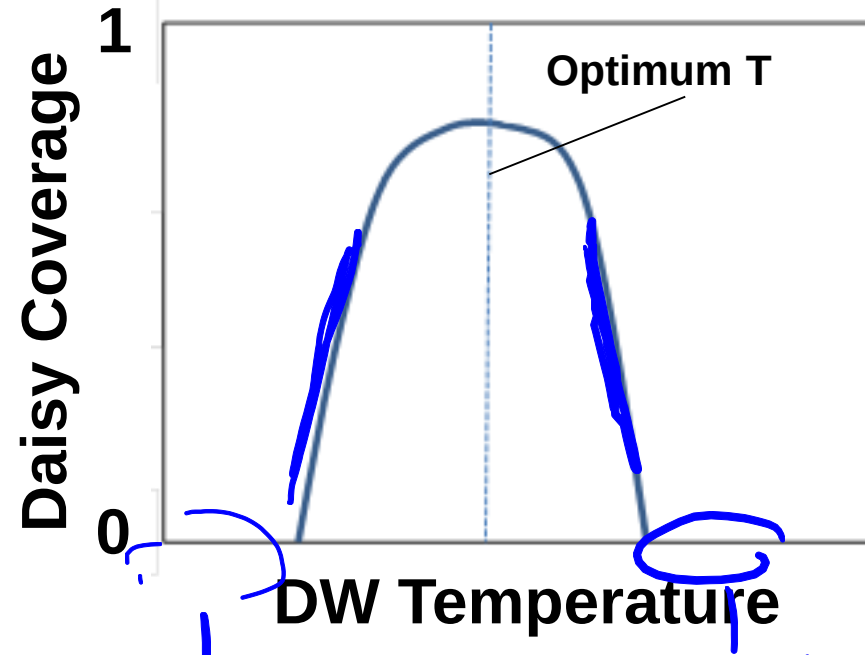
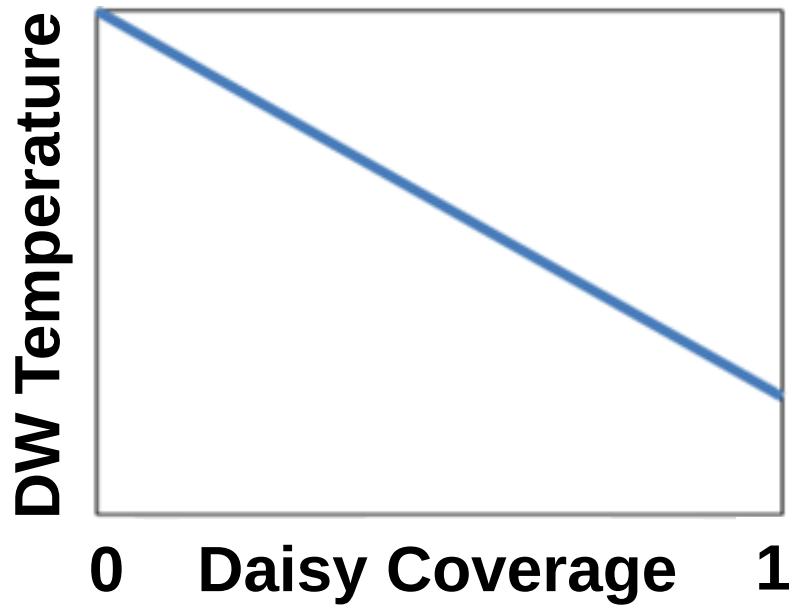
- Planetary Albedo – “reflectivity”, fraction of solar energy intercepted by planet, but not absorbed



Daisy World Climate System

- Similarities to Earth
 - DW has a star around which it orbits & provides energy
- DW supports life but only as "white" daisies
- "White" refers to contribution to DW albedo ("reflectivity")
- Daisies grow/die @ rate determined by DW Temperature (T)
 - ↳ amount of daisies w/ "coverage"

Daisy World Energy Balance



more than 1 coupling for
same component + couplings can
change w/time



Poll Question



Pick the most accurate statement about couplings on Daisy World

 **Poll locked.** Responses not accepted.

Daisy coverage is positively coupled to T;
T is negatively coupled to daisy coverage

Daisy coverage is negatively coupled to T;
T is negatively coupled to daisy coverage

Both 1 and 2

Neither 1 nor 2

Visual settings 

Activate 

Show results 

Show correct 

Lock 

Clear results 

Fullscreen 

Next 

Previous 

Total Results: 0

Poll Question

W

Suppose the DW's star gradually increases its output for many millions of years. If daisies existed, what would the response be



Respond at Pollev.com/thornton211



Text **THORNTON211** to **22333** once to join, then **1, 2, or 3**

T will decrease more and more

No change in T because of a negative feedback

Slow change in T at first, and then a sudden catastrophic increase in T

Visual settings

Activate

Show results

Show correct

Lock

Clear results

Fullscreen

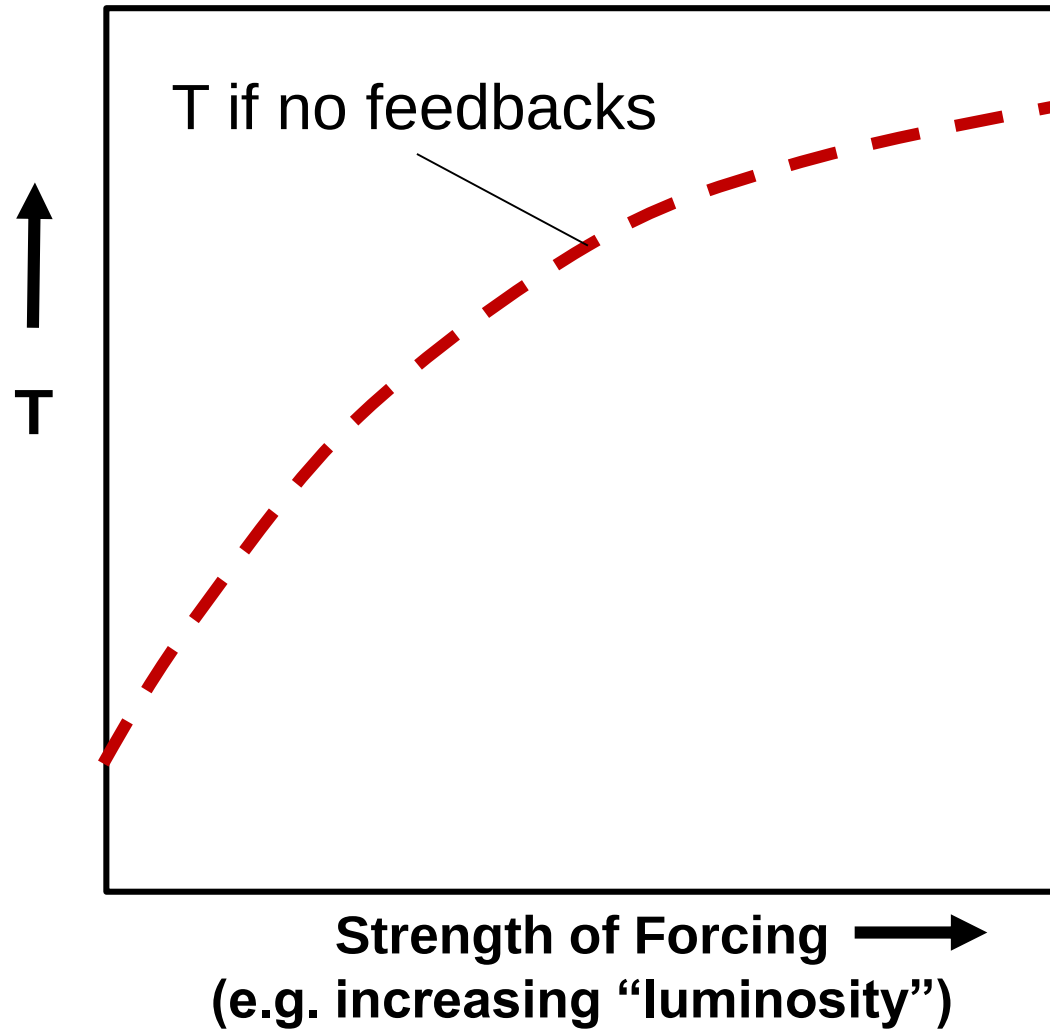
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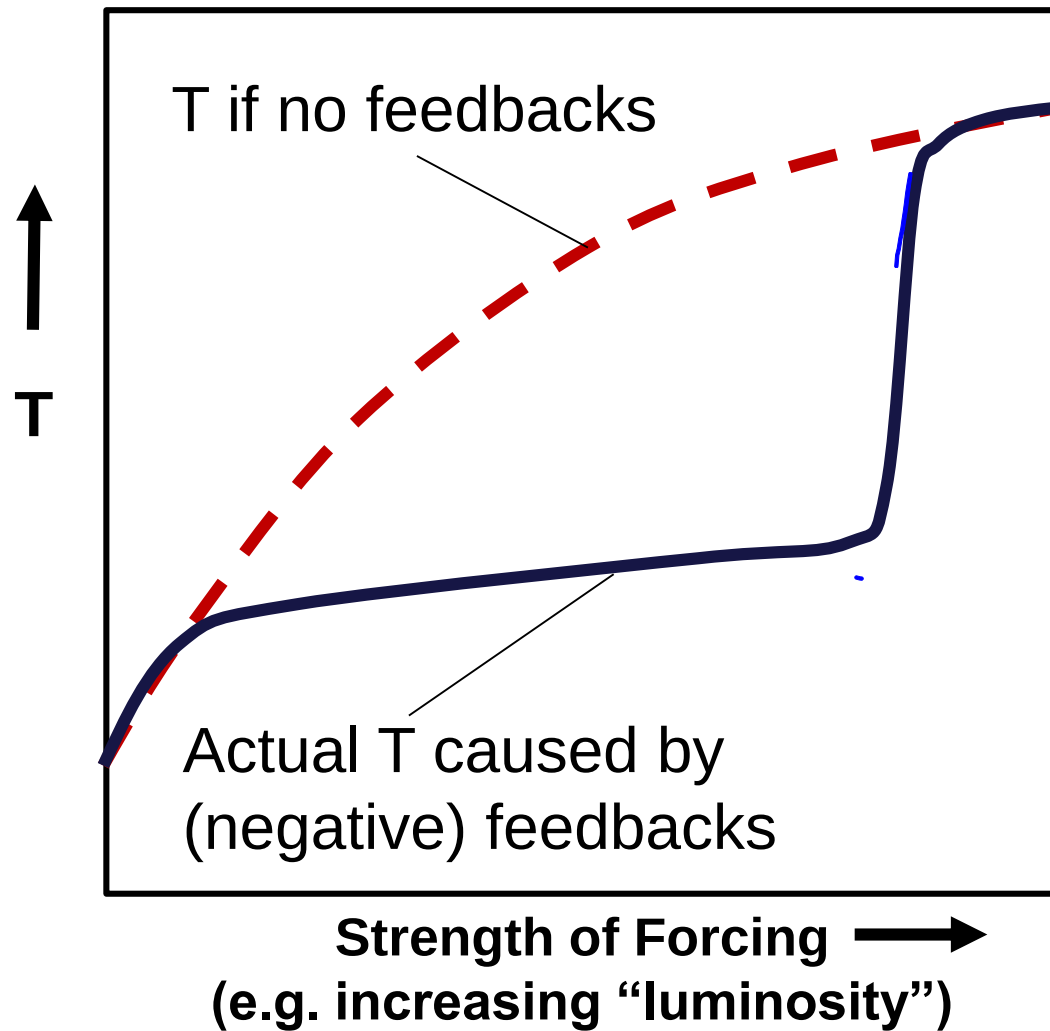
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Daisy World Couplings and Feedbacks

Feedback Factor – DW Example



Feedback Factor –DW Example



Feedback Effect –DW Example

