

Ch 2: Systems approach

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GAIA HYPOTHESIS



JAMES
LYNN

LOVELL
MARGULUS

Daisyworld

DAISY ~~LIFE~~ WORLD

LIFE IS RESPONSIBLE FOR STABILITY
OF EARTH'S CLIMATE.

FORCINGS

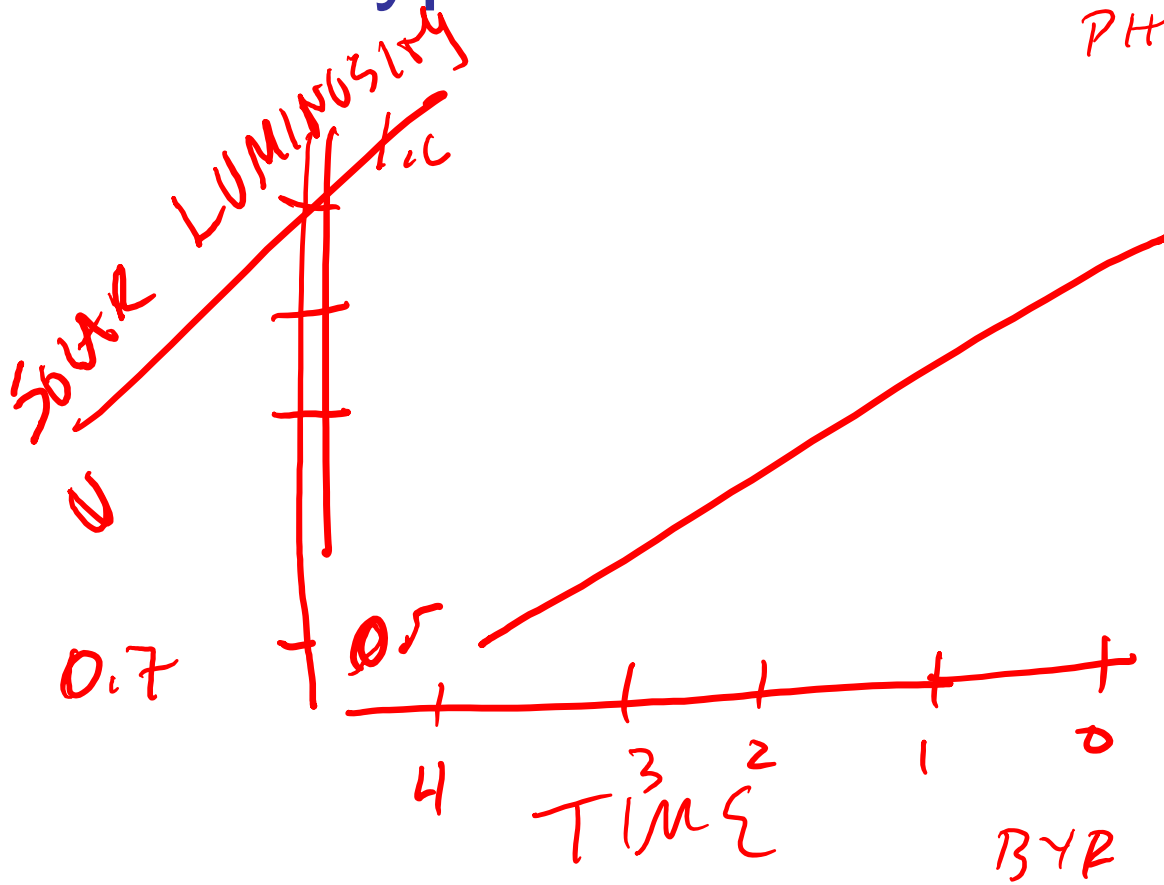
CHANGE IN TEMP
" " CO₂

GRADUAL CHANGES

↳ PERTURBATIONS

TEMPORARY DISTURBANCES

Gaia hypothesis : LIFE AFFECTS PHYSICS



SUN IS GETTING HOTTER

TEMP IS STAYING ~ SAME





PROTECTS US

FROM UV

RADIATION

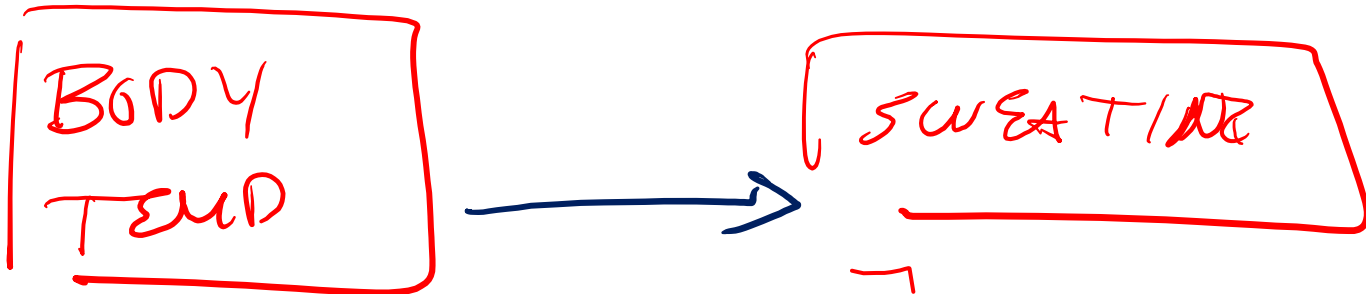


Systems approach



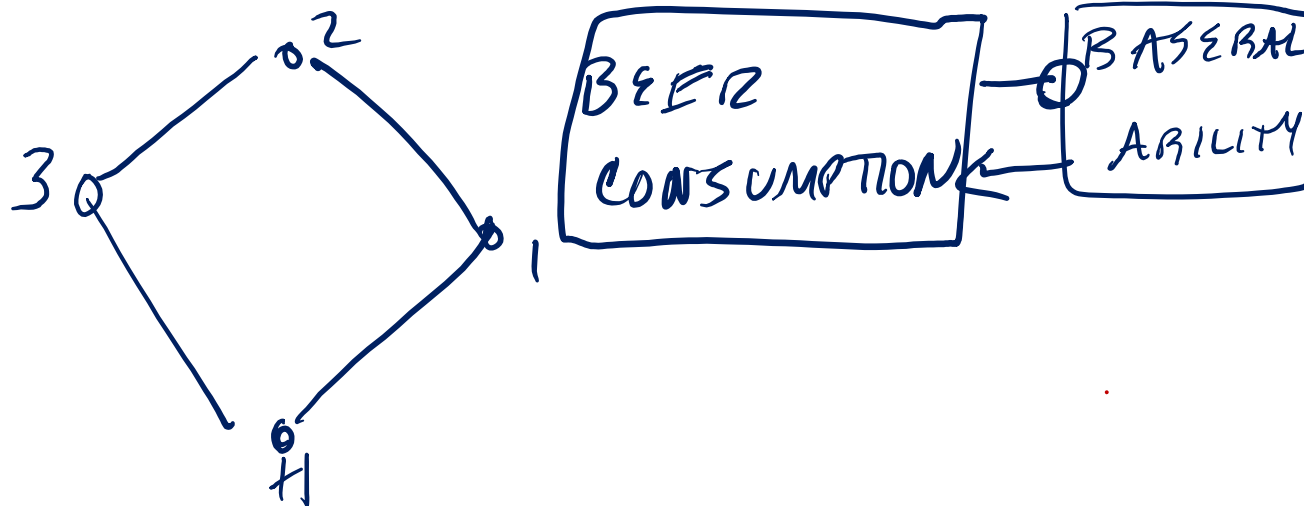
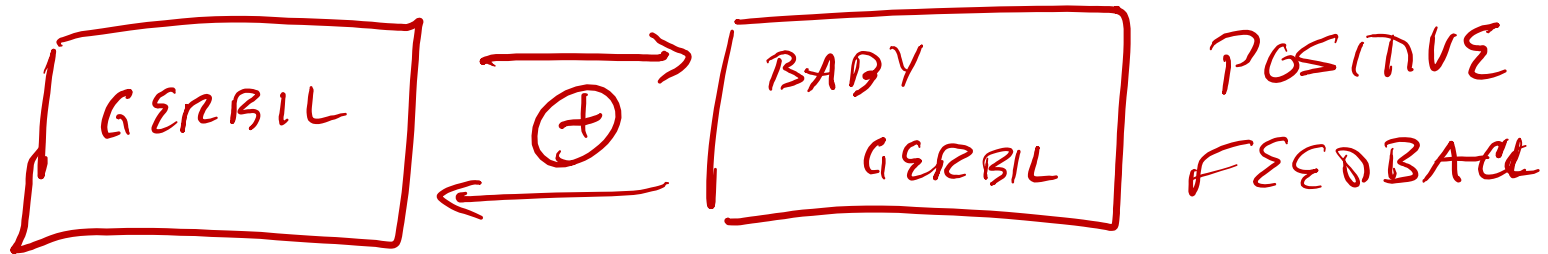
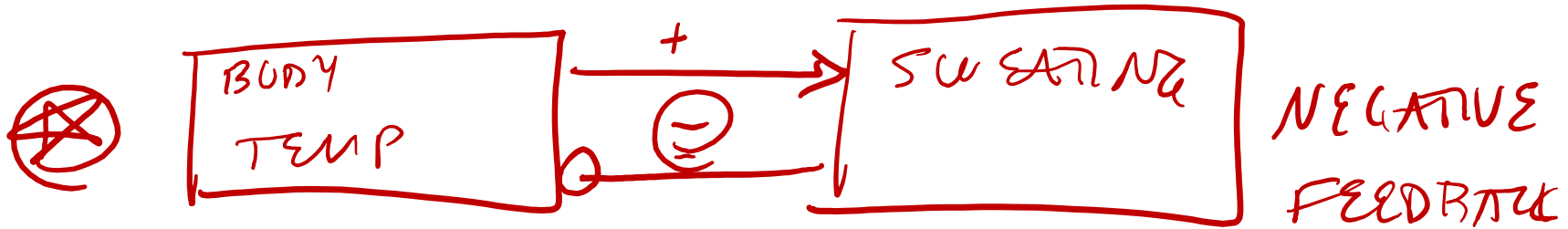
- COMPONENTS - MATTER
ENERGY - TEMP
ATTRIBUTE OF SYSTEM

- COMPONENTS ARE RELATED TO EACH OTHER BY COUPLINGS

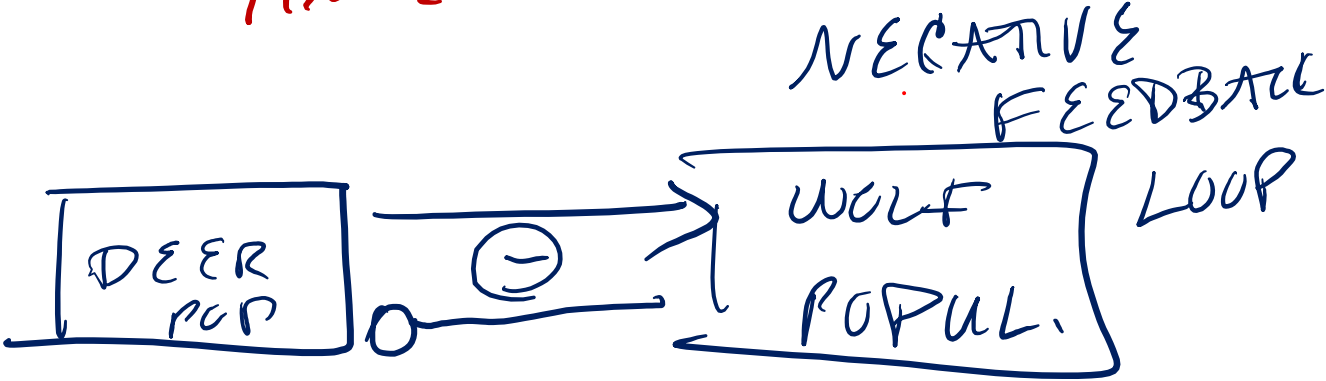
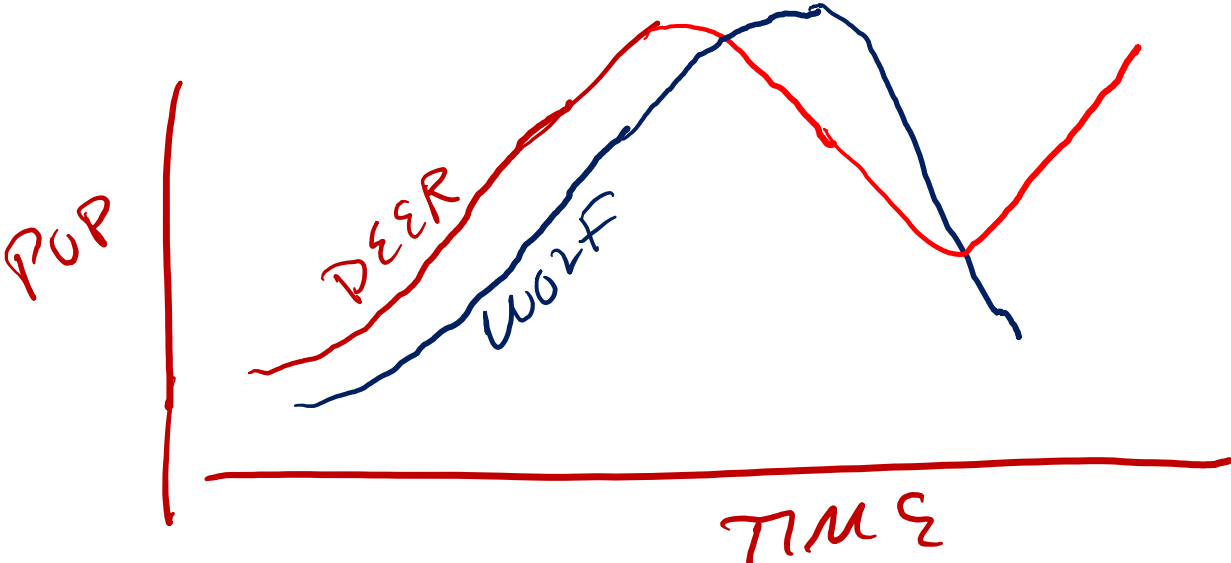


FEED BACK LOOPS

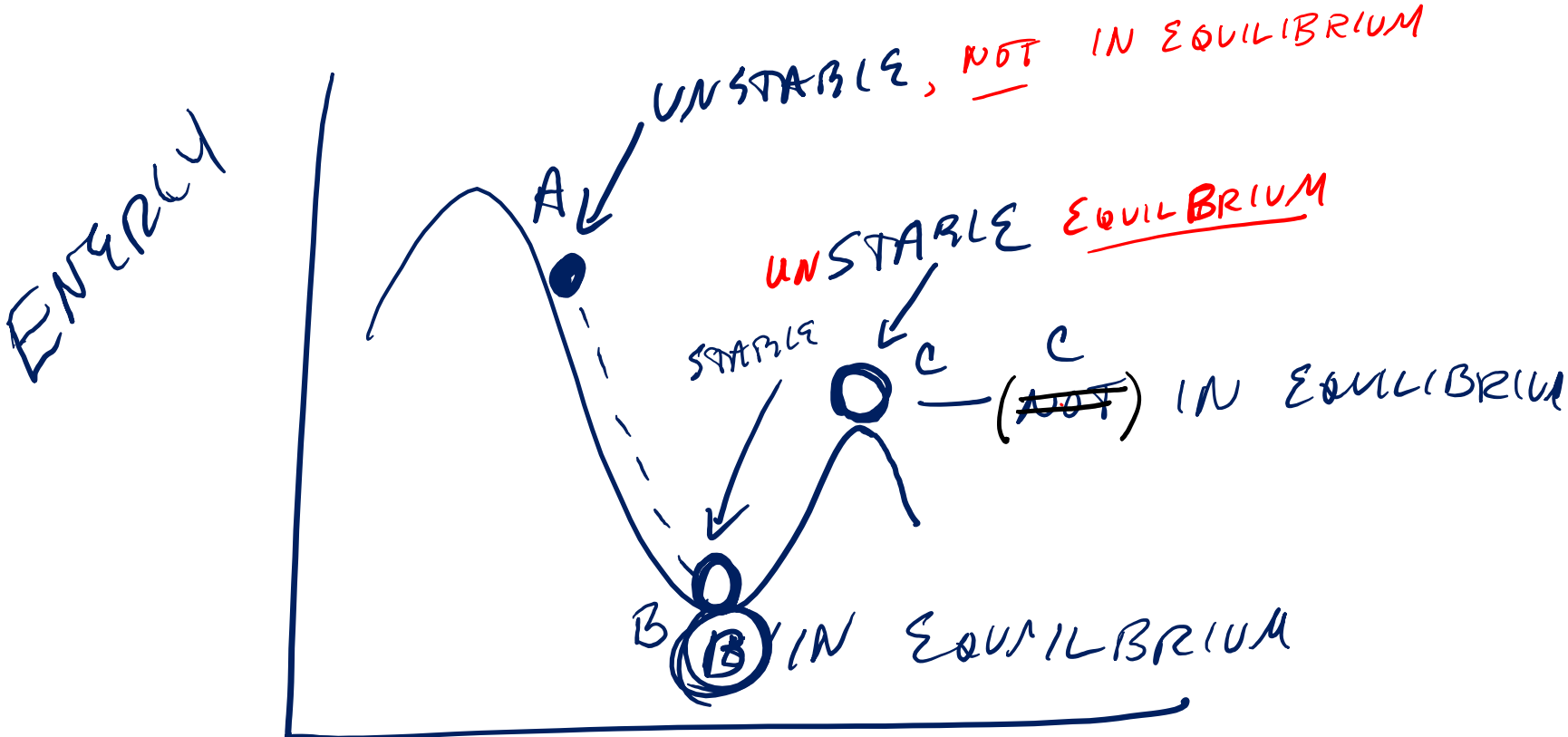
Systems approach



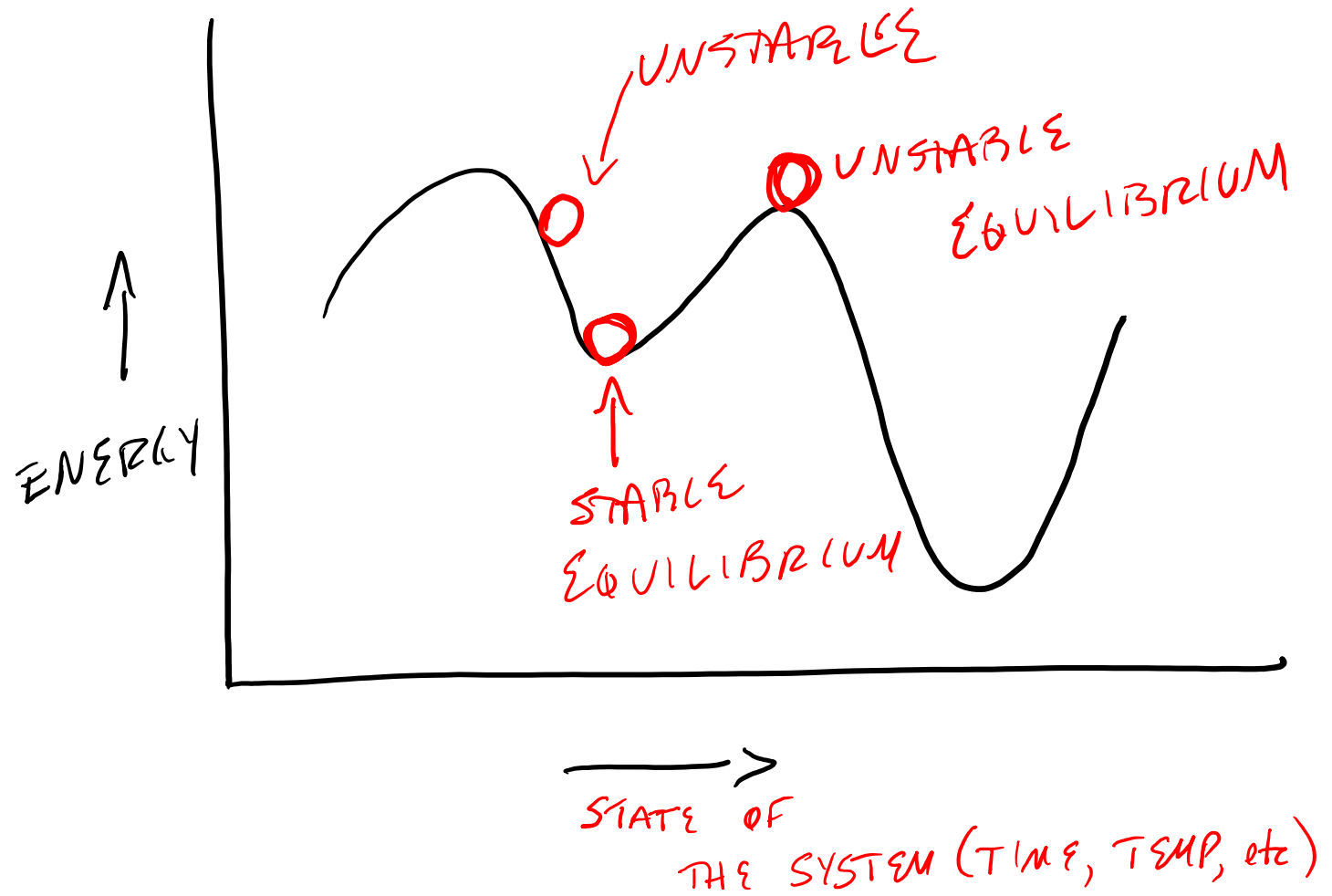
Systems approach: negative feedback loop



Systems approach: equilibrium states



Systems approach: equilibrium states



PERTURBATIONS - 65 MYR METEORITE HIT EARTH

FORCINGS - MORE PERSISTANT, LONG LASTING VARIATION

DAISY WORLD

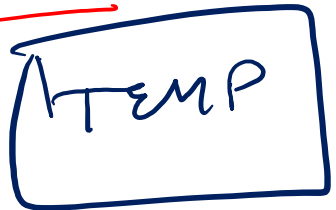
OR WHITE DAISIES, ONLY

AT LOWER TEMP:



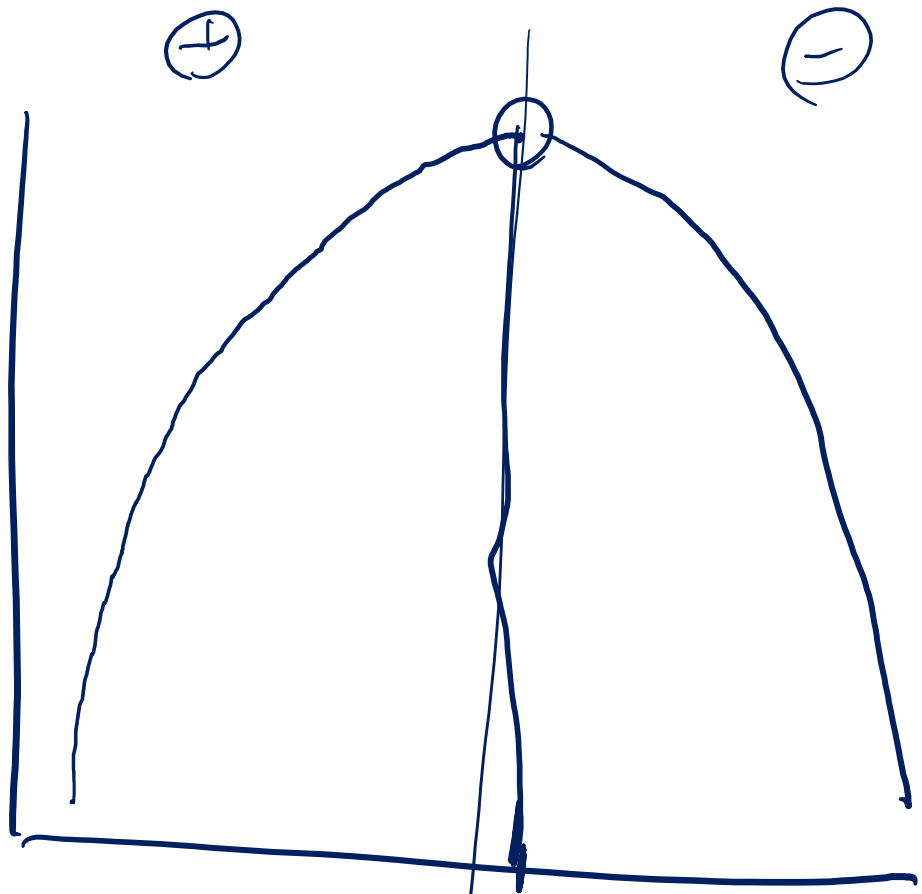
⊕ COUPLING

AT HIGHER TEMP:



⊖ COUPLING

DMSY
COVERAGE



TEMP
↑
! OPTIMUM!

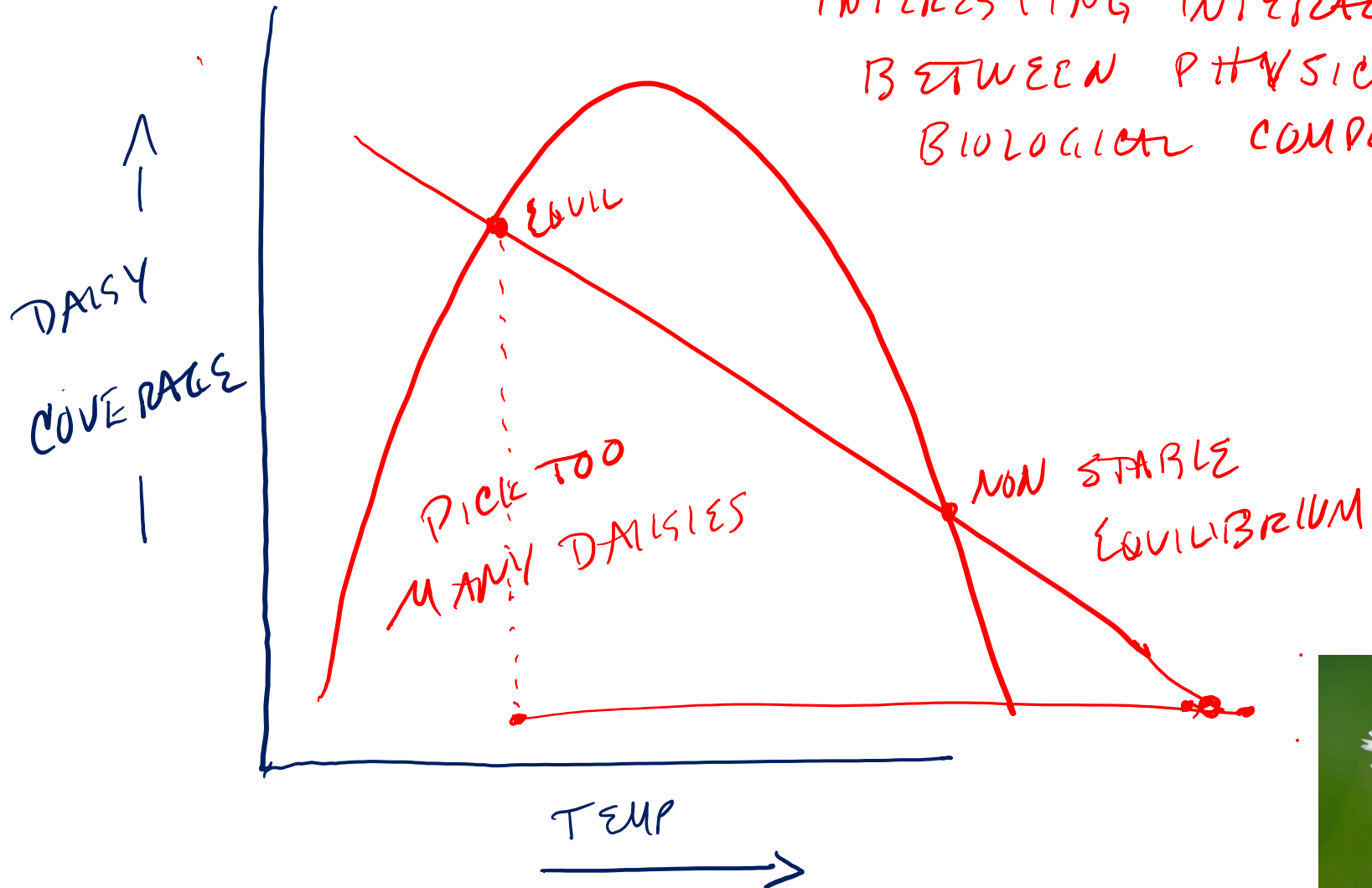
ALBEDO : REFLECTIVE

TABLE 2-1 Albedos of Some Common Surfaces

Type of Surface	Albedo
Sand	0.20–0.30
Grass	0.20–0.25
Forest	0.05–0.10
Water (overhead Sun)	0.03–0.05
Water (Sun near horizon)	0.50–0.80
Fresh snow	0.80–0.85
Thick cloud	0.70–0.80



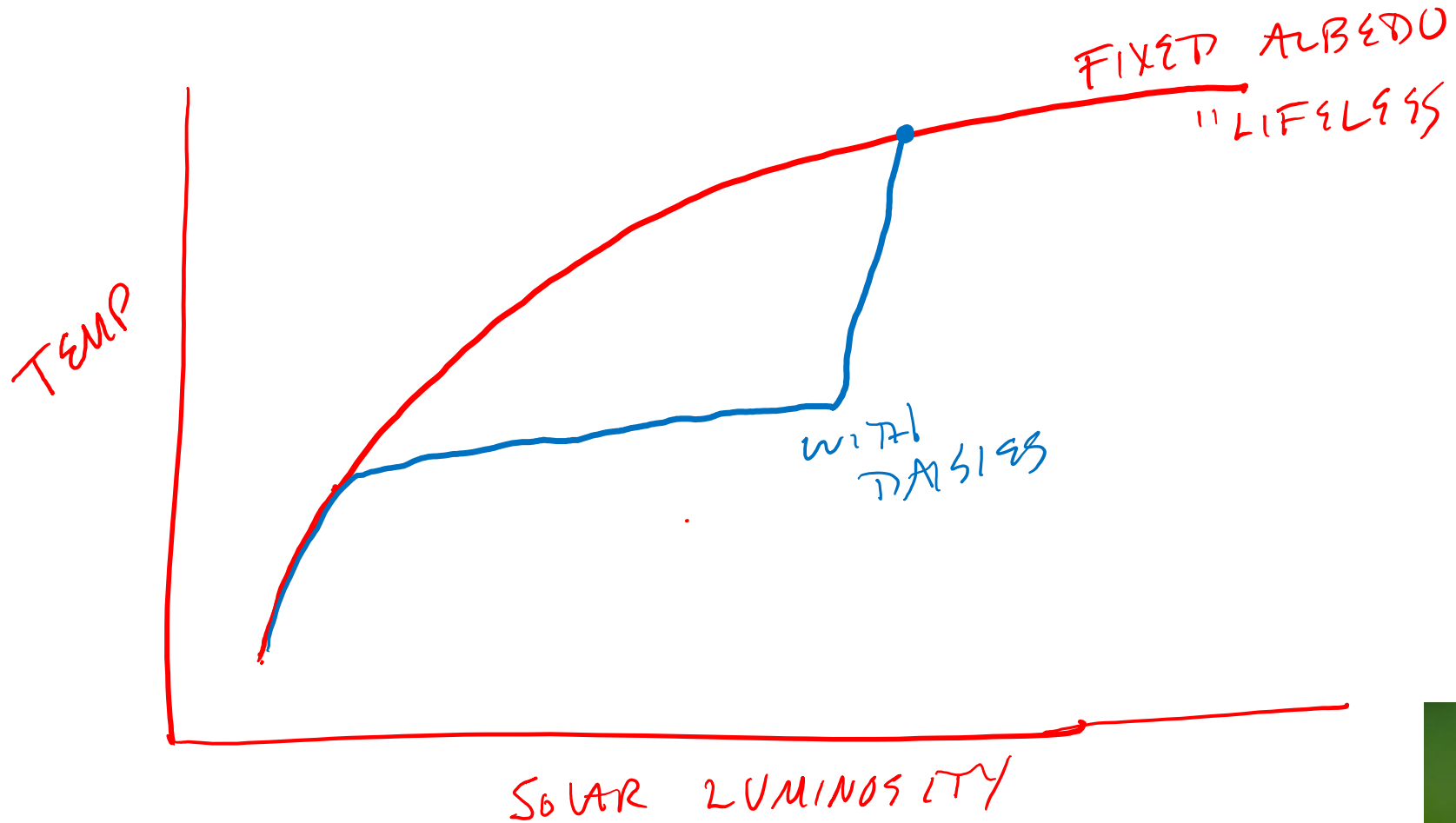
Systems approach: Daisy world

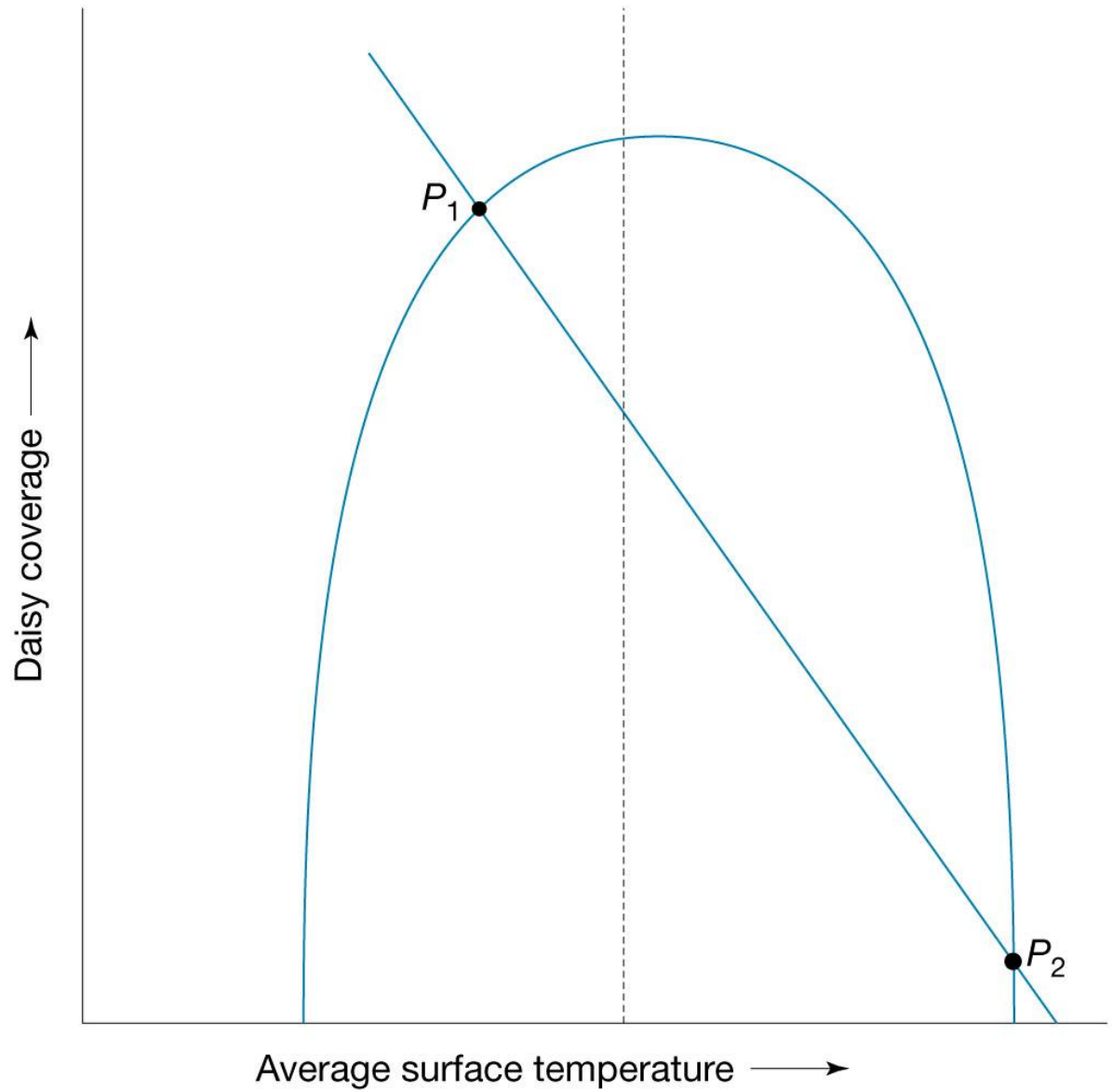


INTERESTING INTERACTION
BETWEEN PHYSICAL +
BIOLOGICAL COMPONENTS

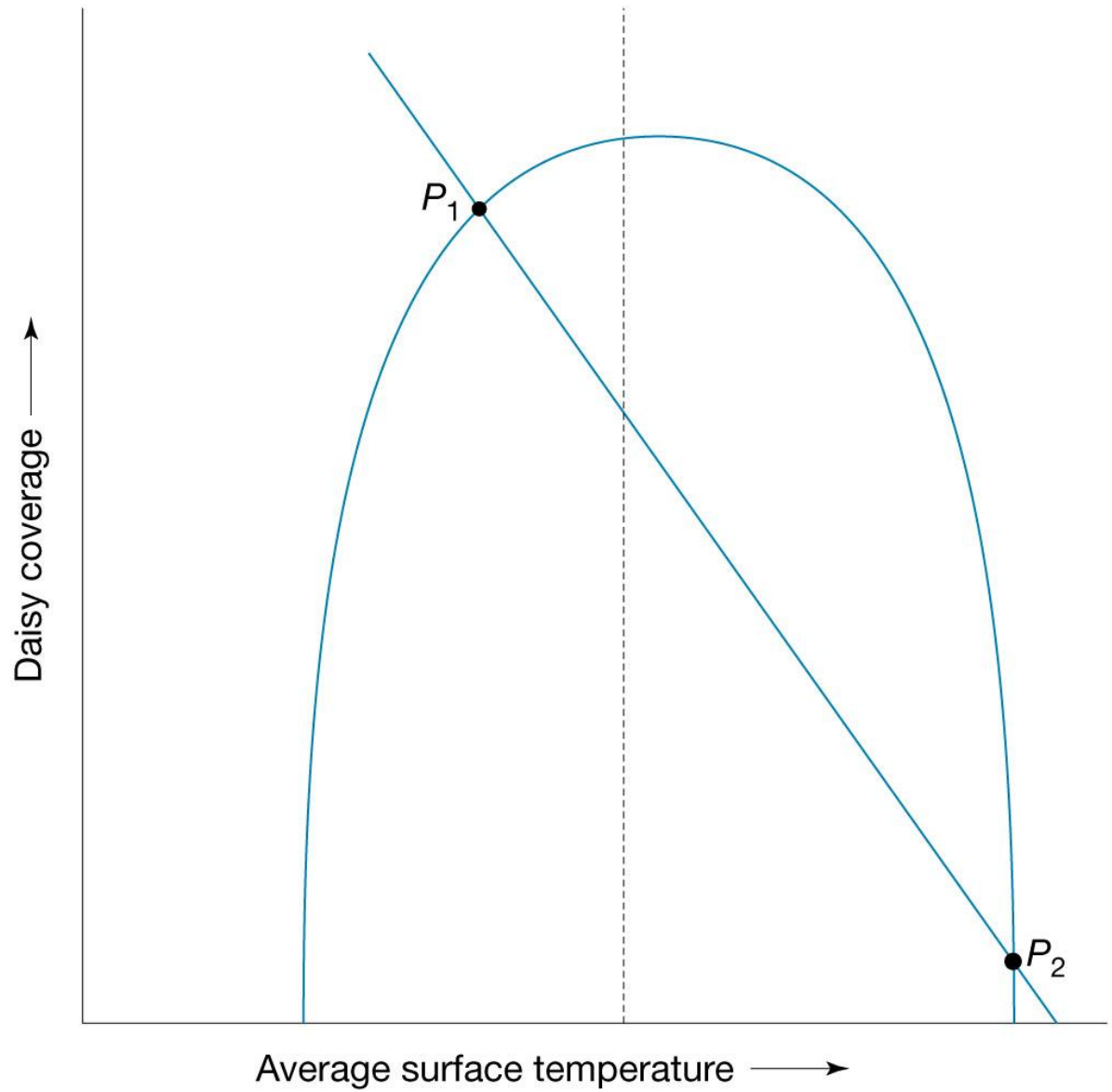


Systems approach: Daisy world



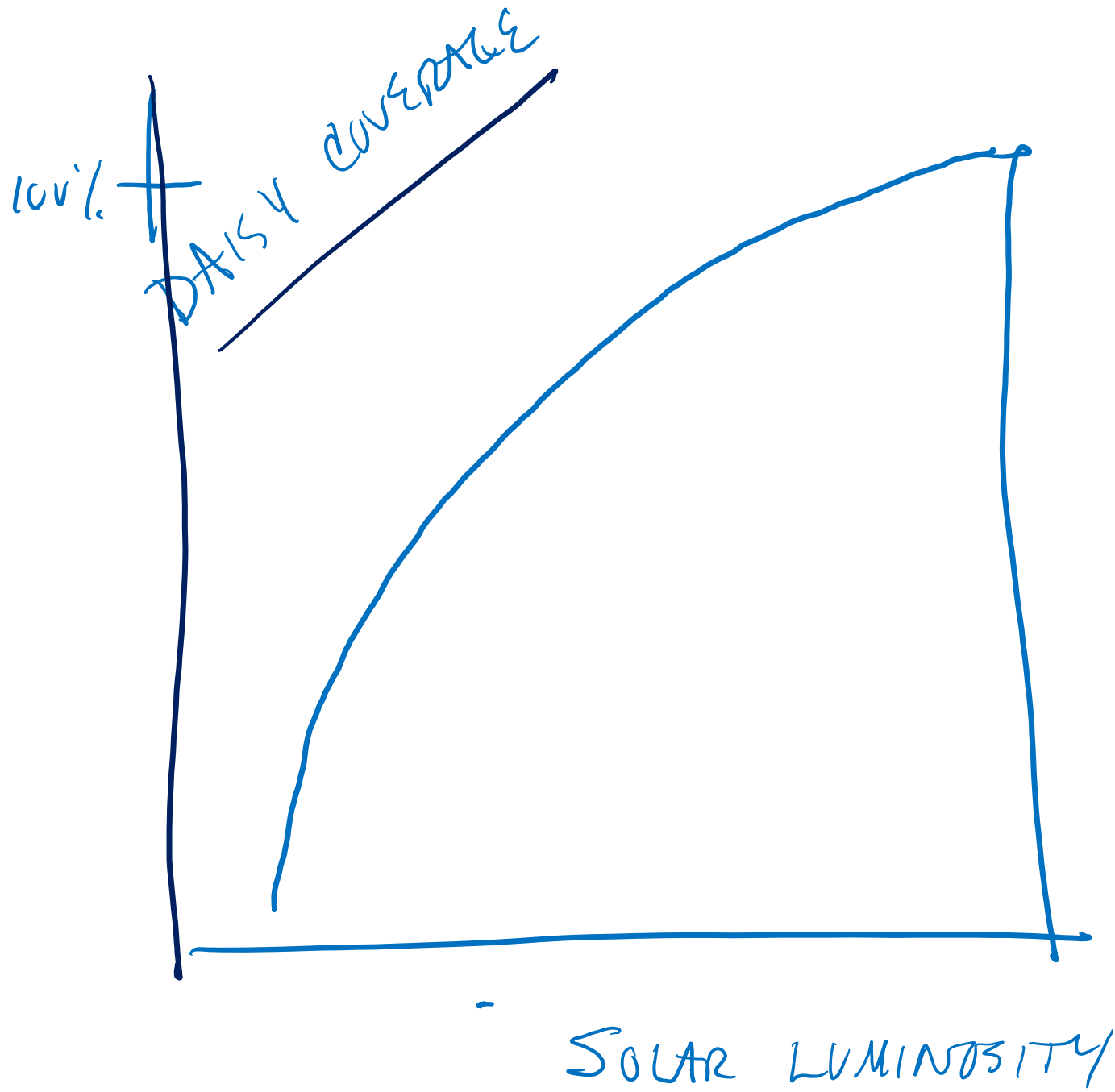


(a)



(a)

3NO DISK



External forcings: *what happens if we increase solar luminosity?*

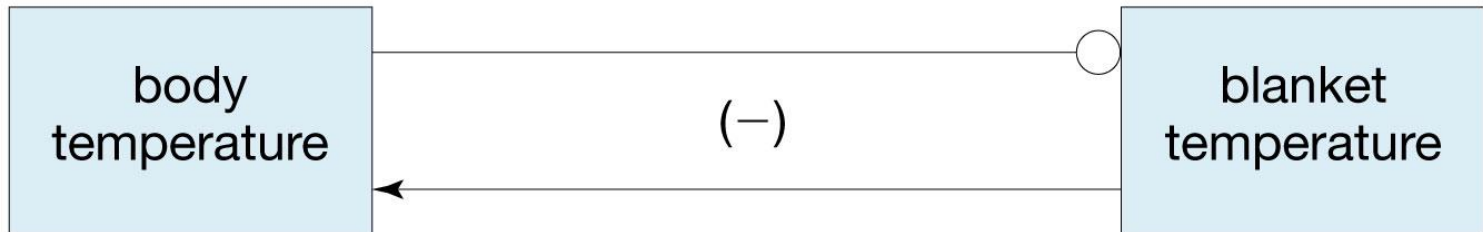




(a) Positive coupling



(b) Negative coupling



(c) Feedback loop (negative)