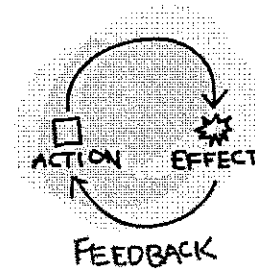


Title: Intro to Feedback Loops

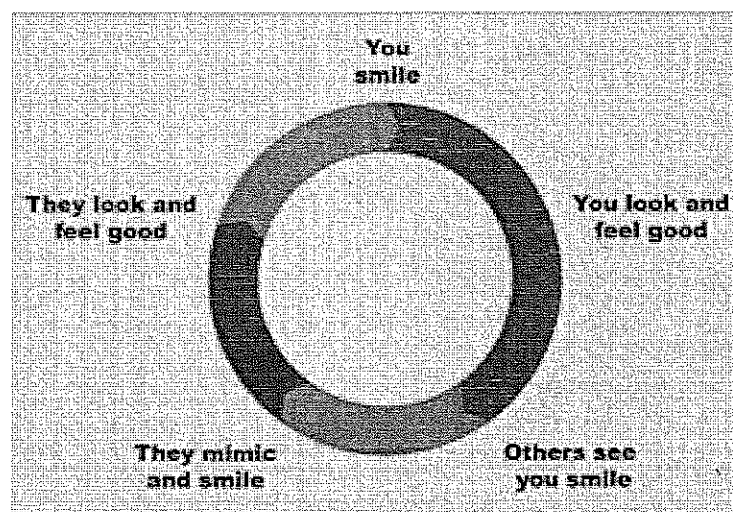
Introduction: The dynamic changes that take place through interactions of the geosphere, atmosphere, hydrosphere and biosphere can be better understood, modeled and predicted through the use of feedback loops. In this activity, you will learn what a feedback loop is and how they are used. Lets begin with the concept of **equilibrium**. Equilibrium can be defined as a system in balance, when the inputs and outputs do not vary over time. If something is in a state of equilibrium it is stable but not unchanging. When nature is left to itself, it often reaches equilibrium, at least until the next volcano or ice age arrives. These events are **actions**. People also create the "action" when we alter natural systems.

The action is often followed by an "effect". Think of what would happen if you reached over and poked the person next to you. What effect would you expect this to have on that person? Scientists call the reaction "feedback" and it can be negative or positive. Do not let these terms fool you, they may only be positive or negative depending on your point of view.

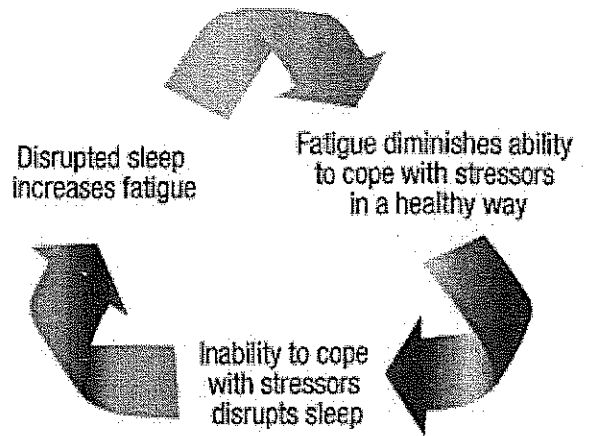


Lets say the person next to you yells and calls the teacher over to report your misbehavior. You promise not to poke anyone again. This would be an example of a **negative feedback loop** because the feedback reduces the action in the future. A **positive feedback loop** increases the likelihood of the action to occur again. Often, in a system negative feedback loops help to maintain equilibrium.

Lets look at some other examples. Smiling has been found to be contagious. Is this a positive or negative feedback loop? Does one smile increase or decrease the chances of another?



How about another important teen issue? Sleep and fatigue can be modeled in a feedback loop. Is this a positive or negative loop? Does disrupted sleep (like sleeping next to your phone) increase or decrease the likelihood of a poor nights sleep the next night?



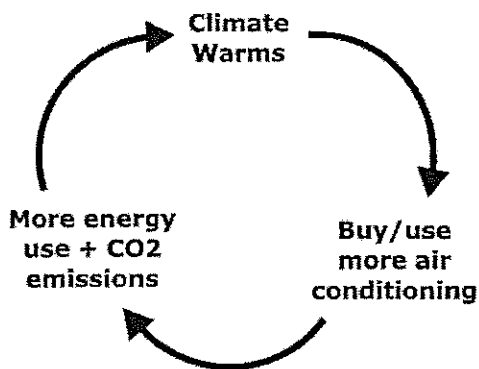
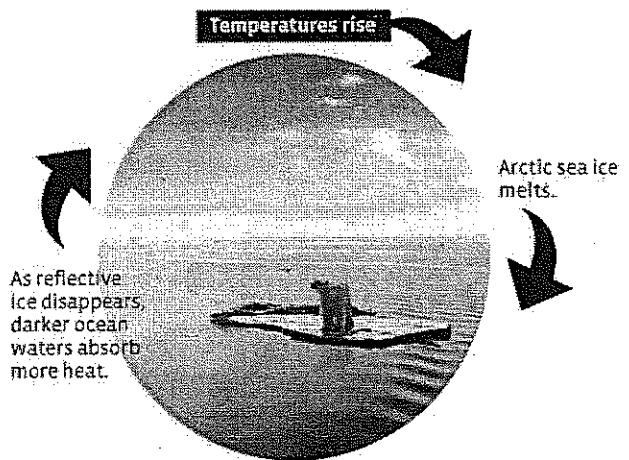
Lets look at some Earth Systems examples:

Is this a positive or negative loop?

How does this feedback loop help us better understand the dynamics of changes to planet Earth?

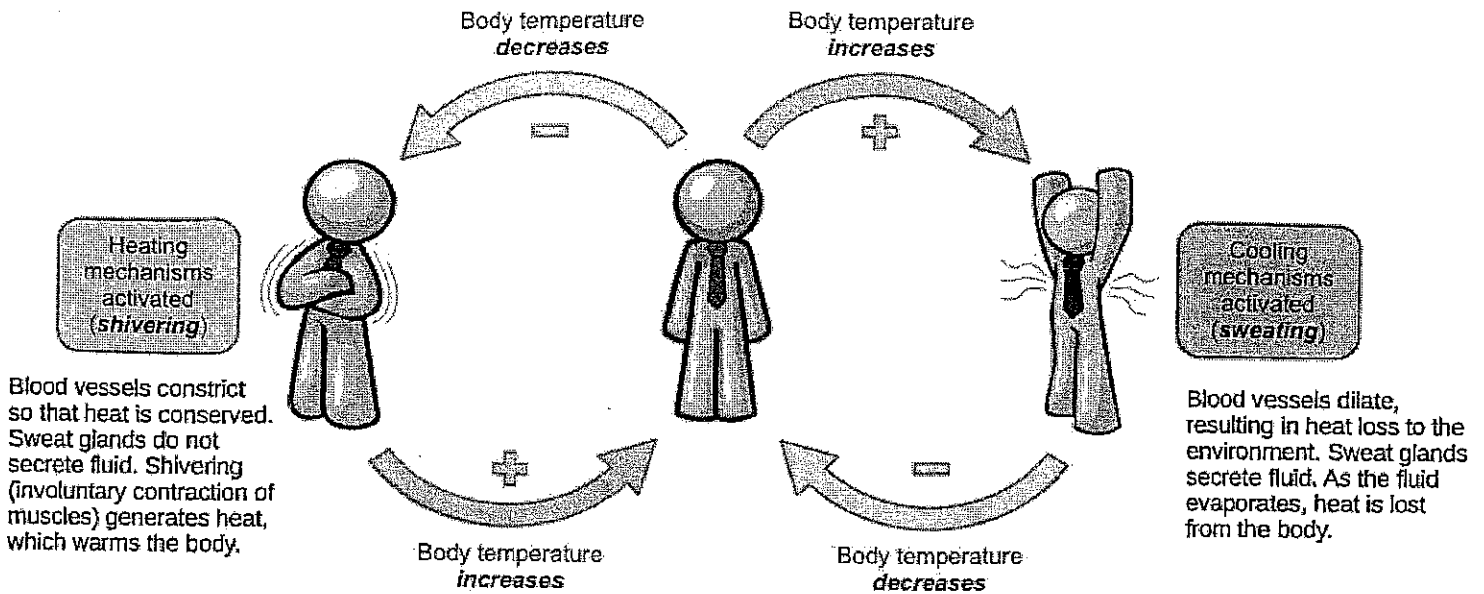
Why are feedback loops a way to see what direction our planet may he heading and how to prevent harmful changes?

VANISHING ARCTIC ICE



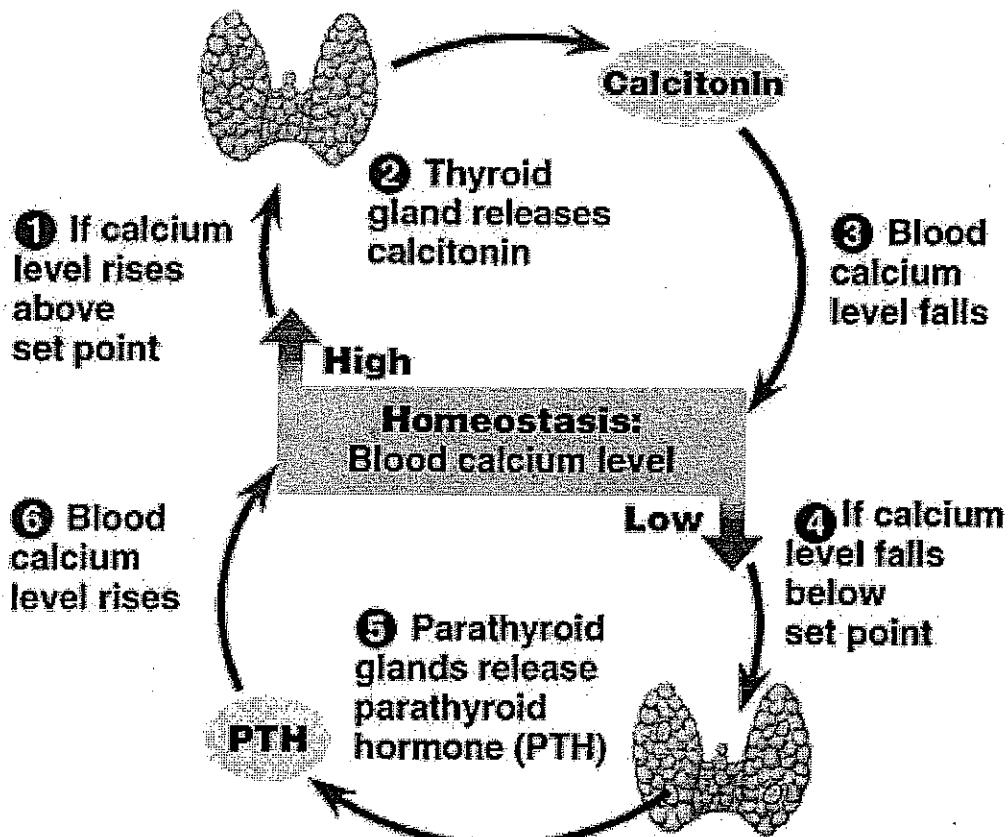
Here is another one. Positive or negative?

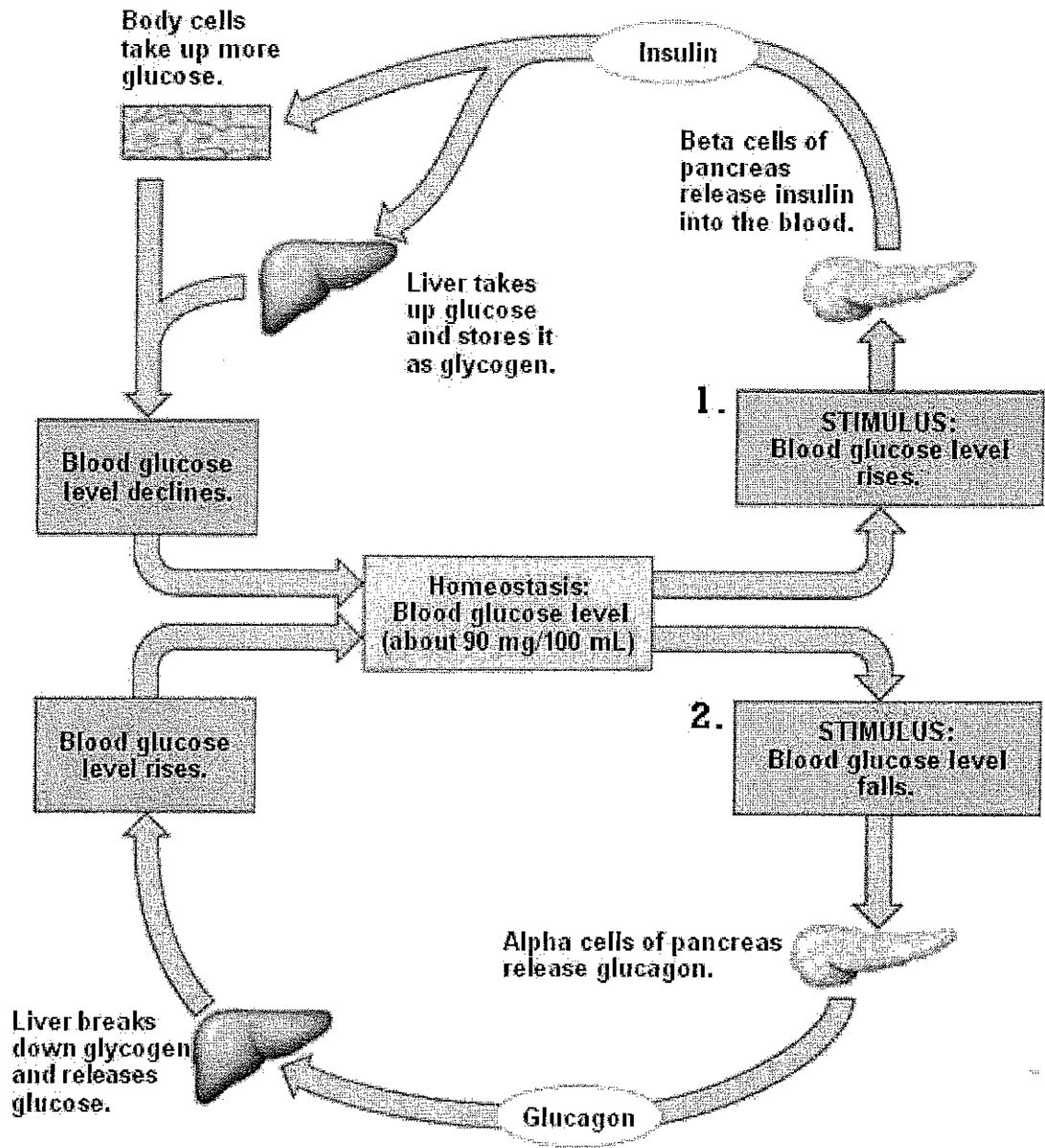
Can a cycle like this be changed once it starts?

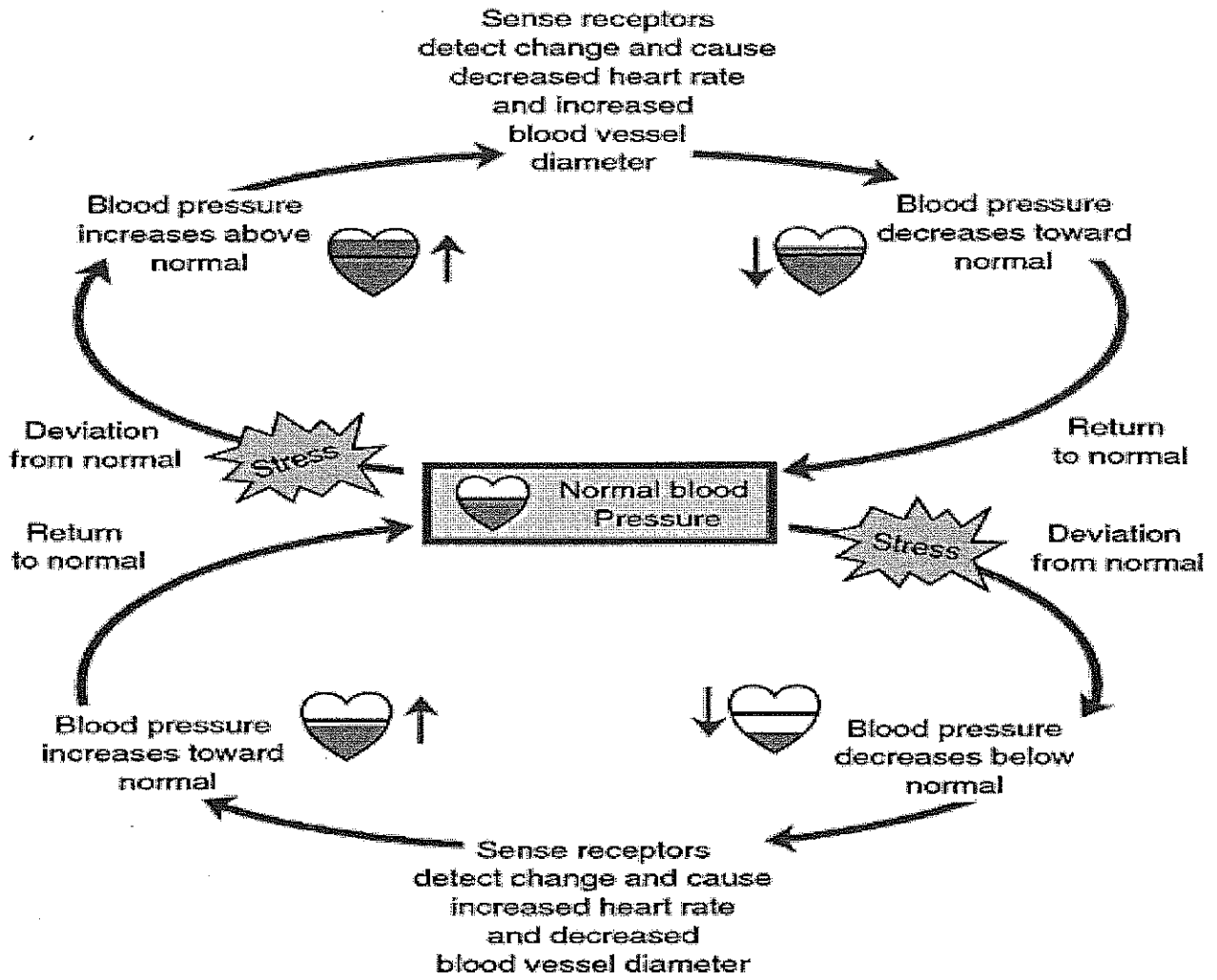


Body temperature

- Temp above 98.6F causes hypothalamus (in brain) sends signal for blood vessels to dilate and sweat to secrete.
- Temp lowers to 98.6F which stops the signal
- Temp below 98.6F causes hypothalamus to send signal for muscles to shiver, blood vessels to constrict
- Temp raises to 98.6F which stops the signal







Positive Feedback in Blood Clotting

