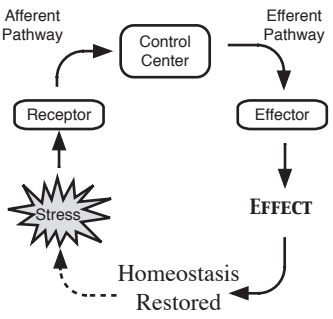
Feedback Systems

An Introduction to

Negative and Positive Feedback Systems

with emphasis on

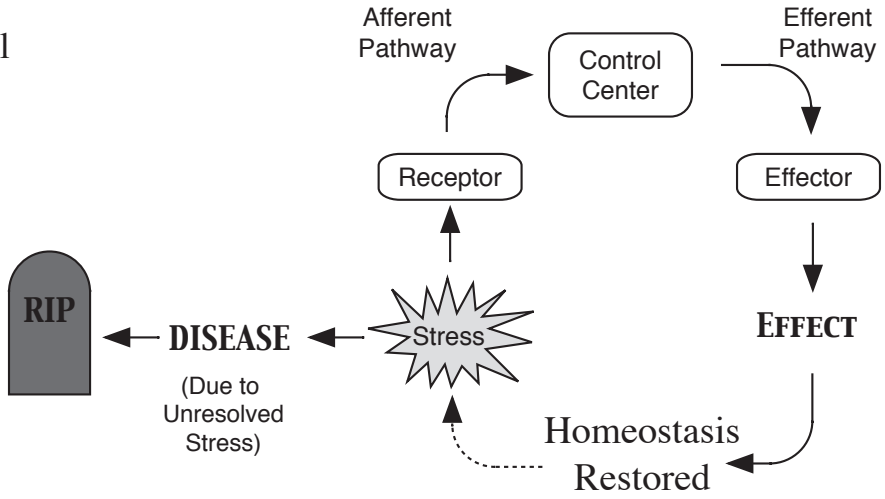
Homeostasis and Stress



By Noel Ways

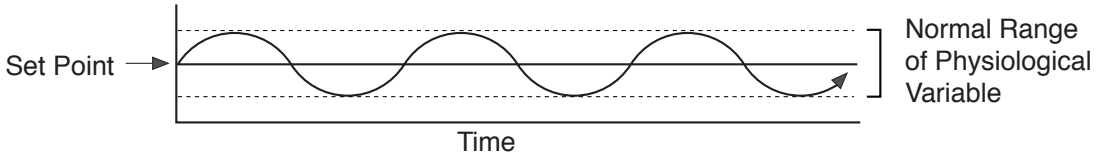
Control Paradigm
(Negative Feedback System)

Homeostasis refers to the ability of the body to control physiological variables within precise and optimal ranges where health is sustained. Such variables will include body temperature, blood pressure, ion and mineral concentrations, to name a few. Each physiological variable will be monitored by a control center. The control center having received information regarding the physiological variable will evaluate it with reference to a genetically predetermined set point. Should the variable have deviated above or below the set point, a state of "stress" will have occurred, and the system will respond to negate the "stress".



A disruption of Homeostasis will activate the system.

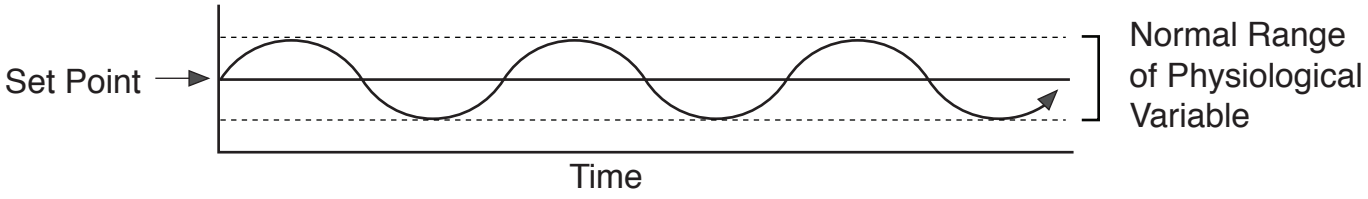
System inactivated once homeostasis is restored



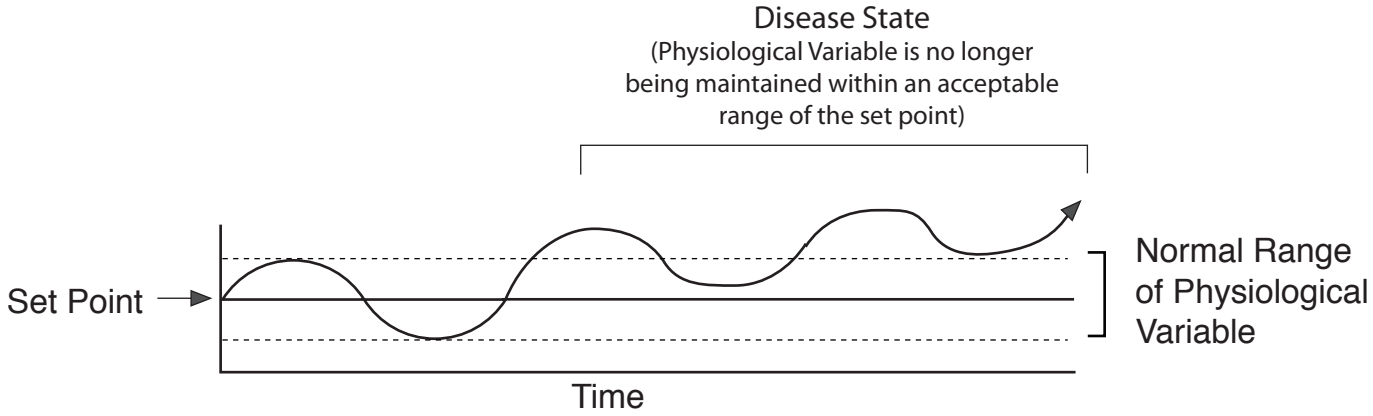
Such a system that negates stress is called a negative feedback system as the stress is negated or removed.

When considering a particular physiological variable, unique cells or collections of cells called receptors will have a specific function to respond to the variable. The types of receptors are vast: chemoreceptors, baroreceptors, light receptors, stretch receptors are examples. The information received will then be transmitted to the control center by an afferent pathway. If a determination is made that stress exists, a message will then be sent by an efferent pathway to an effector. The effector will have the job of bringing the variable back to the set point (the effect). Once accomplished, homeostasis is restored.

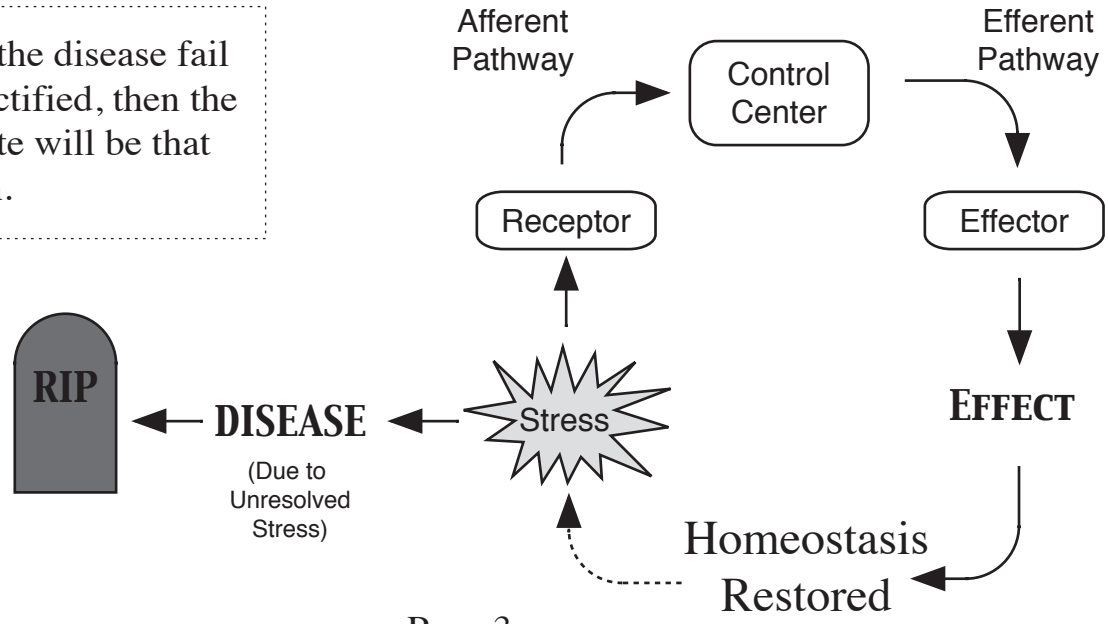
Physiological variables tend to oscillate within an acceptable range above and below the set point. Each time the variable deviates above or below the set point, the appropriate negative feedback system will bring the variable back to the set point.



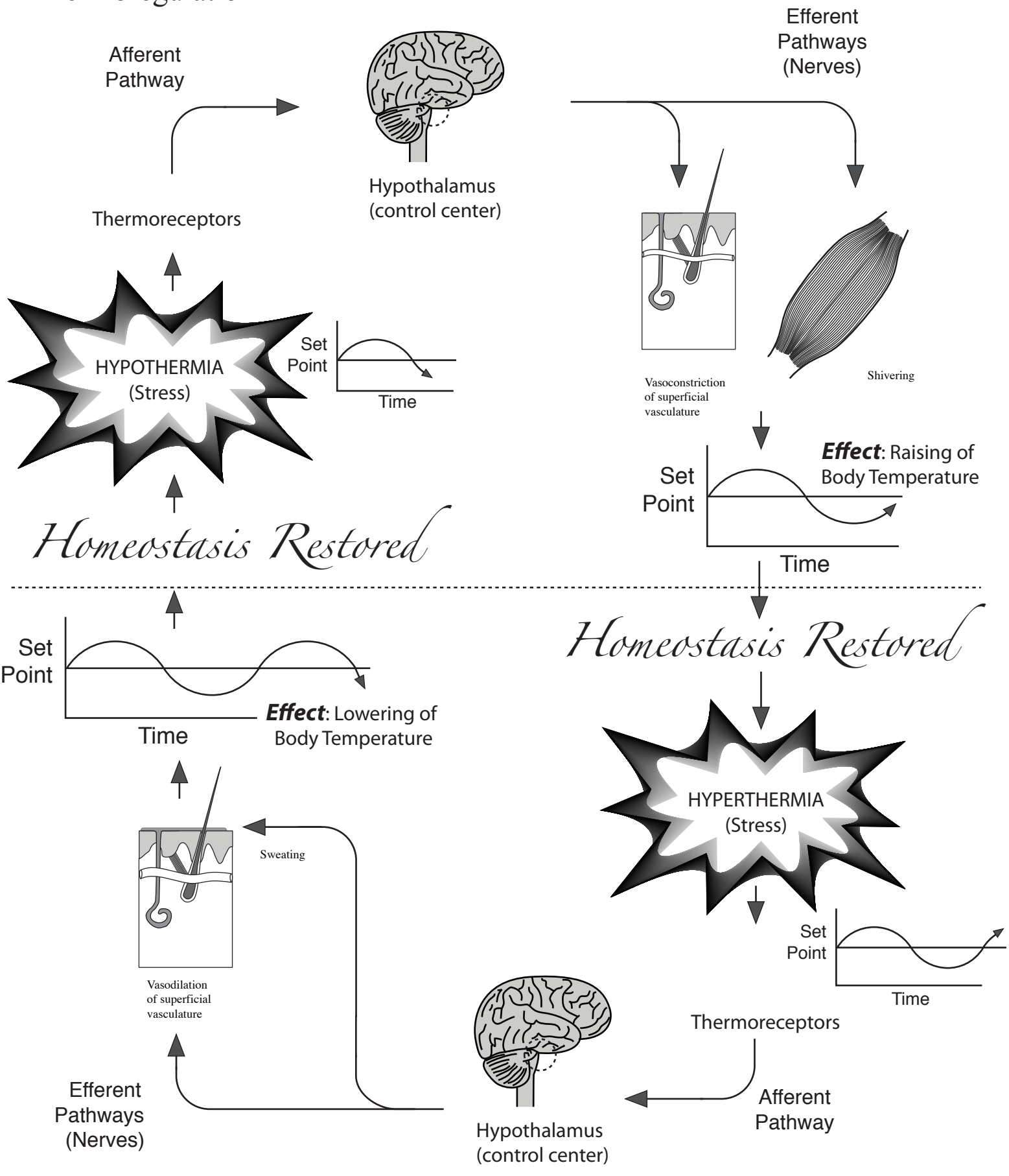
Should there be a breakdown in a control mechanism, sustained stress will occur. Conditions (or a condition) are no longer optimal to support life and a state of disease will result. If the state of disease is not remediated, a state of death will ultimately occur.



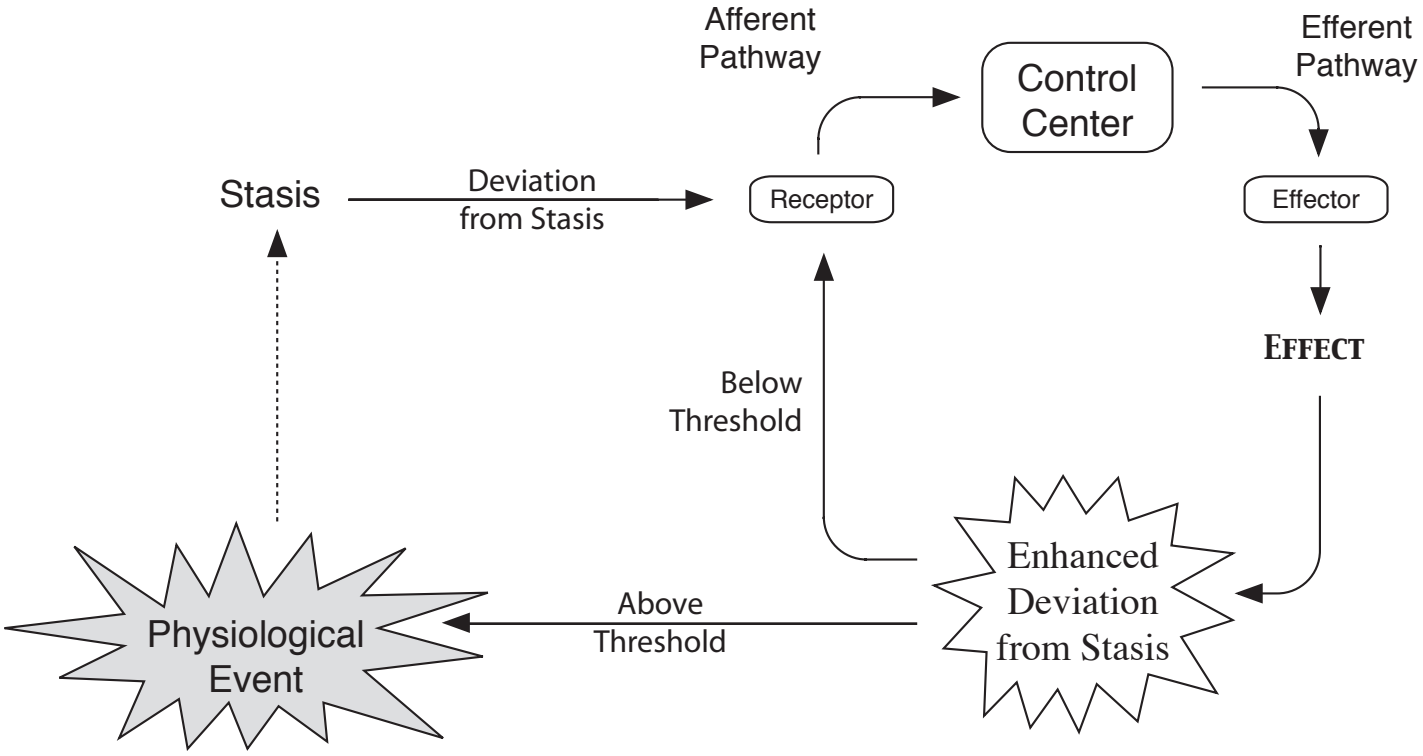
Should the disease fail to be rectified, then the next state will be that of death.

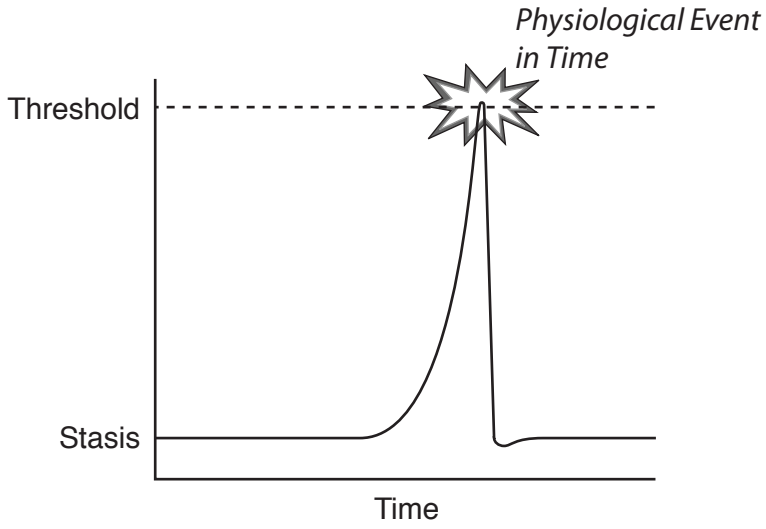


Example of a Negative Feedback System: Thermoregulation

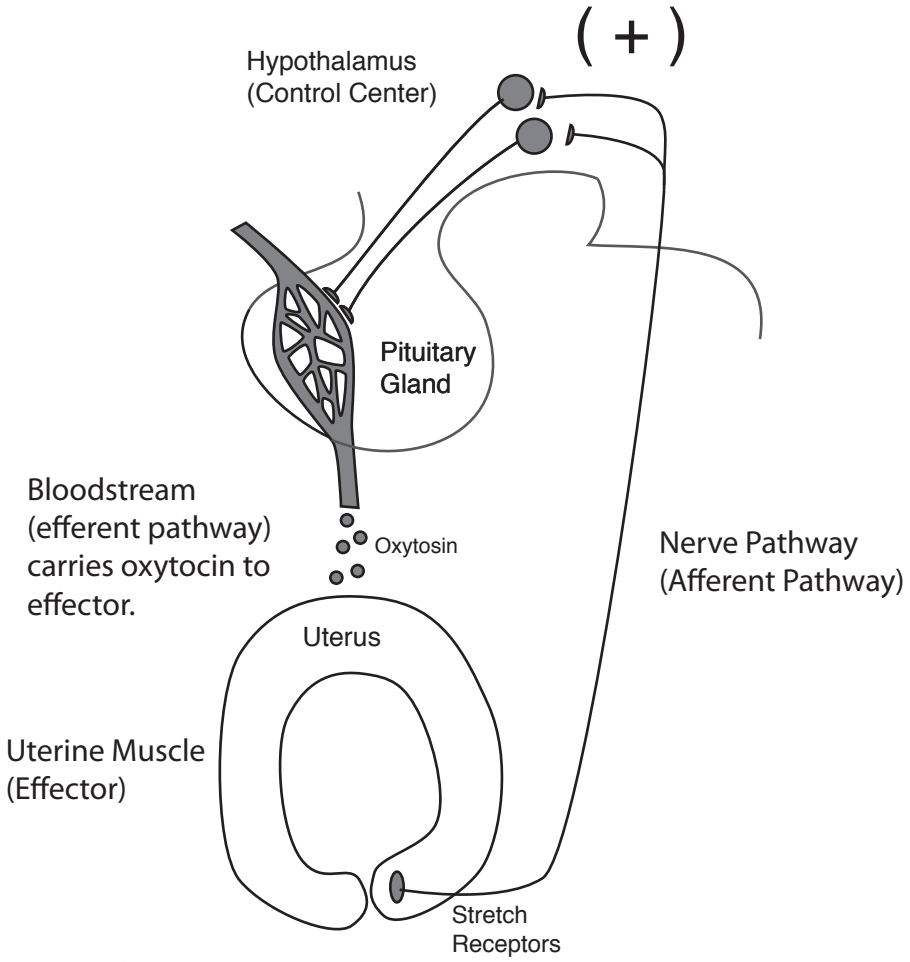


Control Paradigm
(Positive Feedback System)

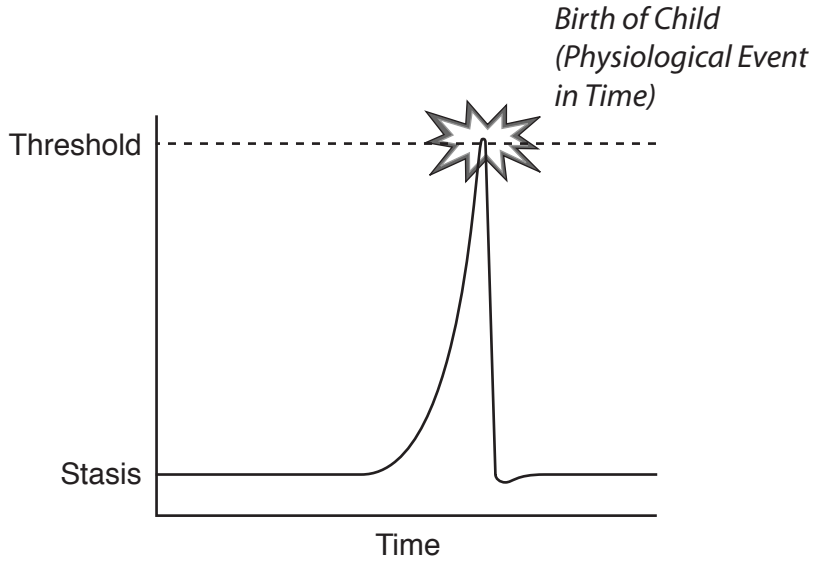




Example of a Positive Feedback System: Childbirth



Effect: increased contractions / pressure will lead to a physiological event: birth.



Childbirth is an example of a positive feedback mechanism. Where the original stimulus will enhance or reinforces. The result will be a building process that culminates in a physiological event in time. Once the event occurs the system ceases. In this particular system, the term stasis is used instead of "set point". Once the system is set in motion the building process proceeds until a particular threshold is hit at which time a physiological event occurs

In the case of childbirth, the initial stretching of the cervix causes local stretch receptors to send nerve impulses (afferent pathway) to the hypothalamus (control center), which in turn causes the pituitary gland to secrete the hormone oxytocin into the blood stream (efferent pathway). The oxytocin signals the muscular uterus to contract to result in further stretching of the stretch receptors. These receptors will further signal the hypothalamus to yet again have the pituitary gland secrete more oxytocin. The cycle continues with ever increasing contractions as more and more oxytocin is secreted. Eventually, the pressure reaches a threshold at which point the baby is expelled (a "threshold" has been reached), and the system returns to stasis.