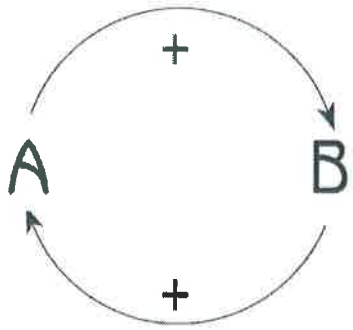
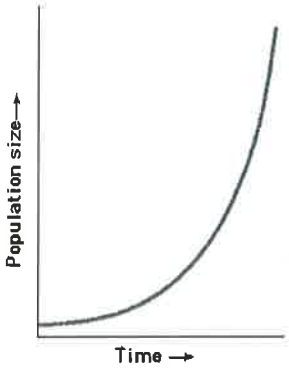
Name Key Date _____

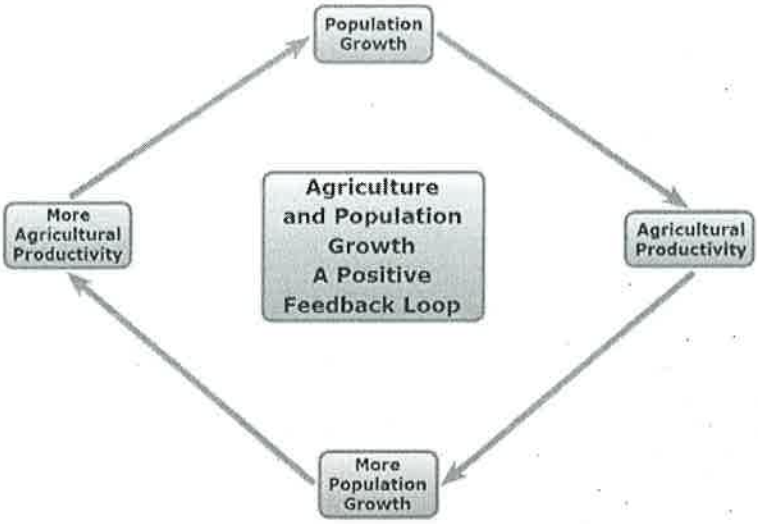
Positive and Negative Feedback Loops

Feedback loops can be shown on 2 different types of graphs.

The graph to the left below is called a feedback loop graph. Specifically this one is illustrating a positive feedback loop in the fact that A leads to B which in turn leads to an **increase** A which in turn leads to an **increase** B and so on and so forth—a snowball effect. The same is true of a decrease as well. A system that is in a positive feedback loop is normally considered in a state of chaos because this system cannot proceed indefinitely. The graph to the right below is a trend line graph of a positive feedback. It shows exponential growth.

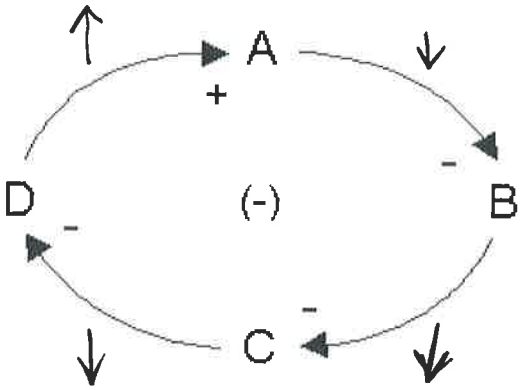


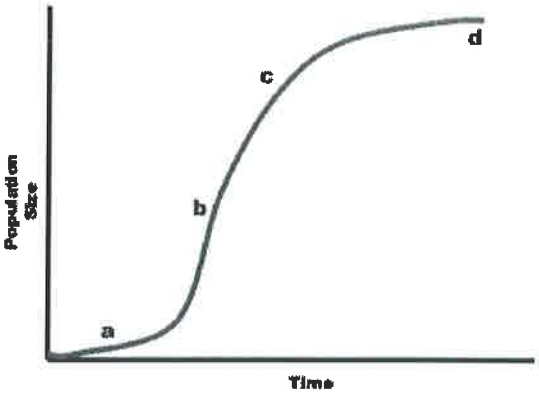




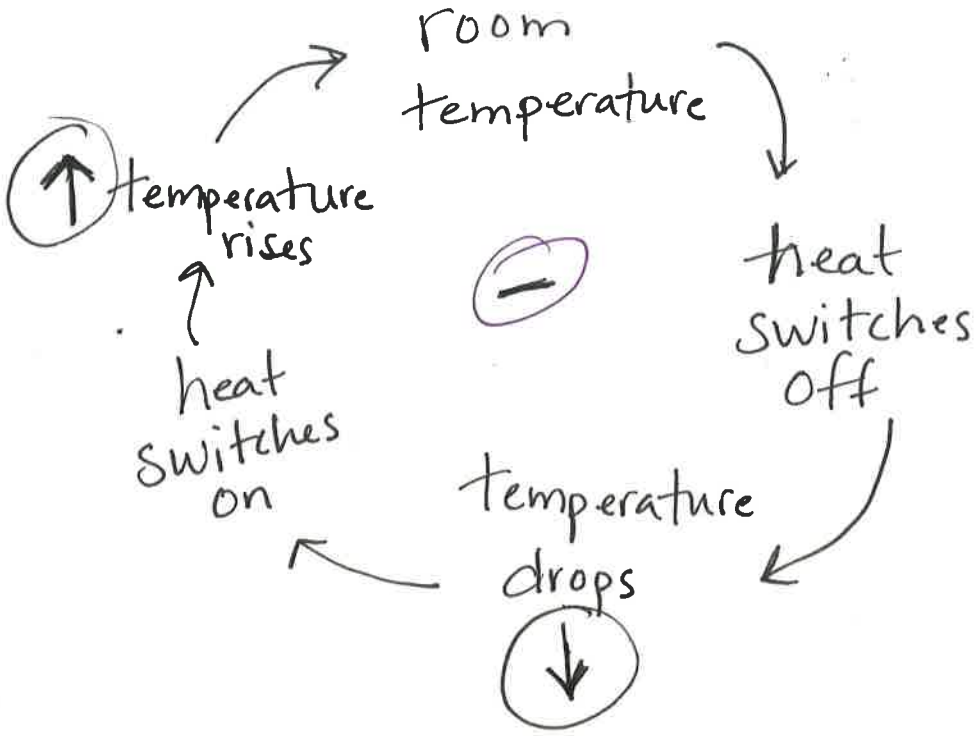
The example to the left shows how **increased** production of food leads to an **increase** in the human population. The more people there are the more food is needed which leads to an **increase** in food production which, in turn, leads to an **increase** in the number people.

A negative feedback loop keeps the system from going into a snowball effect. The graph to the left below show how some factors **decrease** thus keeping the **increases** in check. The graph to the left below shows how a negative feedback looks on a trend line. It shows a logistical growth. A system in a negative feedback is normally considered in equilibrium and can proceed this way indefinitely.



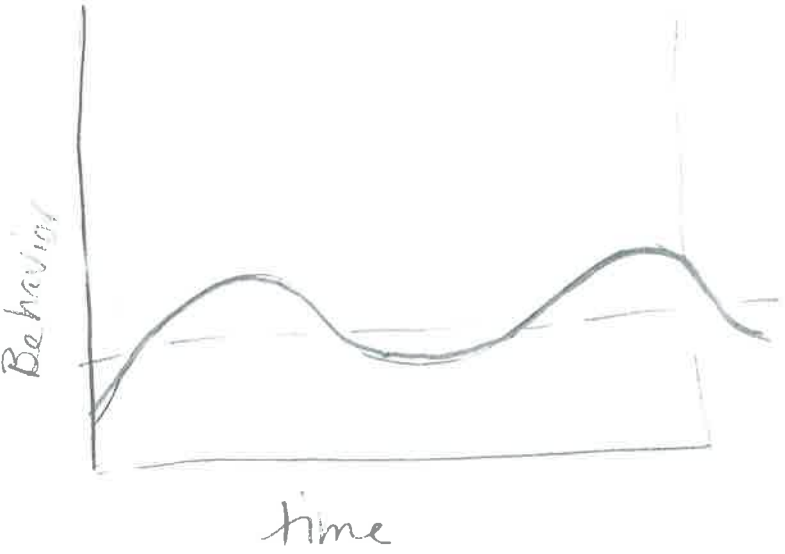


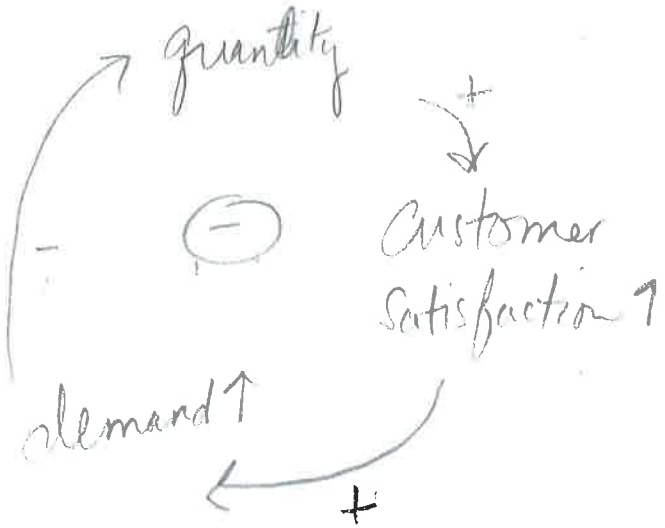
In the negative feedback loop below you can see how your thermostat at home works to keep your house at a constant temperature. As your house temperature **decreases** the thermometer on your thermostat detects the drop in temperature which tells your furnace to switch on. This causes the temperature to **increase** back to the normal temperature which, in turn, switches the heat off. Eventually the temperature in your house **decreases**, so the heat switches back on.



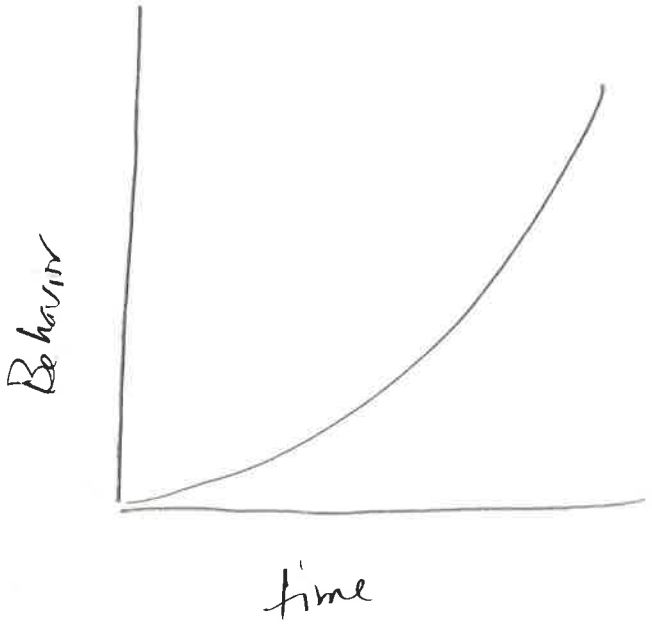
Draw a feedback loop AND a trend graph (with labeled axis) for the following scenarios:

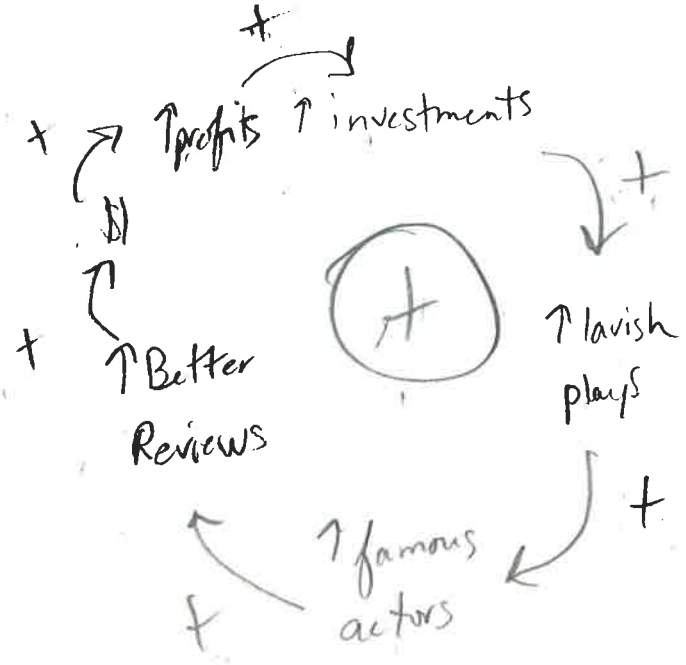
1. An under-resourced company is trying to raise quality. If customer satisfaction is raised then demand for the product will increase. More demand typically makes the quality of the resources go down.





2. A theatre is trying to improve its profitability by investing more in productions. As more investment is put into a production, the theatre is able to put on more lavish plays with more famous actors. Better plays should bring better reviews, and therefore higher ticket sales. This should lead to higher profitability, and therefore more money available to invest in future productions.





Global Warming and Feedback Loops

3. Here are a number of examples of how both positive and negative feedback mechanisms might operate in the physical environment. No one can be sure which of these effects is likely to most influential, and consequently we cannot know whether or not the Earth will manage to regulate its temperature, despite human interference with many natural processes.

Label each example as either positive or negative feedback. Draw loop graphs of one example of positive feedback and one example of negative feedback. Label your arrows with the words increase or decrease and put a + or – sign in the middle of the loop to show a positive or negative feedback.

___ a. As carbon dioxide levels in the atmosphere rise, the temperature of the Earth rises. As the Earth warms the rate of photosynthesis in plants increases, more carbon dioxide is therefore removed from the atmosphere by plants, reducing the greenhouse effect and reducing global temperatures.

___ b. As the Earth warms, ice cover melts, exposing soil or water. Albedo decreases (albedo is the fraction of light that is reflected by a body or surface). More energy is absorbed by the Earth's surface. Global temperature rises. More ice melts.

___ c. As the Earth warms, upper layers of permafrost melt, producing waterlogged soil above frozen ground. Methane gas is released into the environment. The green house effect is enhanced. The Earth warms, melting more permafrost.

___ d. As the Earth warms, increased evaporation produces more clouds. Clouds increase albedo, reflecting more light away from the Earth. The temperature falls. Rates of evaporation fall.

___ e. As the Earth warms, organic matter in soil is decomposed faster, more carbon dioxide is released, the enhanced greenhouse effect occurs, the Earth warms further and rate of decomposition increase.

___ f. As the Earth warms, evaporation increases. Snowfall at high latitudes increases. Icecaps enlarge. More energy is reflected by increased albedo of ice cover. The Earth cools. Rates of evaporation fall.

___ g. As the Earth warms, polar icecaps melt, releasing large numbers of icebergs into oceans. Warm ocean currents such as the Gulf Stream are disrupted by additional freshwater input into oceans. Reduced transfer of energy to the poles reduces temperature at high latitudes. Ice sheets reform and icebergs retreat. Warm currents are re-established.

Diagram 1
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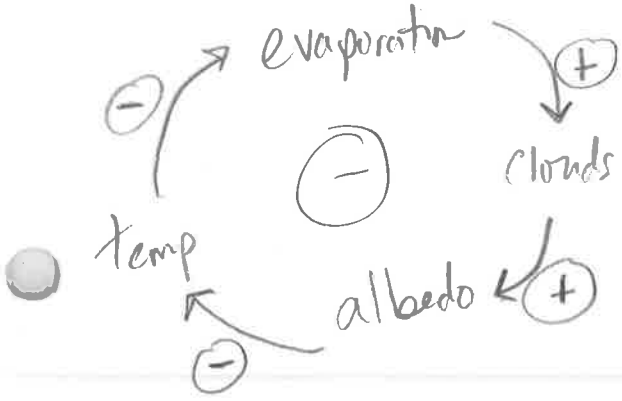

Diagram 2
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