Climate Change Factors (quick review)

Climate Prediction

Feedback Mechanisms

Climate Change Factors

External

Solar Variations
- Orbital Patterns
- Sunspots

Solid Earth Variations
- Position of Plates
- Spreading Rates
- Volcanism
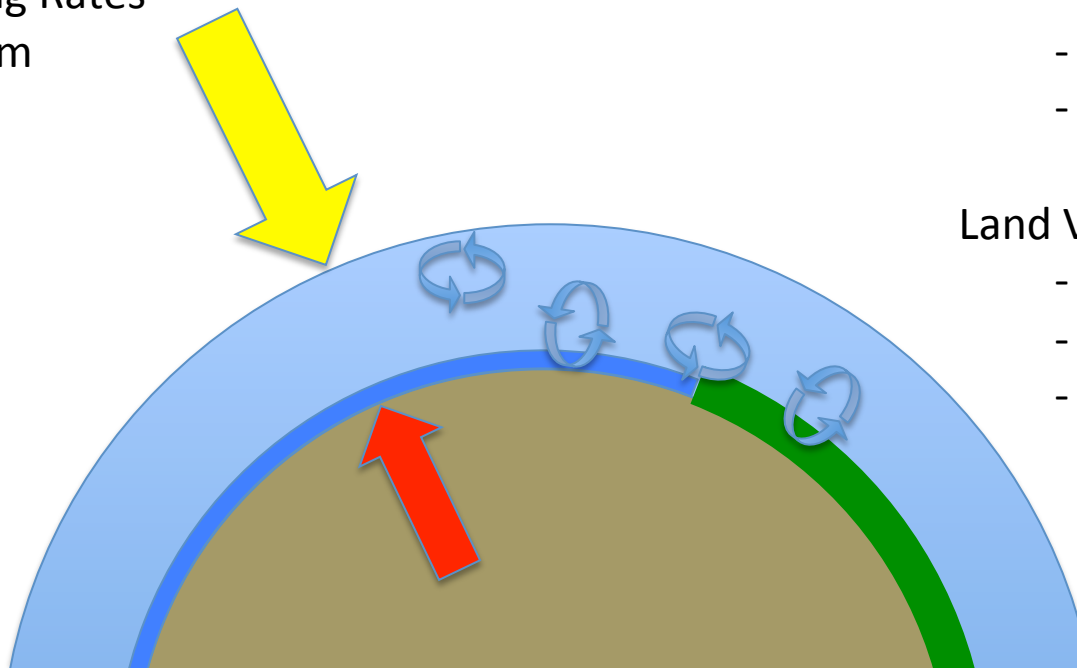
Internal

Atmosphere Variations
- Clouds
- Winds
- Composition

Ocean Variations
- Ocean Circulation
- Composition
- Ice Cover

Land Variations
- Land use
- Sea Level
- Vegetation

How will an increase in clouds impact global climate ????

Think-Pair-Share
- Create causal chain (e.g., clouds increase => cause A => cause B => cause C)
- Hint: think temperature & evaporation

Clouds Increase
=> Earth cooler during day
=> Less evaporation
=> **Clouds decrease**
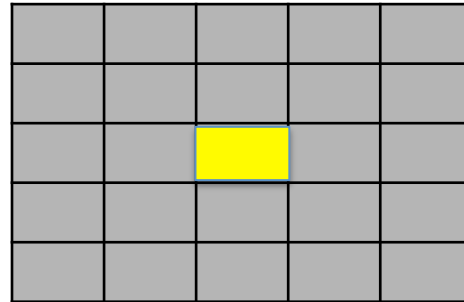=> Earth warms
=> More evaporation
=> **Clouds increase**

Clouds Increase
=> Earth warmer at night
=> More evaporation
=> **Clouds increase**
=> Earth warmer at night
=> More evaporation
=> **Clouds increase**

Negative Feedback   Positive Feedback
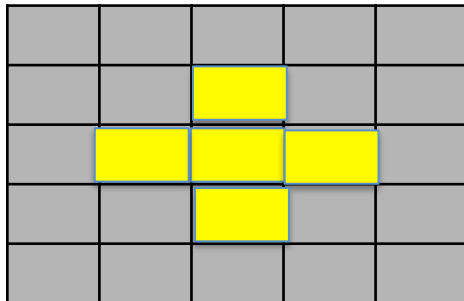
Activity

Model Earth

<u>Step 1</u>
- Place yellow post-its (i.e., daisies) on any grid cell

Repeat Step 2

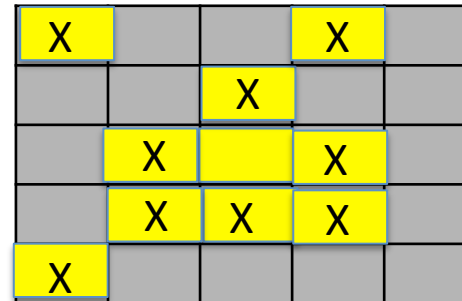<u>Step 2</u>
- Count no. of daisies & record on graph

If no. daisies < 10

If no. daisies >= 10

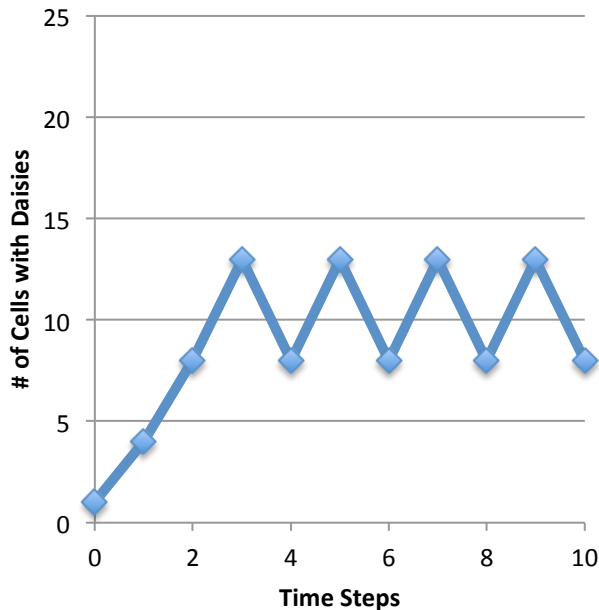Repeat Step 2

<u>Step 3a</u>
- Place new daisies next to existing daisies

<u>Step 3b</u>
- Remove daisies adjacent to gray grid

1 Daisy (Yellow Post-it) anywhere

# of Yellow Post-its (y-axis: 0, 5, 10, 15, 20, 25)

Time Step (x-axis: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10)

5 Daisies (Yellow Post-it) anywhere

# of Yellow Post-its (y-axis: 0, 5, 10, 15, 20, 25)

Time Step (x-axis: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10)

Daisies Increase
=> Increase Albedo (reflectivity)
=> Earth cools
=> **Temp. still good for daisies, so daisies increase**
=> Increase Albedo
=> Earth cools
=> **Temp. bad for daisies, so daisies decrease**
=> Decrease Albedo
=> Earth warms
=> **Temp. good for daisies, so daisies increase**

Clouds Increase
=> Earth cooler during day
=> Less evaporation
=> **Clouds decrease**
=> Earth warms
=> More evaporation
=> **Clouds increase**

Clouds Increase
=> Earth warmer at night
=> More evaporation
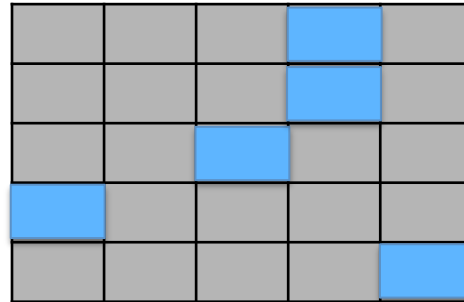=> **Clouds increase**
=> Earth warmer at night
=> More evaporation
=> **Clouds increase**
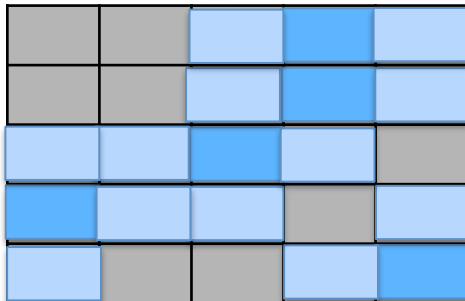
Activity

Model Earth

Step 1
- Place 5 blue post-its (i.e., glaciers) on any grid cell

Repeat Step 2

Repeat Step 2
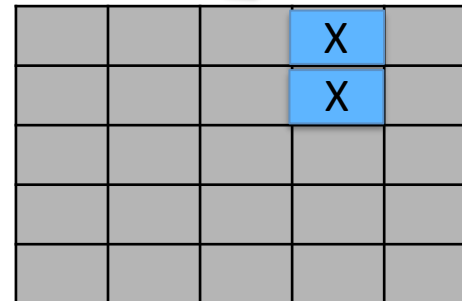
Step 2
- Count no. of glaciers, negate & record on graph

If -glaciers < minimum T (**-2**)

If –glaciers >= minimum T (**-2**)

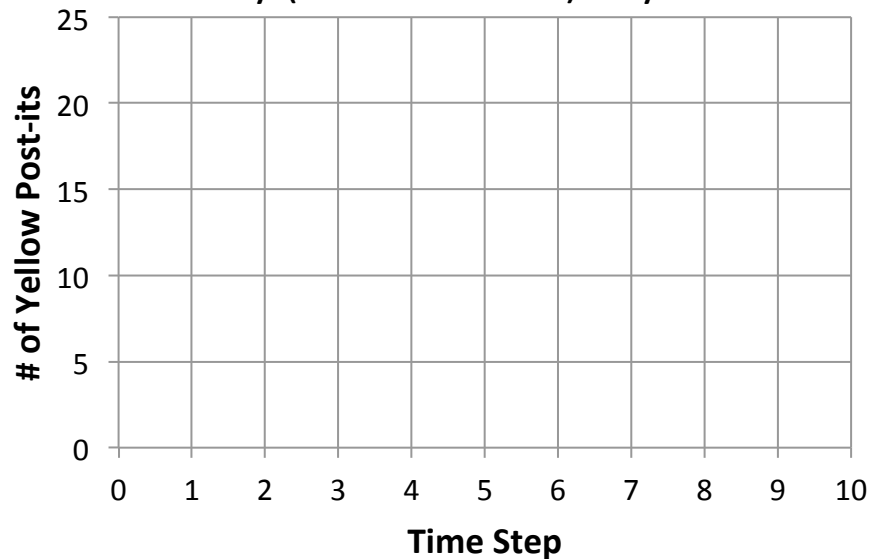|			X	
			X	

Step 3a
- Place new glaciers next to existing glaciers

Step 3b
- Remove glaciers adjacent to gray grid

1 Daisy (Yellow Post-it) anywhere

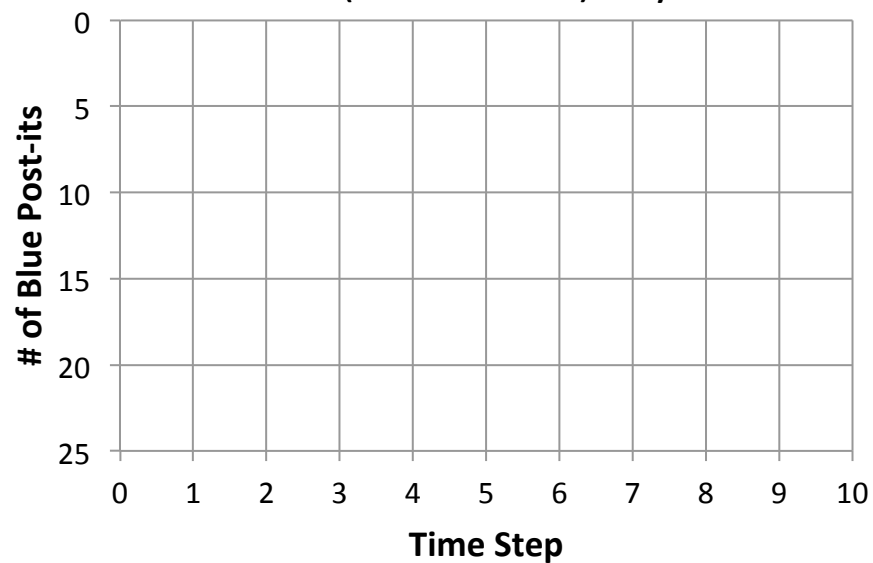Y-axis: **# of Yellow Post-its** (0, 5, 10, 15, 20, 25)
X-axis: **Time Step** (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10)

1 Glacier (Blue Post-it) anywhere

Y-axis: **# of Blue Post-its** (0, 5, 10, 15, 20, 25)
X-axis: **Time Step** (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10)

5 Daisies (Yellow Post-it) anywhere

Y-axis: **# of Yellow Post-its** (0, 5, 10, 15, 20, 25)
X-axis: **Time Step** (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10)
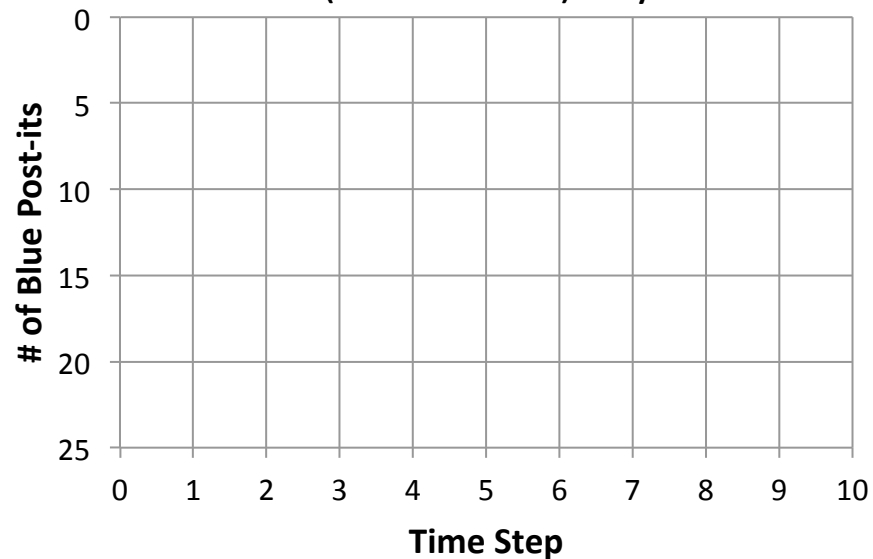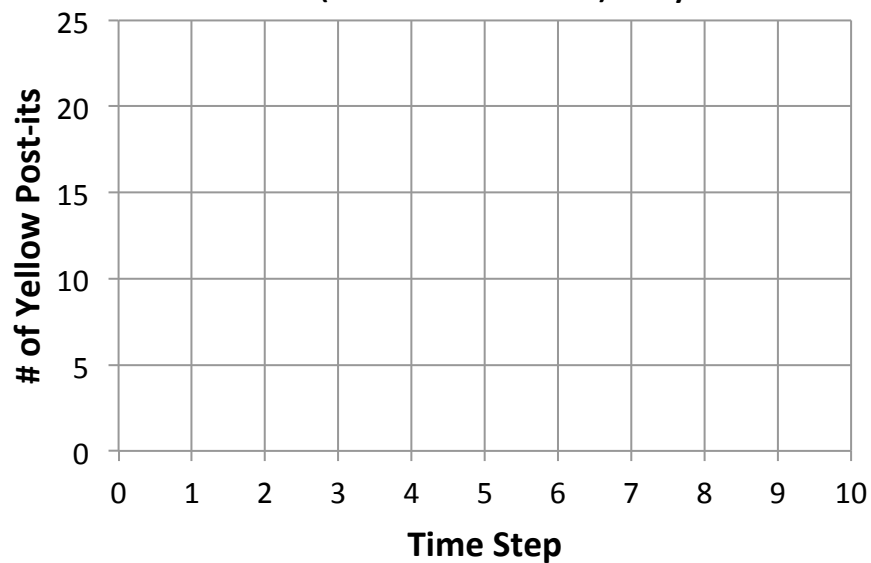
5 Glaciers (Blue Post-it) anywhere

Y-axis: **# of Blue Post-its** (0, 5, 10, 15, 20, 25)
X-axis: **Time Step** (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10)
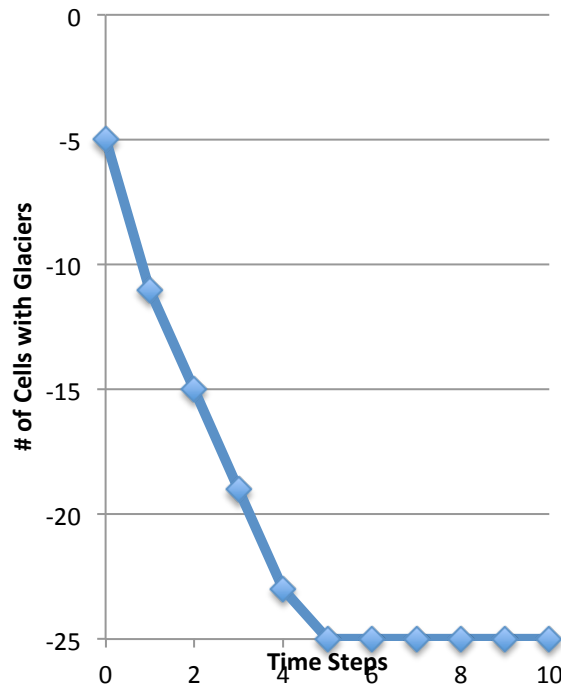
Glaciers increase
  => Increase Albedo (reflectivity)
    => Earth cools
      => **More ice formation, glaciers decrease**
        => Increase Albedo
          => Earth cools
            => **More ice formation, glaciers decrease**
              => Increase Albedo
                => Earth cools
                  => **More ice ice formation, glaciers decrease**

Clouds Increase
  => Earth cooler during day
    => Less evaporation
      => **Clouds decrease**
        => Earth warms
          => More evaporation
            => **Clouds increase**

Clouds Increase
  => Earth warmer at night
    => More evaporation
      => **Clouds increase**
        => Earth warmer at night
          => More evaporation
            => **Clouds increase**

Feedback Mechanisms
    Impact of present actions on future conditions

    Causal Chains
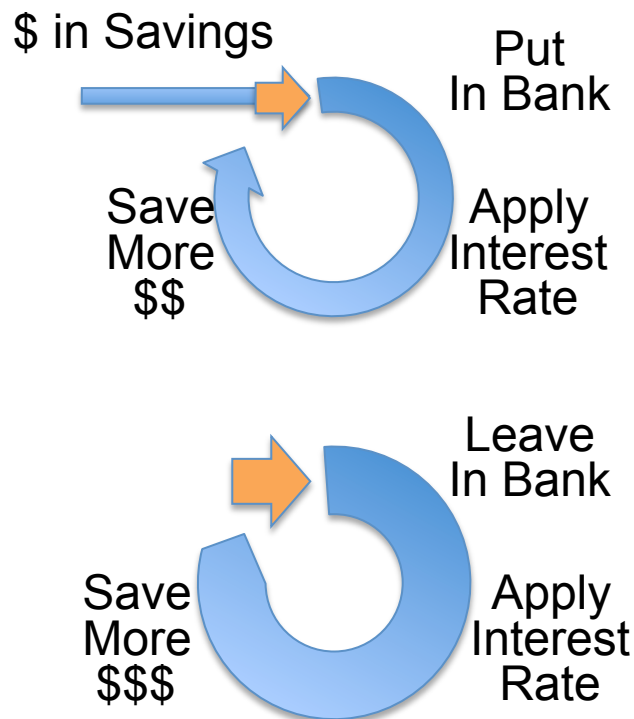   1) Gas Prices

        2) Interest on Savings

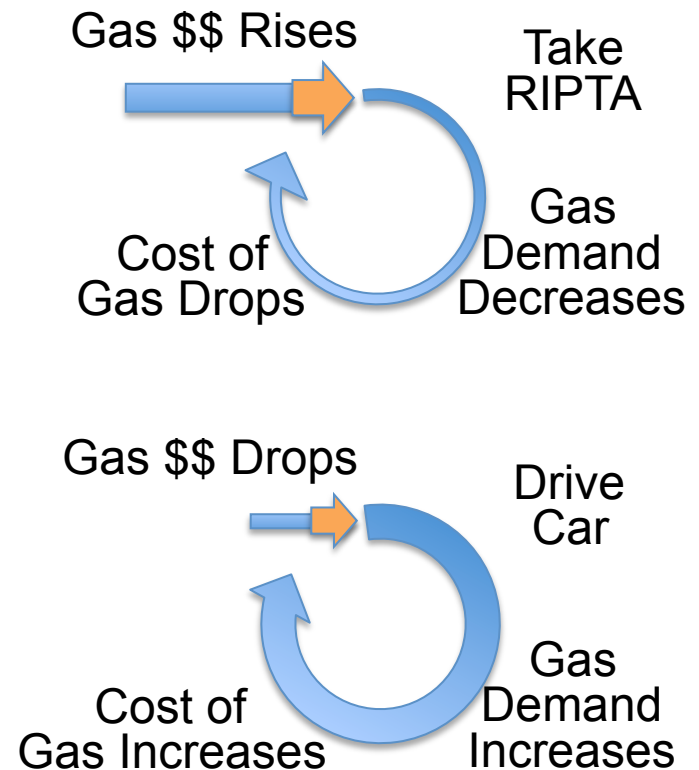   3) Not Paying Credit Card Bills

Feedback Mechanisms

Impact of present actions on future conditions

Positive => amplifies change
(e.g., interest rates)

Negative => minimizes change
(e.g., supply & demand)

$ in Savings

Put
In Bank

Save
More
$$

Apply
Interest
Rate

Leave
In Bank

Save
More
$$$

Apply
Interest
Rate

Gas $$ Rises

Take
RIPTA

Cost of
Gas Drops

Gas
Demand
Decreases

Gas $$ Drops

Drive
Car

Cost of
Gas Increases

Gas
Demand
Increases

Feedback Mechanisms

Impact of present actions on future conditions

Positive => amplifies change
(e.g., interest rates)

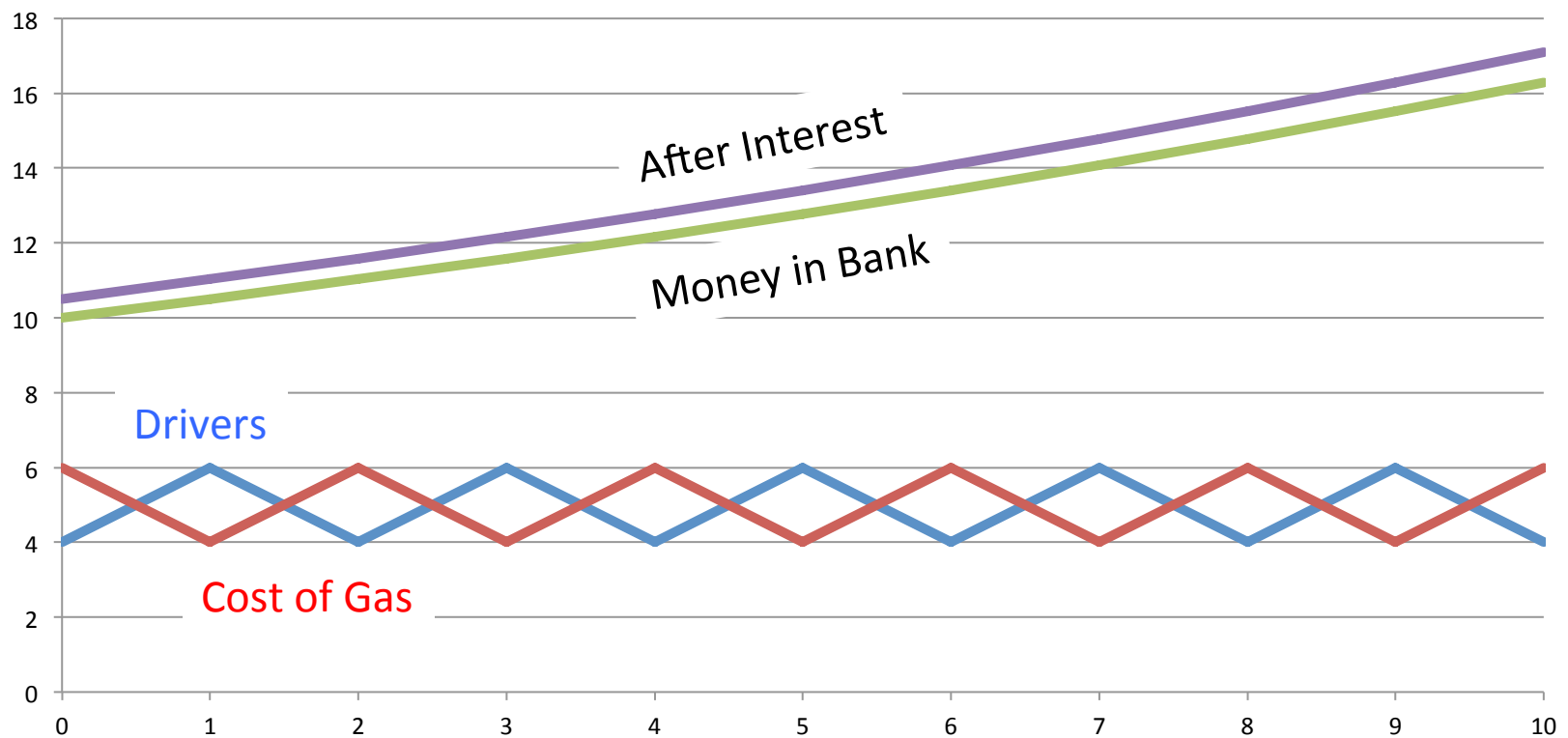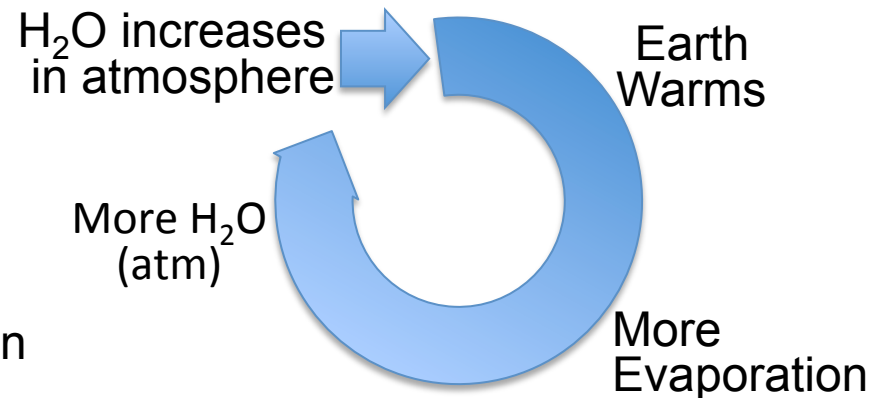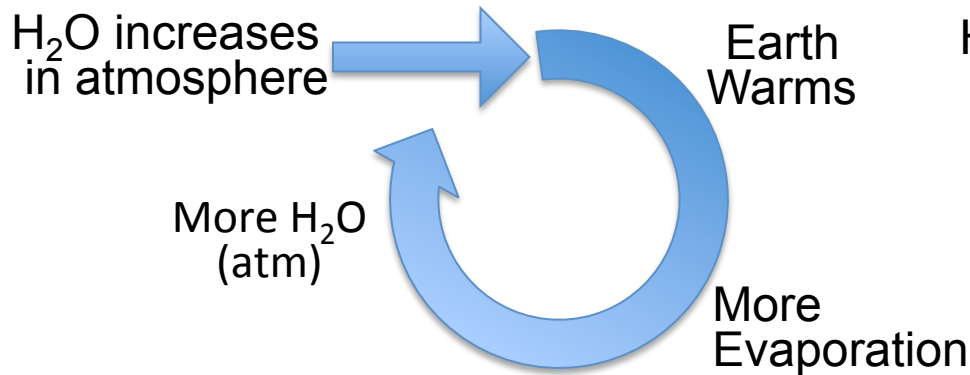Negative => minimizes change
(e.g., supply & demand)

Feedback Mechanisms

(+) Water Vapor (Greenhouse Gas)

H_2O increases in atmosphere → Earth Warms → More Evaporation → More H_2O (atm)

H_2O increases in atmosphere → Earth Warms → More Evaporation → More H_2O (atm)

(-) Water Vapor (Increase Albedo)

Clouds increase → Earth Cools → Less Evaporation → Clouds Decrease

Clouds Decrease → Earth Warms → More Evaporation → Clouds Increase