Introduction to systems thinking terminology

A system is a set of connected things or parts forming a complex whole

How do you rate your knowledge of systems diagrams right now?

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Introduction to systems thinking

Goals:

Define systems terminology.

Read and interpret simple systems diagrams.

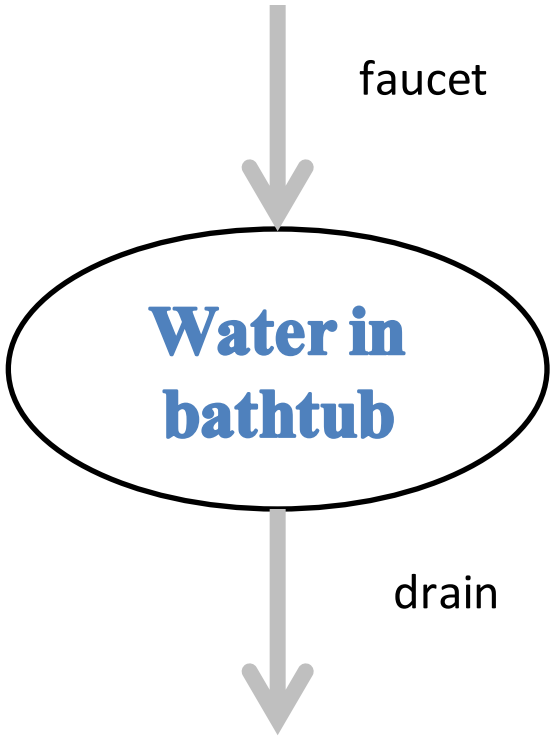
Evaluate a diagram's fit to a description of a system.

Describe how a bathtub works (in 3 minutes)

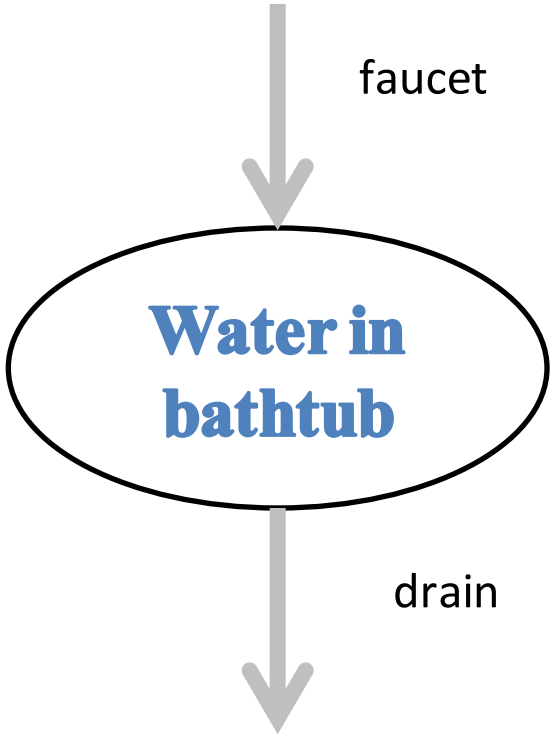
- Take out a blank sheet of paper and write 2–4 complete sentences.

(now turn over the paper and set it aside until the end of class)

Here is my bathtub, visually:



The water in the bathtub is the reservoir



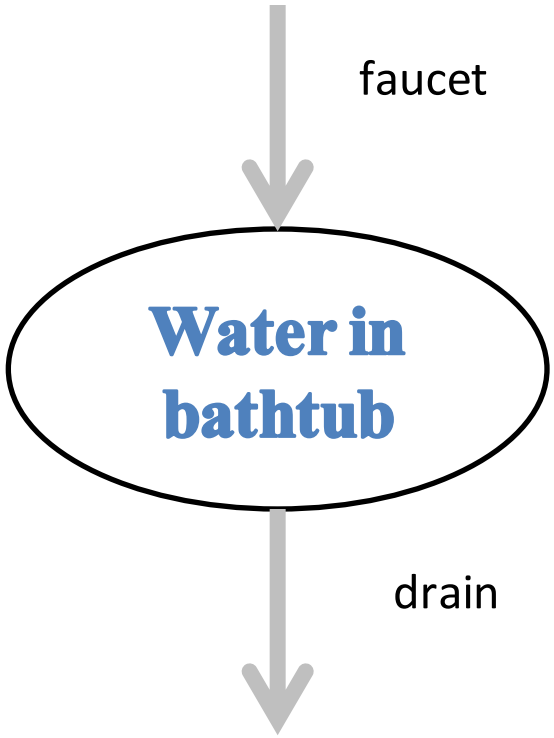
We measure the amount in the reservoir

- Water level in cm
- Liters
- Gallons

The faucet represents a flux: the input or inflow of water

We measure the rate of water flowing through the faucet

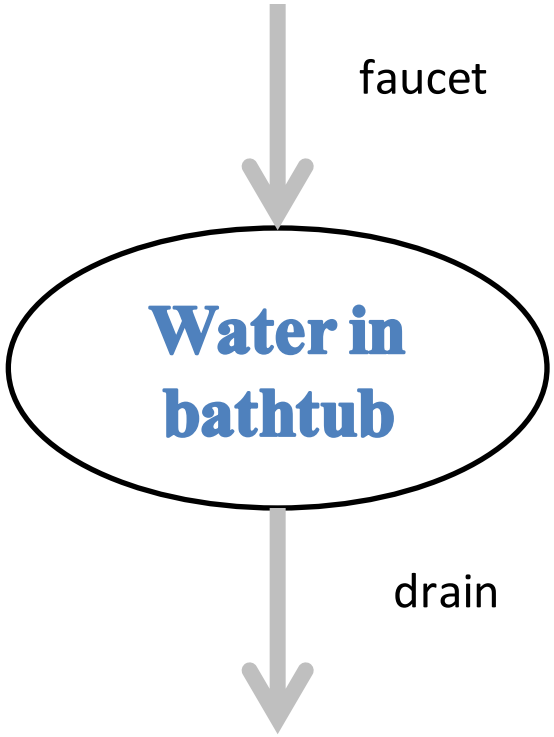
- Liters/second
- Drops/minute



The drain also represents a flux: the output or outflow

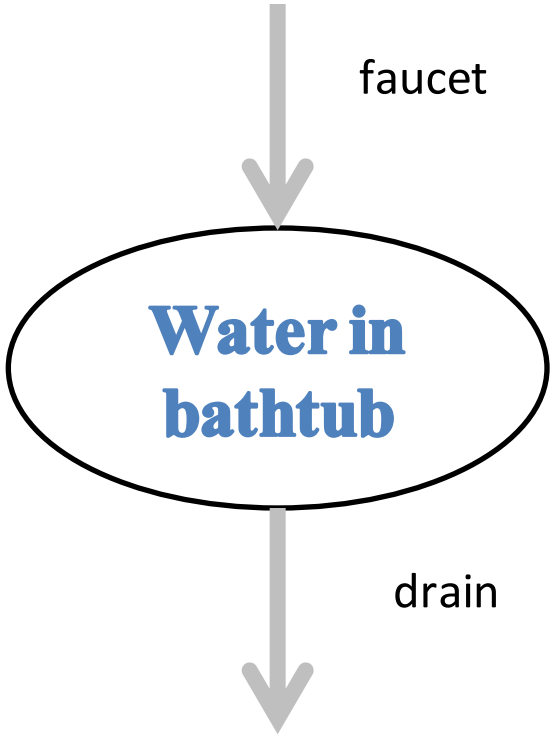
We measure the rate of water flowing down the drain

- Liters/second
- Drops/minute



Open system

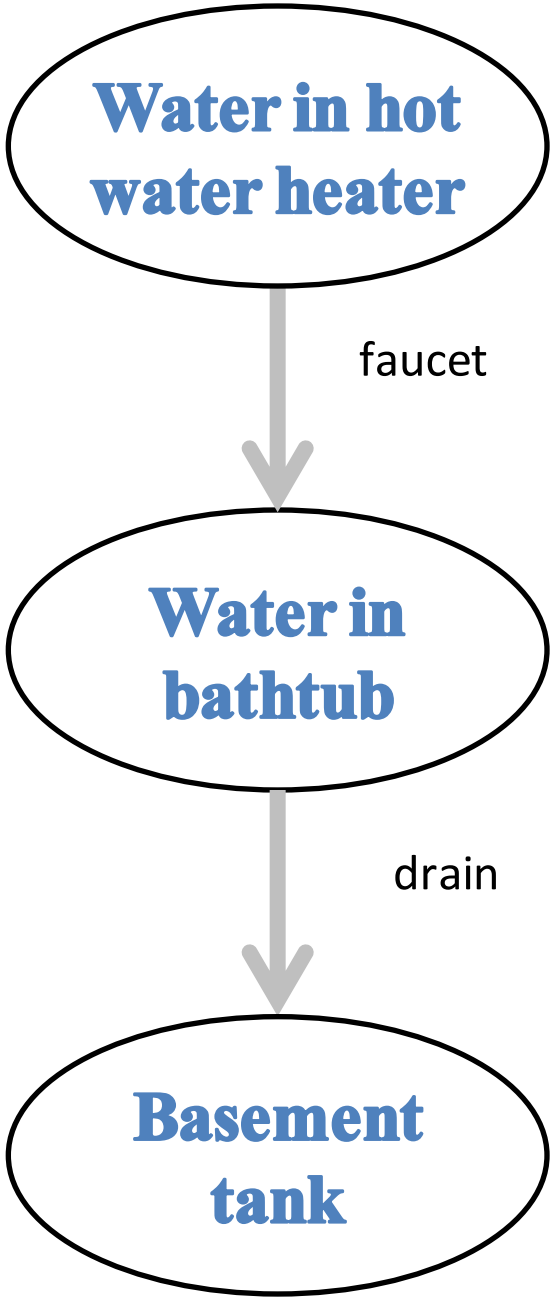
That is, we have not connected both ends of the arrows to the ultimate sources and sinks of water.



If you wanted to draw a closed system, what might you add?

Closed system

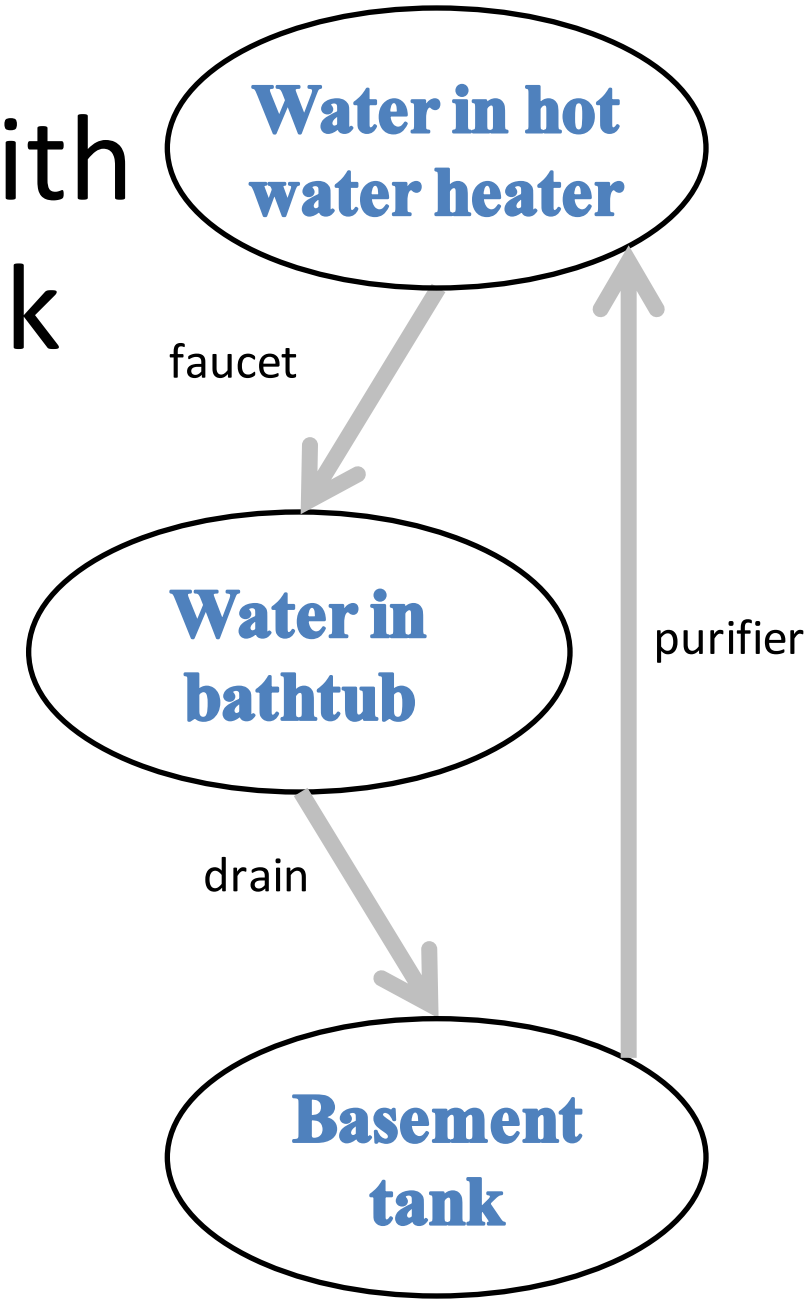
Now we do not have any unconnected arrows!



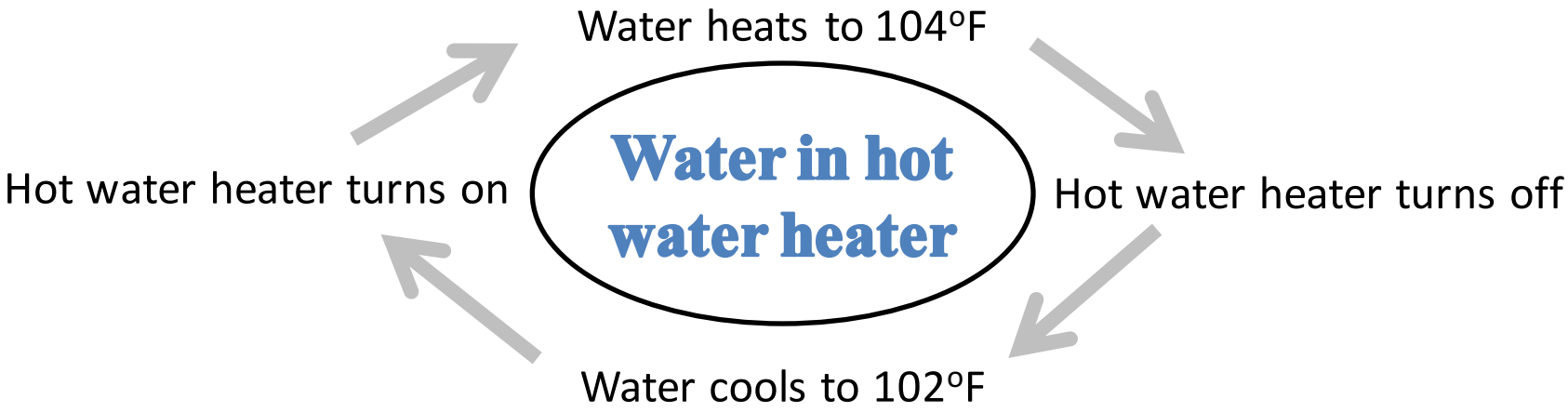
If you wanted to draw a closed system, what might you add?

Lets say you want to disconnect from town water…

Closed system with feedback loop



If you wanted to recycle your bathwater, you might connect some home water-purifying system…



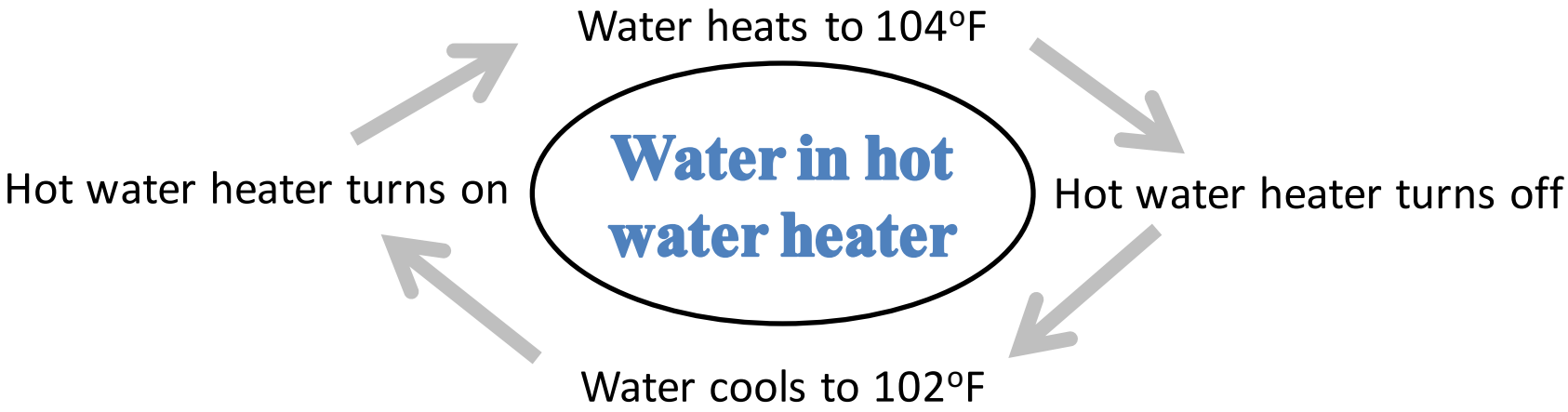
Which type of feedback loop is in the hot water heater?

Balancing (negative) feedback loops

hold a system to an equilibrium state and make it more stable.

Reinforcing (positive) feedback loops

tend to move a system away from equilibrium and make it more unstable.



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Reinforcing feedback loops underlies many environmental problems

Recall: Reinforcing feedback loops tends to make a system more unstable.

Examples:

- loss of biodiversity
- degradation of agricultural soils
- global climate change

To address these problems, we need to consider complex interactions, rather than merely one component alone or a single cause-and-effect relationship!

Systems thinking is an essential tool for addressing **societal challenges**

Such as

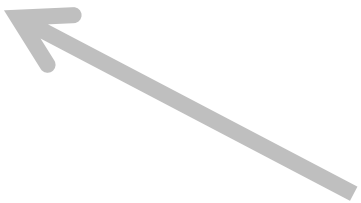
- energy, food, water resources
- climate change
- poverty
- hazards

These challenges cut across human and natural systems, involve multiple interdependent variables and feedbacks that are changing over time and space and are

- critically important, yet
- complex to predict

Recall today's goals

- Define systems terminology.
- Read and interpret simple systems diagrams.
- **Evaluate a diagram's fit to a description of a system.**



Now we will do this

Listen to the first 2:00 of this news story

http://play.publicradio.org/default/d/podcast/minnesota/podcasts/climate_cast/2015/07/millerclimatecast_20150709_64.mp3

(until Eric S. Kasischke begins speaking)

Write down anything you can identify as influencing climate.

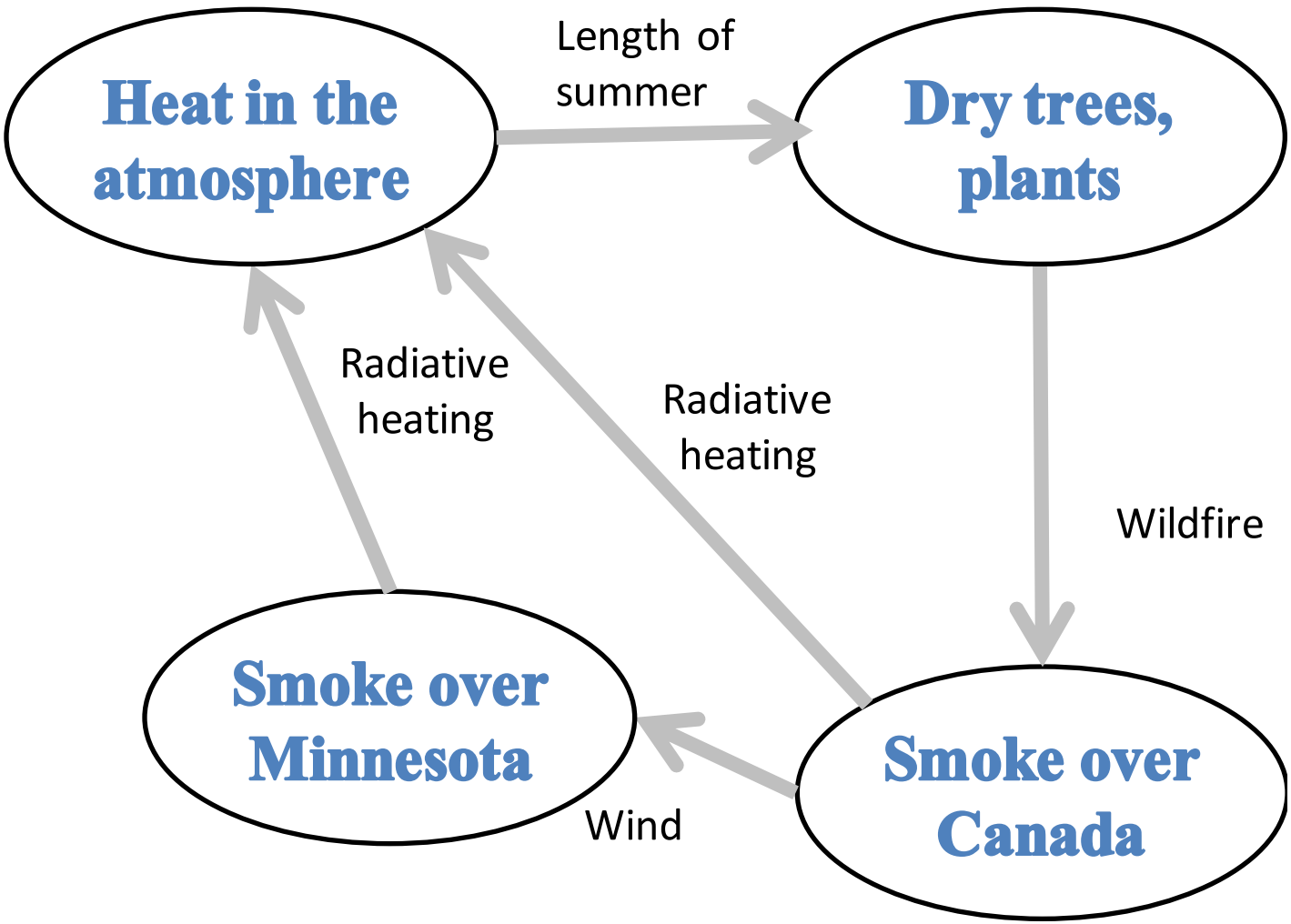
Work with a partner to compare lists then sort into categories:

- fluxes
- reservoirs
- feedbacks

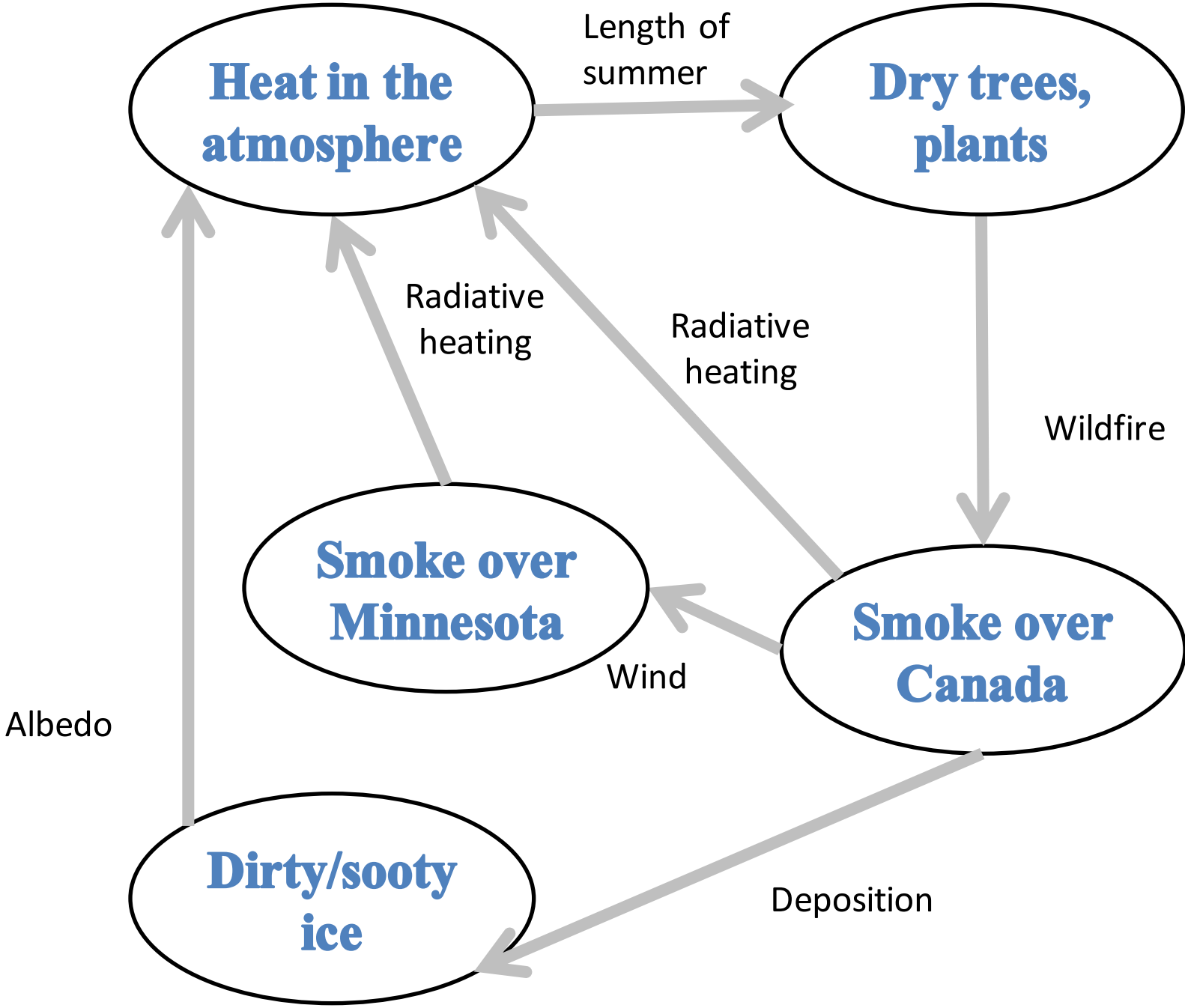
(3 minutes!)

With your partner discuss:

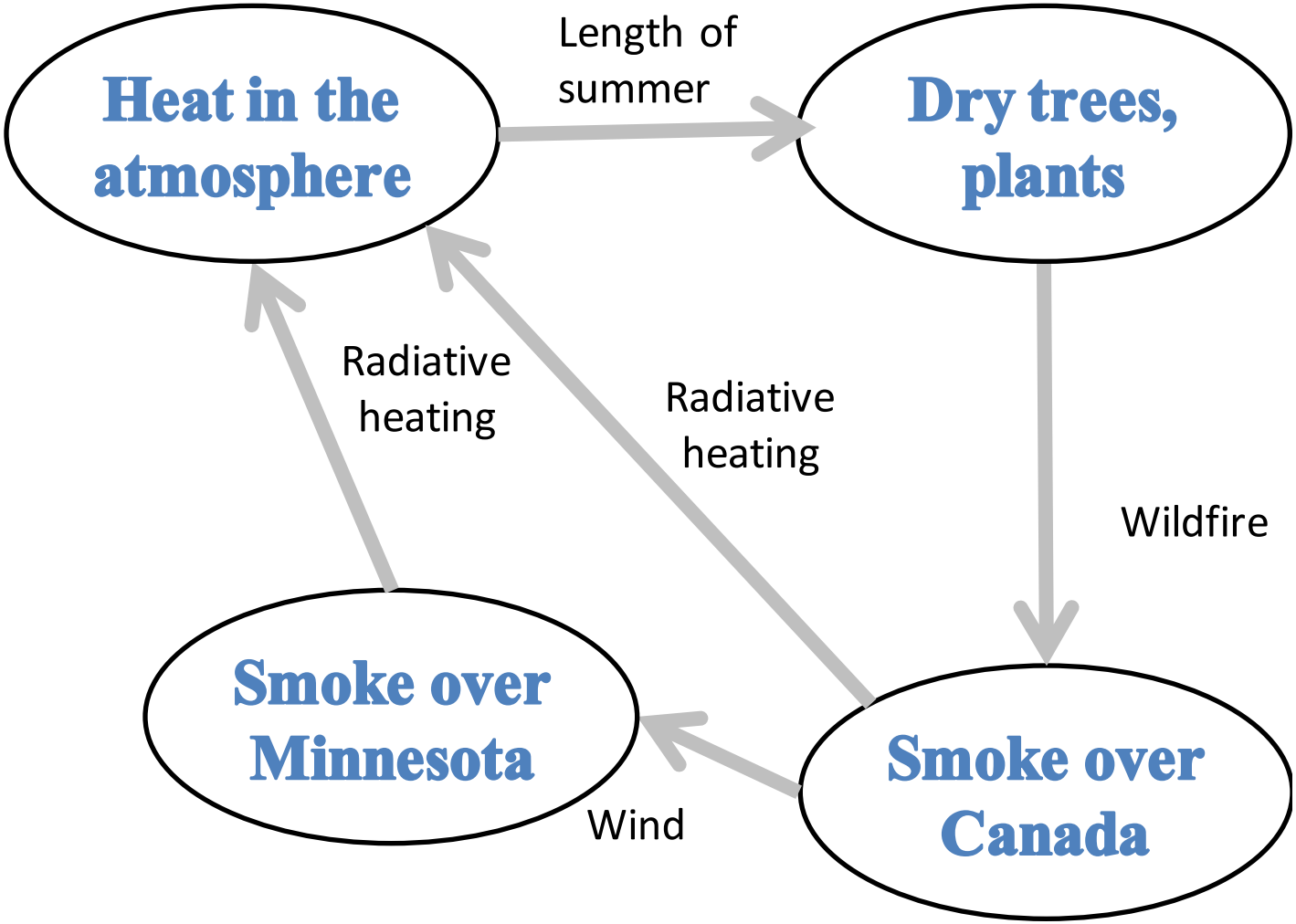
Does the diagram fully represent the complexity of the system described by the speaker? If not, add to the diagram.



One option


Heat in the atmosphere
Length of summer
Dry trees, plants
Radiative heating
Radiative heating
Wildfire
Smoke over Minnesota
Smoke over Canada
Wind
Albedo
Dirty/sooty ice
Deposition

Your answers



How is your bathtub different from the simple open system bathtub we imagined in class?

1. On the back of your bathtub description, draw a system diagram of your bathtub at home and use systems vocabulary to explain how it works in a paragraph.
2. Using systems vocabulary, write a paragraph to explain the differences.
3. What questions do you still have about your diagram?

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And, reflect briefly on your learning today:

What aspect of class most helped you improve your knowledge of systems? Why?