

AOS 630: Introduction to Atmospheric  
and Oceanic Physics  
Lecture 18 • Fall 2021  
*Discussion 3*

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# How was your weekend?

## Extended Forecast for Madison WI

**This  
Afternoon**



Partly Sunny

**High: 59 °F**

**Tonight**



Mostly Clear

**Low: 33 °F**

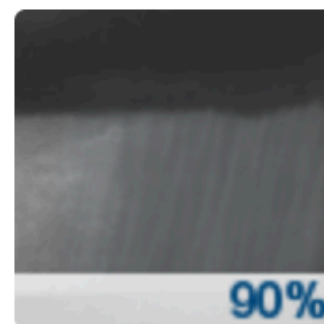
**Wednesday**



Partly Sunny

**High: 57 °F**

**Wednesday  
Night**



90%

Showers and  
Breezy

**Low: 44 °F**

**Veterans  
Day**



70% → 20%

Showers  
Likely then  
Slight Chance  
Showers

**High: 53 °F**

**Thursday  
Night**



20%

Partly Cloudy  
then Slight  
Chance  
Rain/Snow

**Low: 33 °F**

**Friday**



30%

Chance  
Rain/Snow

**High: 38 °F**

**Friday  
Night**



Chance  
Flurries

**Low: 29 °F**

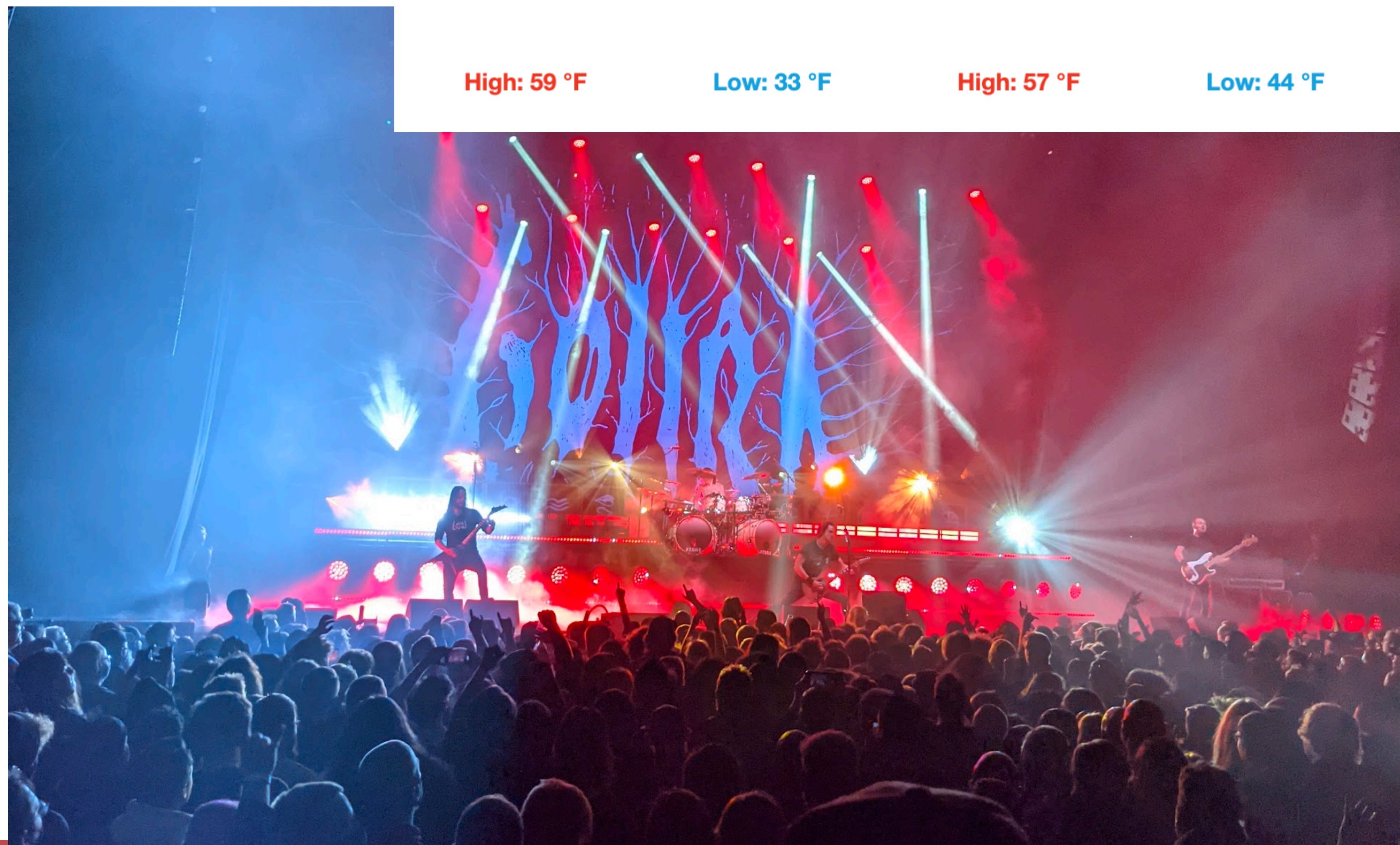
**Saturday**



10%

Mostly Cloudy  
then Chance  
Sprinkles/Flurries

**High: 38 °F**



# Announcements

There's a Skew-T a week from this week. Due next Tuesday.

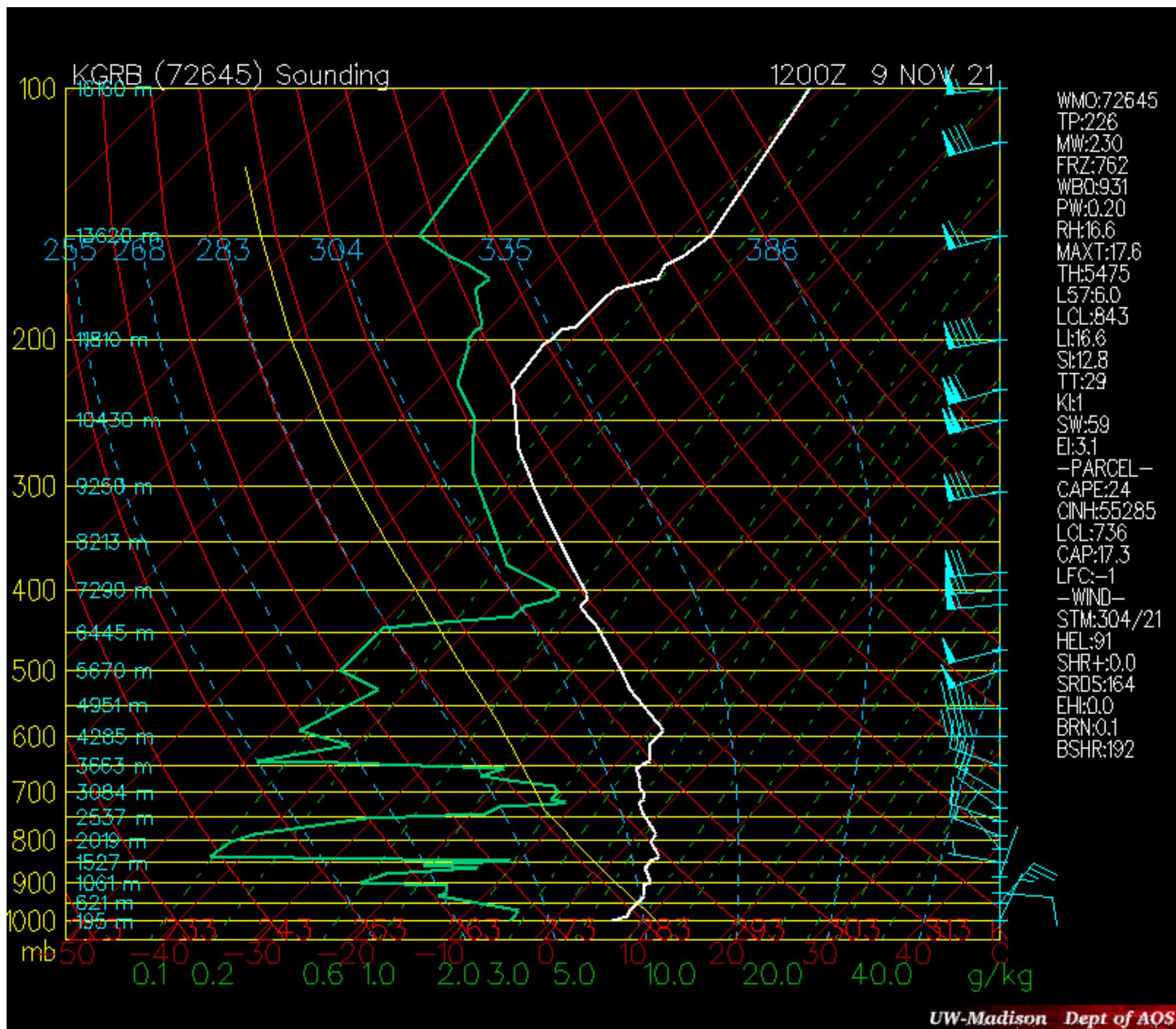
HW4 is due next week on Thursday.

Changes were made to Nov 30 schedule. Any questions about this?

<https://www.tropicaltidbits.com/analysis/models/>

Point and click soundings.

# Skew-T a week



Download a sounding from wherever

Find the tropopause in the sounding.  
What criteria did you use to identify it?

What is the lapse rate of that region?

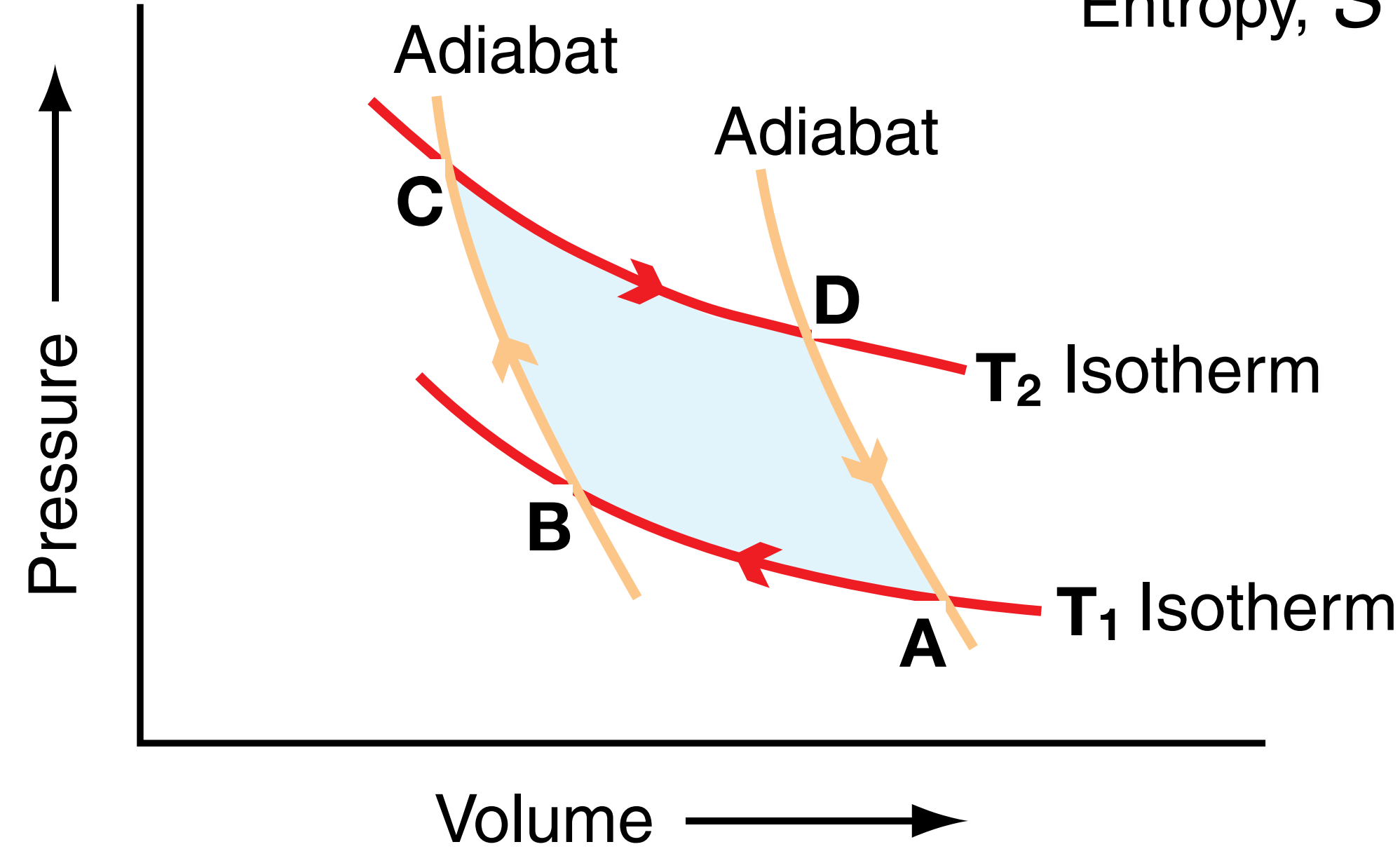
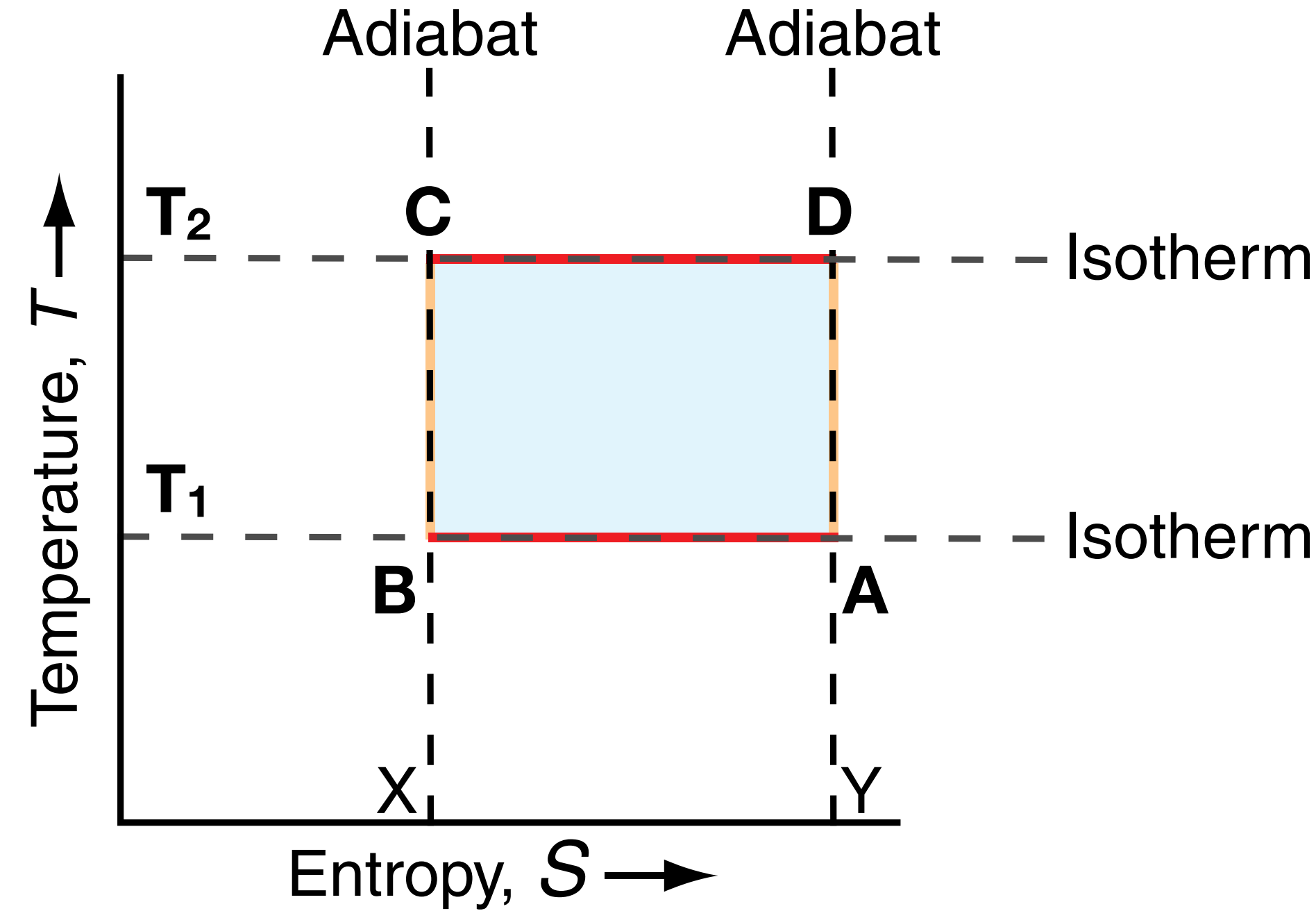
# Last Class: Carnot Engine

By expanding the integral into the four components of the cycle we find that

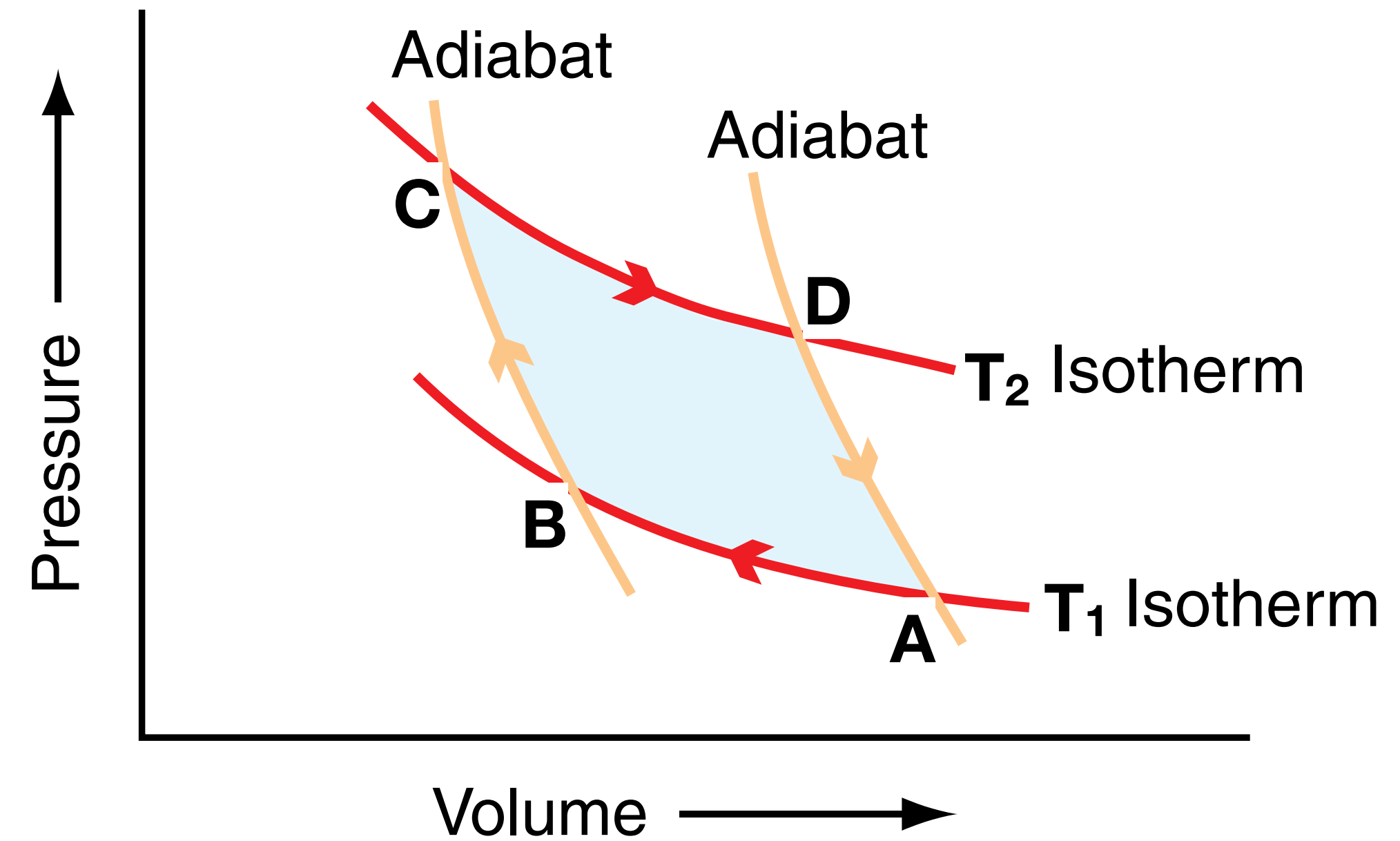
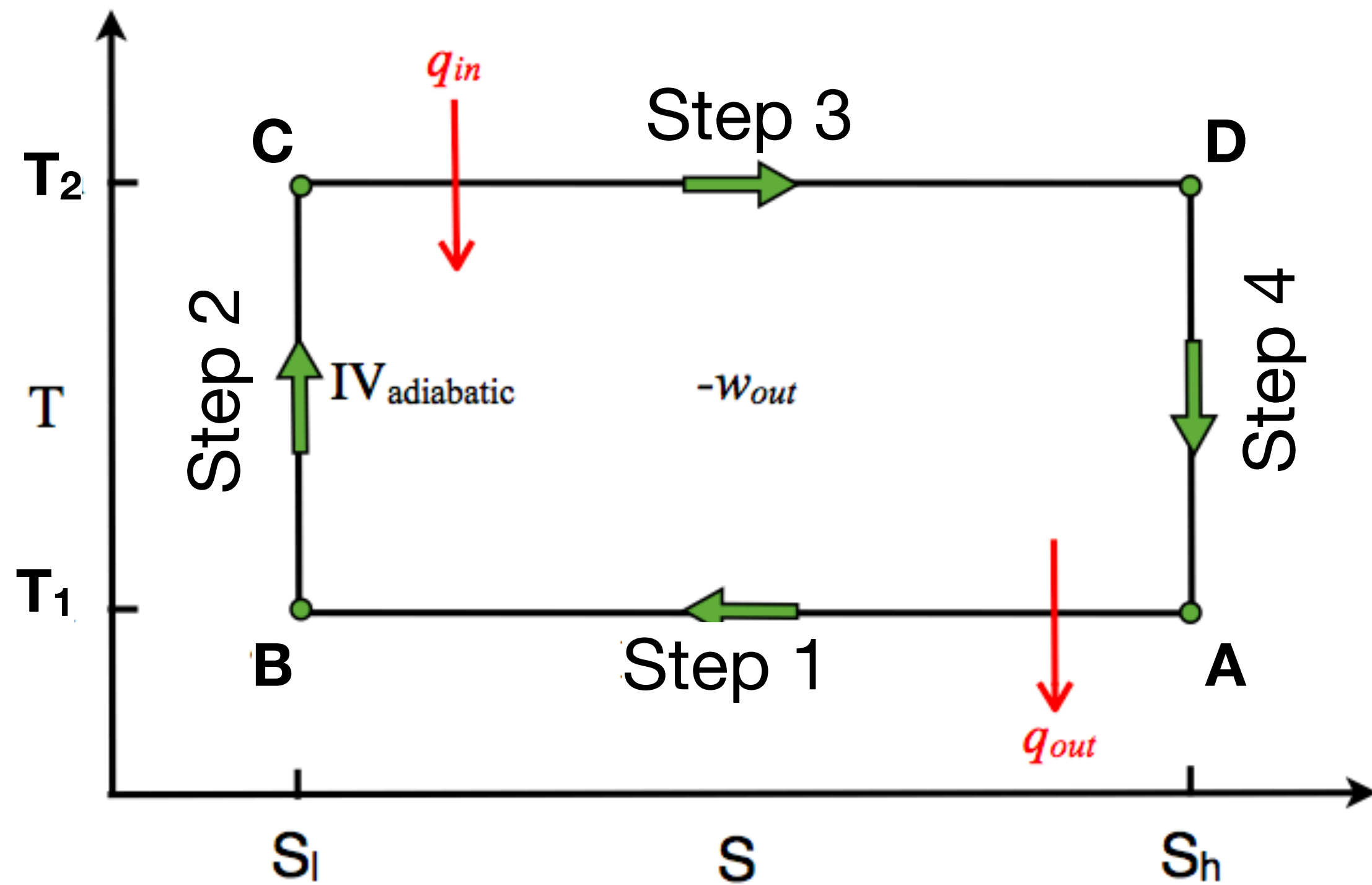
$$W = \oint p d\alpha = q_{in} - q_{out} = \varepsilon T_1 (s_{in} - s_{out})$$

$$\varepsilon = \frac{\text{Work done}}{\text{Heat absorbed}} = \frac{T_2 - T_1}{T_2}$$

Is the Carnot Efficiency

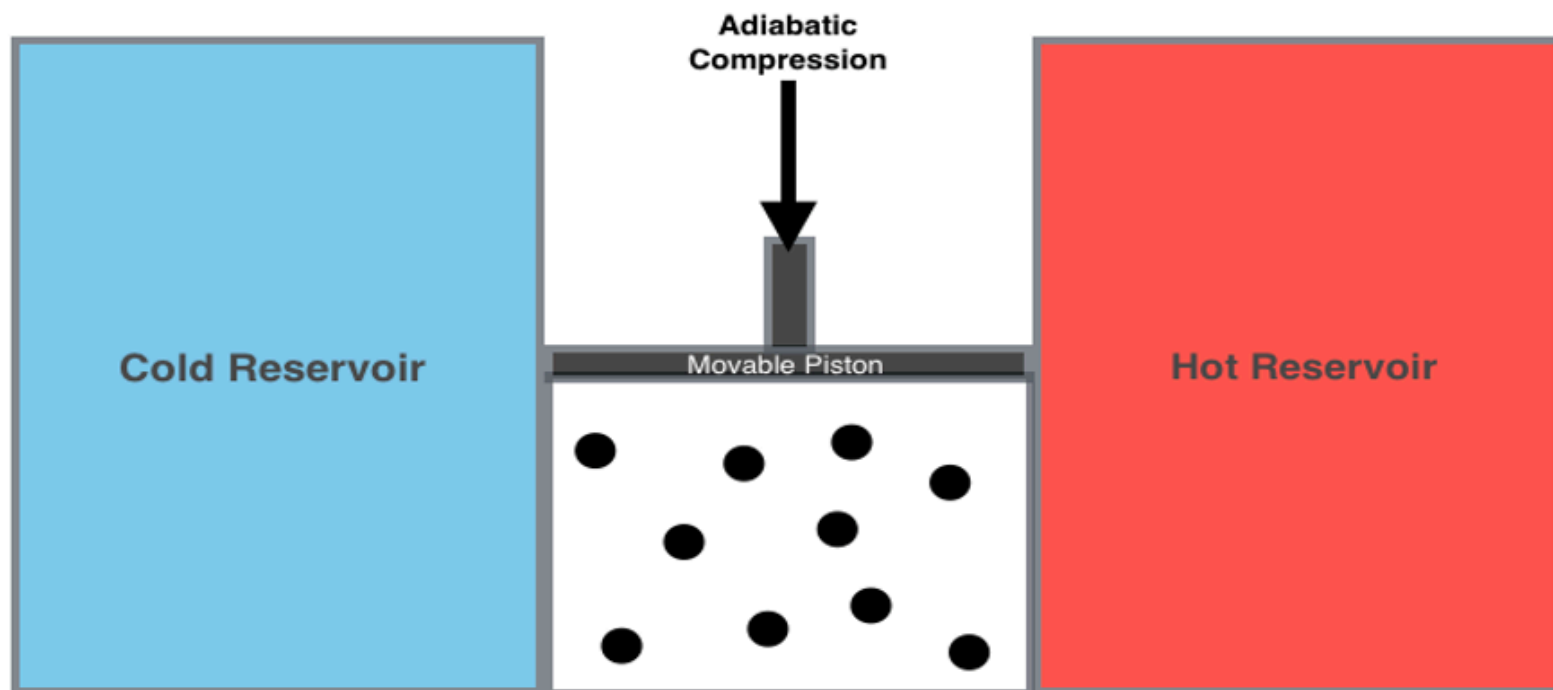
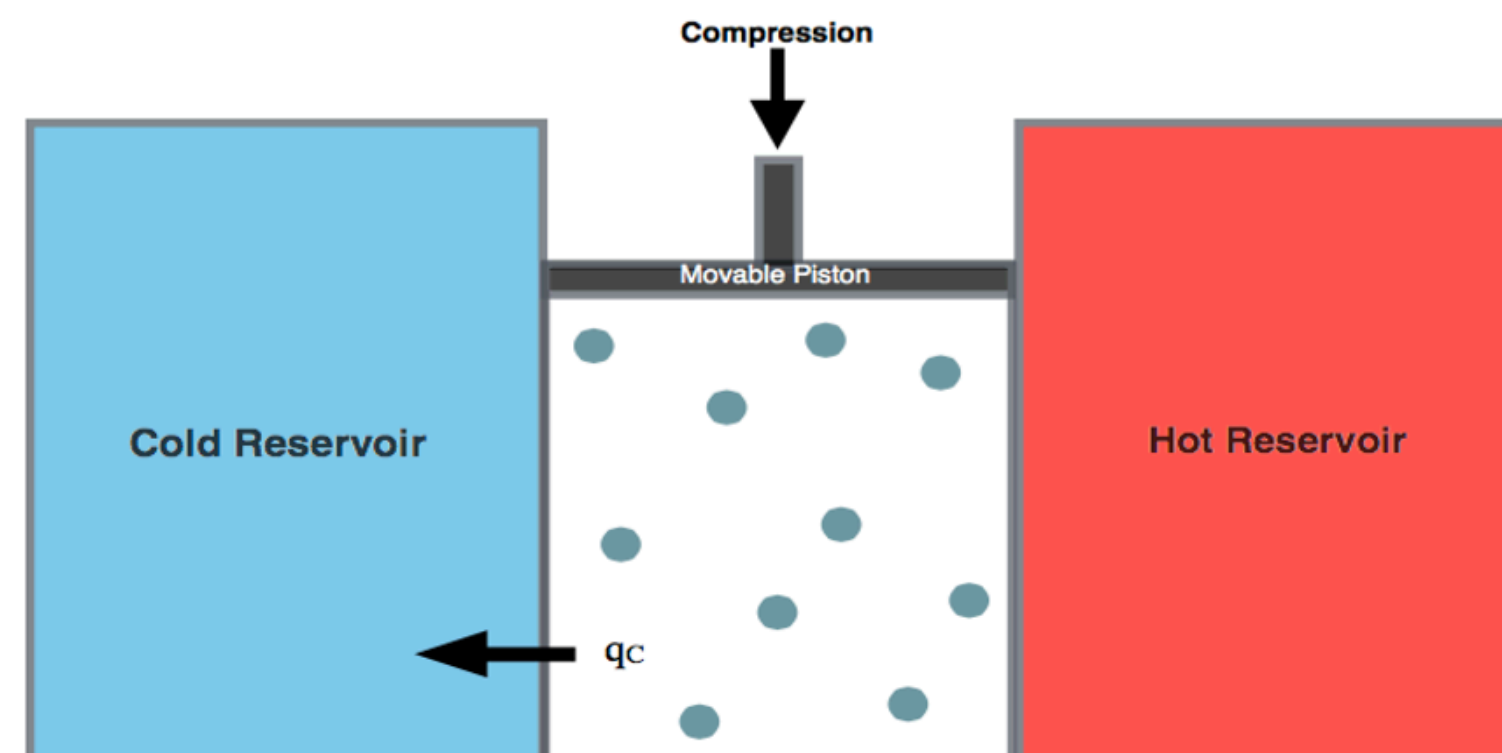
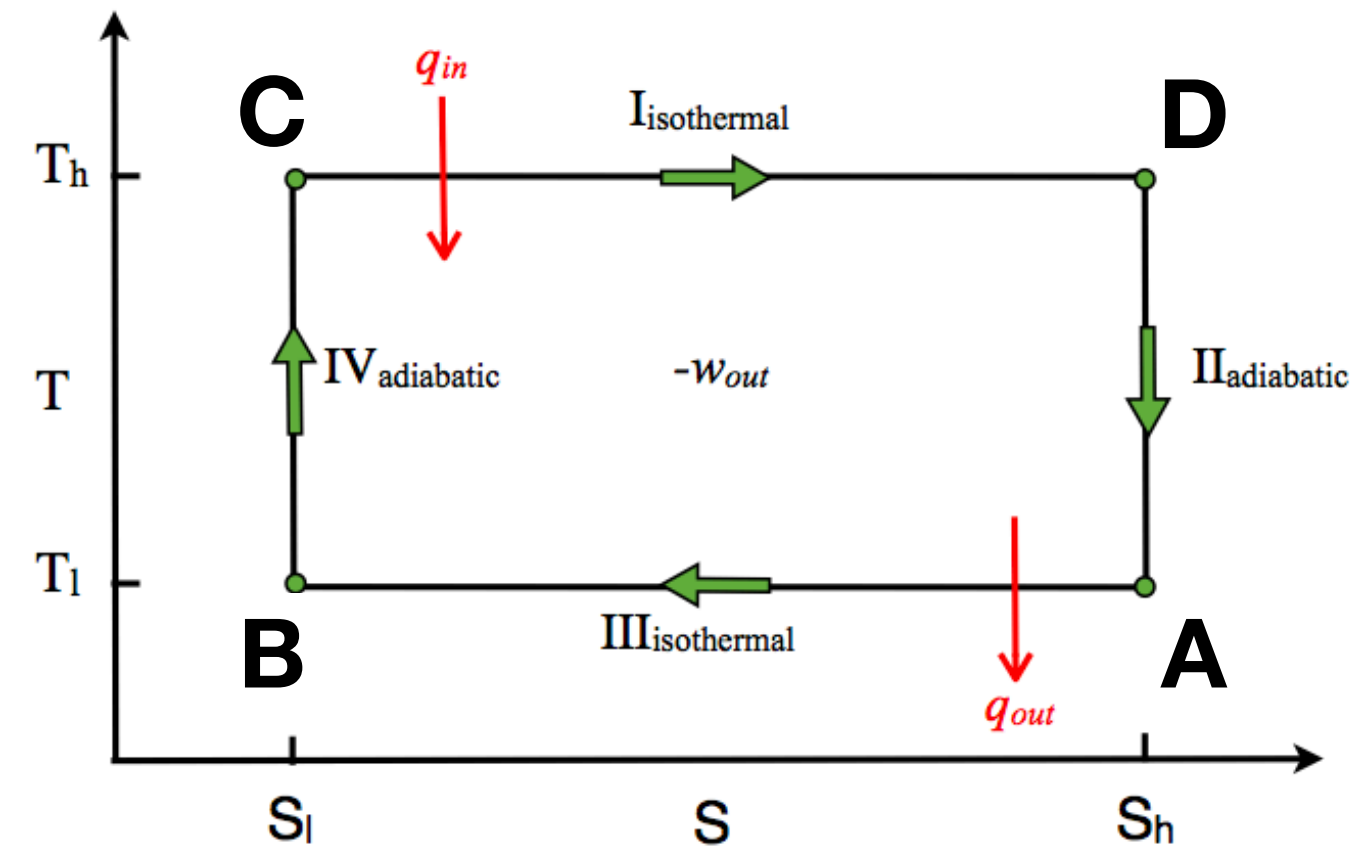
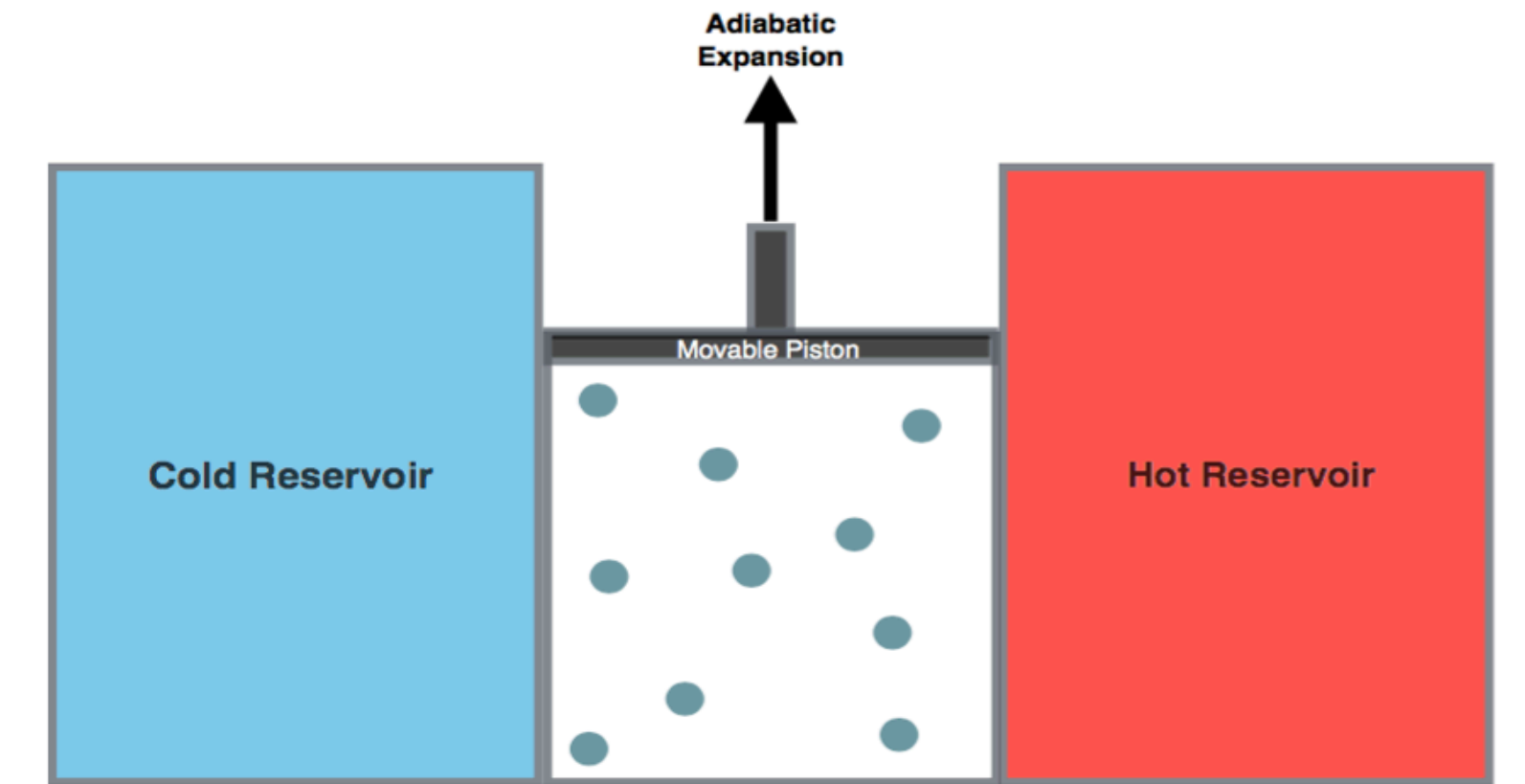
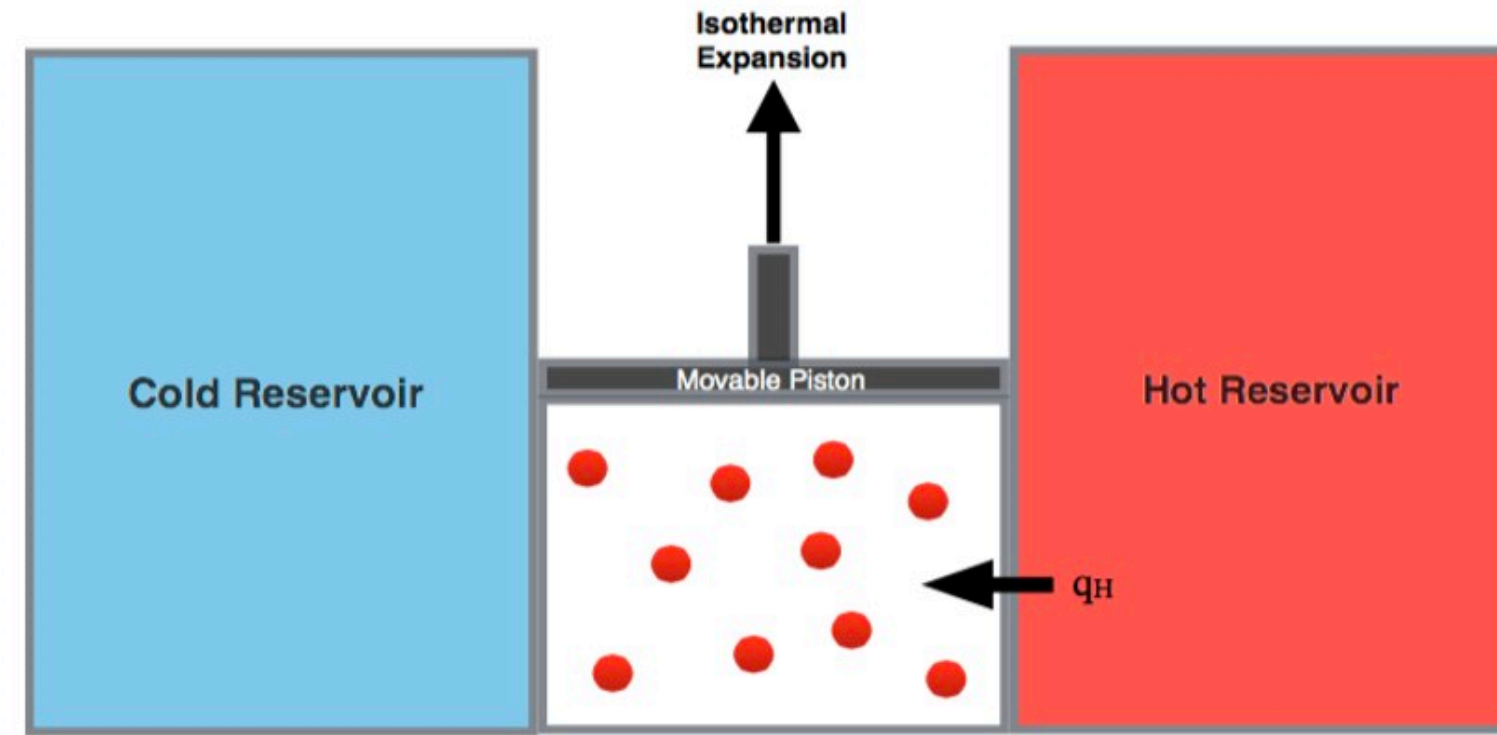


# Carnot Engine



1. Isothermal compression at a cooler  $T_1$
2. Adiabatic compression to  $T_2$
3. Isothermal expansion at  $T_2$
4. Adiabatic expansion back to  $T_1$

# Carnot Engine





# Class exercise

Break into groups and answer the following questions

1. What is the heat source  $Q$  of mature hurricanes?
2. What is the hurricane doing work against?
3. What happens from point a to c?
4. What about c to o?
5. What about o to o'?
6. What about o' to a?
7. What is the net result of the cycle? Where is the energy going to?
8. Discuss each step of the Carnot Cycle within the context of the piston schematic.
  - A. Write the variables that go into the plot in the middle and put the locations as well (a,c,o and o').
  - B. Write what  $Q_{in}$  and  $Q_{out}$  are in terms of the TC cycle.
  - C. Identify the cold reservoir, the hot reservoir, and the piston in every step.

