Worksheet .... Name

Heat Capacity .... Date

It is often pointed out that the heat capacity of water is "exceptionally large" and that this has many ramifications for the Earth's climate, for physiology, ecology, and more. Is water really all that exceptional?

In the following, we will determine for a number of substances not only the molar heat capacity C, but also the *specific* heat capacity c. The specific heat capacity (or short "specific heat") is the heat capacity per *gram* rather than per mole. The conversion between between the two quantities involves the molar mass M:

$$c = C / M$$

- **Start** simulations of the following substances:
  - (◉) **Water**
  - ( ) **Hydrogen Cyanide**
  - ( ) **Copper**
  - ( ) **Ammonia**
  - ( ) **Oxygen**
  - ( ) **Iron**
  - ( ) **Hydrazine**
- **ODYSSEY** can determine the molar heat capacity from a simulation without having to change the temperature:

  $$C = \textbf{....}$$

  Rough estimates from simulation runs of $\sim 20 \cdot 10^{-12}$ s duration are sufficient for a qualitative comparison of the substances. (For accurate figures, longer runs may be required.)

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- Together with the information for the molar mass

  $$M = \mathbf{18.01\ g\ mol^{-1}}$$

  you can determine the specific heat capacity.

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1. Give the molar heat capacities:

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2. Are the molar heat capacities of the substances all that different? If yes, where does water fall within the range?

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3. Give the specific heat capacities:

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4. Are the specific heat capacities of the substances all that different? If yes, where does water fall within the range?

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5. In what sense is the heat capacity of water "exceptionally large"?

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6. Is water the only substance with an "exceptionally large" heat capacity?

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7. The specific heat capacity of solid water (ice) is ~2.0 J K^{-1} g^{-1} and for gaseous water (steam) it is ~2.0 J K^{-1} g^{-1}. Is it water in general or is it just *liquid* water that is "special"?

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