

How different types of questions guide students' reasoning about global warming

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Chemical reasoning is defined as reasoning based on chemical knowledge and information and its integration into explanations is an important goal of chemical education. From a philosophical point of view, the level of complexity of mechanistic reasoning depends on the existence of certain system components (entities, activities, properties, organization – figure 1) and the relationships between them (figure 2).[1] Thus, the complexity increases as we go from descriptive to relational, simple causal and emerging mechanistic reasoning. In this qualitative study, the effect of an implicit and an explicit question on the complexity of chemical reasoning was under investigation. Data were collected from written explanations of model high school students on the issue of climate change and analyzed by applying two frameworks of analysis, which are based on the philosophical perspective of mechanistic reasoning that was mentioned above.[2, 3] The analysis revealed that in both questions the level of complexity of reasoning varies. However, the type and wording of the questions clearly affects the complexity: when a mechanistic explanation of the phenomenon is explicitly asked, reasoning tends to become more complex. Instead, reasoning is limited when the mechanism is implicitly requested and indications of spatio-temporal organization are not always present, as well.

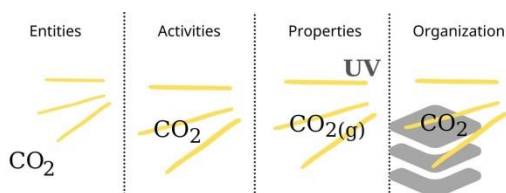


Figure 1: Examples of system components

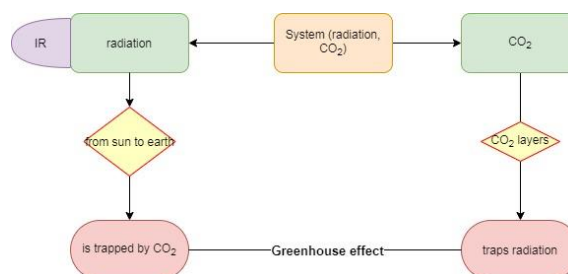


Figure 2: Examples of relationships between system components

References:

1. P. Machamer, L. Darden, C. F. Craver, *Philos. Sci.* **67**, 1 (2000)
2. R. S. Russ, R. E. Scherr, D. Hammer, J. Mikeska, *Sci. Edu.* **92**, 499 (2008)
3. P. Moreira, A. Marzabal, V. Talanquer, *Chem. Educ. Res. Pract.* **20**, 120 (2019)