

## Chemistry Education Research Cumulative Exam

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### **Foundational Concepts for Chemistry Education Research**

Chemistry Education Research (CER) uses certain foundational concepts, including about research methodologies, in pursuing its work in a rigorous way. Being able to state and demonstrate examples of these concepts is essential, in the same way as being able to define and use examples of concepts in important in all areas of chemistry.

There are *four* parts to this cumulative exam, of equal weight. Each of the answers should be given in the form of one or two well-structured paragraphs. Supporting diagrams may be used where needed, but always in support of a written answer. Where a "specific example" is requested, you should state the example and explain in a few sentences how the example functions as an example.

#### **1. Learning theories.**

There are many theories of learning available to CER workers. Being able to state a learning theory and to show how it applies in learning is essential to framing good research.

- (a) Give one learning theory associated with chemistry education.
- (b) Explain how the theory functions as a means to explain how learning does or does not occur.
- (c) Provide a specific example of how that theory will function in framing a good research question.
- (d) Provide a specific example of how the learning theory would work in a particular chemistry education setting.

#### **2. Levels of chemical explanation.**

In part rooted in the work of A. H. Johnstone, chemistry educators (and researchers) commonly refer to three different levels of chemical explanation.

- (a) State the three levels, with a specific example of how all three can be found as part of a particular chemical phenomena.
- (b) Johnstone is adamant that novice learners should *not* be exposed to all three levels at the beginning of their work. Provide a specific example of a learning experience that uses two levels of chemical explanation.

#### **3. Metacognition in chemistry education.**

The concept (some would say phenomenon) of metacognition is likely vital to deep learning.

- (a) Explain what metacognition is, with reference to different kinds of metacognition.
- (b) Give an example of a lesson or assessment prompt that supports student metacognition.

#### **4. Qualitative research methodologies.**

Although chemists are describing things all the time, it is often thought that chemistry primarily uses quantitative methods. Education research also uses rigorous quantitative methods, where appropriate. But CER researchers also understand the value of qualitative methods.

- (a) Please state a specific example of a qualitative research method associated with chemistry education.
- (b) Explain the advantages of the method as a means to study some aspect of learning in chemistry. Cite a specific example of the method used in a CER setting (actual or one you make up).
- (c) Explain the disadvantage of the method as a means to study some aspect of learning in chemistry.