

QUESTION ONE: Arsenic is not the only element that can be poisonous, and for which multiple transport mechanisms serve to extrude it from cells. The transition metals zinc, cadmium and mercury can be either essential (zinc at low concentrations), or toxic. Cadmium and mercury are transition metals of especial concern to human health because they are accumulated in the food chain.

Identify the

- 1) chemical properties of cadmium and mercury relevant to transport.
- 2) biochemical mechanisms of transport, and
- 3) energetics of transport.

Hints: There is a large literature on the genes that play a role in alleviating –or increasing—accumulation within cells. Research on biochemical mechanisms of transport is not so well developed. It is the latter that you should focus on to address the three aspects of the assignment. The best work on this has been done on bacteria, plants and yeast. Chemical properties relevant to the forms that may exist in the cytoplasm are most interesting to a transport physiologist. Biochemical mechanisms should include the type of experiment that was done (radioisotope? cellular? isolated membranes? etcetera). If you find $K_{1/2}$'s and other biochemical measures of enzymatic activity, try to reference their relevance to normal elemental concentrations in the environment. Energetics should include calculations of how effectively the biochemical mechanism can exclude the element.

Ground Rules: Students may (or may not) wish to work with each other on the assignment (especially on bioenergetics calculations). Please ensure that the work you hand in is in your own words (it's your voice I want to hear). I prefer handwritten: it's easier to include diagrams (which I like) and discourages copy/paste. I don't expect to see more than 2–4 substantive references (that is, to the scientific literature); 4–5 pages should suffice.