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| Stage 1 – Identify Desired Results (Goals and Enduring Understandings) |
| **Goals**What relevant goals will this design address (e.g., course objectives, learning outcomes)?**Toxicology Unit Level****Content:** Students will be able to describe the attributes of acute and chronic toxicity in general and as it pertains to a particular metal of interest, how this information is recorded and disseminated, the distinction between hazard and risk, considerations of vulnerable populations. Students will understand persistence, bioaccumulation, biomagnification, and environmental toxicity. Students will understand that no chemical is without hazard, and that decision making around chemical hazard involves value judgments. Students will be familiar with the existence of regulations for metal content in drinking water and for discharge of metals and other materials into water.Students will understand that toxicology translates into public health and social/environmental justice inequalities**Process:** Students will be able to keep track of their searches via a Query Log, and gain skills in identifying databases and determining appropriate search terms. They will learn how to express information in the presence of data gaps. |
| **Understandings:** * What are the big ideas students should understand?
* What are the enduring understandings that are based on the big ideas, and give content meaning & connect the facts & skills?
* What misunderstandings are predictable?
 | Students will understand …* The distinction between hazard and risk
* That data gaps are a reality and need to be considered in decision making
* That toxicology informs public health and has intergenerational effects, both medically and socially
* That regulations for drinking water exist, and the processes by which they are defined are complex and enforcement is variable
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| **Essential Questions:*** What provocative questions will foster inquiry to understand the big ideas and transfer learning?
 | Students construct meaning as they wrestle with the following questions…* Which type of toxicity is “more serious”? Which populations are “most important” to protect? Do we prioritize human health over the environment?
* Is a known carcinogen or a chemical for which no hazard data exists a greater potential hazard?
* What are the invisible long-term effects of exposure to hazardous chemicals on disadvantaged communities? How can we overcome these challenges for Indigenous communities?
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| **Knowledge & Skills:*** What key knowledge and skills will students acquire as a result of this unit?
* What should students eventually be able to do as a result of such knowledge and skills?
 | Students will know …* The major categories of human health and environmental hazard
	+ Acute, chronic, intergenerational
	+ Dose response curves including endocrine
	+ Toxicokinetics (absorption, distribution, biotransformation, excretion)
* That while they are not complete, many excellent resources do exist for toxicology, including Pharos, DataCommons, ToxNet, HSDB…
* That computational tools are emerging to fill data gaps, but these are hard to use on metals compared to organics
* That GreenScreen full profiles exist for a number of chemicals and materials, and that LEED platinum certification includes material health choices
* How to keep track of literature/database/online research findings using a query log
* How to evaluate credibility of an information source, and judge conflicting evidence
* How to search a series of databases for toxicology information
* How to interpret toxicology data from primary literature in reference to that found in curated databases

Students will be able to …* Distinguish between hazard and risk, and know the legal implications of a “risk assessment”
* Describe major categories of human and environmental toxicological hazard
* Describe, at an introductory level, by what chemical processes Hg, Pb, Cr, Cd and a few other metals are active toxicants
* Qualitatively identify relevant exposure pathways for metals in drinking water
* Describe the possible interactions of contaminants in a complex system (synergy, antagonism, changes in bioavailability)
* Understand vulnerability as a summation of situational factors
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| Stage 2 – Assessment Evidence |
| **Assessment Tasks:*** Through what tasks, which offer multiple opportunities to explain, interpret and apply their thinking, will students demonstrate their understandings? (e.g., quizzes, discussions, tests, observations, homework, journals)?
* By what criteria will understanding be judged?
* How will students reflect upon and self-assess their understanding?
 | Students demonstrate their understanding with the following tasks…Students self-assess their understanding through the following tasks…* completion of self-checks in ToxTutor
* Submission of Query Log showing a variety of sources have been searched and search terms modified to find more information
* *Possible 30-45 minute toxicology test [is this useful??] – based around applying toxicology to public health, intergenerational effects, toxicology of mixtures*
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| Stage 3 – Learning Plan & Activities |
| **Learning Activities:**What learning experiences and instruction will enable students to achieve the desired results? Students will learn most of the core content of this section from ToxTutor (NIH); the concepts from ToxTutor will be reviewed in class but the emphasis will be on database searching and using data for decision making. Students will work individually and together to brainstorm search terms, with the goal of each student bringing 3 different sources on toxicology so that each group has a variety of information to compile. Students will also search for regulations governing their metal in drinking water. Students will comment on differences between information learned on Google, Wikipedia, provided databases, and other places they would typically search, as well as tools learned from Librarian (Aditi) – the library tools will be introduced in the context of the subsequent unit, but will allow students to go back and fill data gaps for the final project.Students will have one lecture of basic toxicology, rounding out the ideas of the ToxTutor and introducing the Query Log and Data CommonsSecond session will introduce other tools, encourage broader searching.Third session will be a discussion of data gaps, computational toxicology, and work time to continue searching and sharing query log learnings with the group, starting to turn four separate sets of query logging into a group submission on hazard profile of the metal under discussion. Third session will end with a discussion of regulations, that they are often driven by hazard and exposure data, but are imperfect.Fourth Session will be a lecture from a public Health Expert who works with Indigenous communities.[This will be followed by a classroom session spent in the library with Aditi, learning about databases for broad searching. Specifically applied to scoping the industrial function, but also back-applies to this assignment] |
| * How will students know where the unit is going and what is expected?
* How will instruction and tasks activate and connect students’ prior knowledge?
* How will instruction and tasks engage students & sustain their interest?
* How will instruction and tasks encourage students to experience and explore the big ideas and enduring understandings?
* How will instruction and tasks offer students the opportunities to think about and discuss ideas with peers, and others more knowledgeable?
* How will instruction and tasks allow students to reflect on, evaluate, and revise their work?
* How will instruction and tasks be inclusive to the different needs, motivations/expectations, attitudes/beliefs, and abilities of learners?
 | * Process and content goals will be presented at the start of the unit
* Starting with general search functions students know, we will build to better search tools
* Students will work together to generate search terms and bounce ideas off each other for what they learn
* Keeping good Query Logs will reward students when they go back for “breadcrumbs”
* Query logging will lead to idea bouncing, class in the library will give access to Aditi for this information and continued throughout the course.
* As students come together to write up hazard information, they will find the gaps in what they have written.
* Opportunities to work solo and together
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This template is modified from a version created by the Tasmanian Department of Education using Wiggins and McTighe’s (2005) *Understanding by Design*. https://www.wku.edu/library/dlps/infolit/documents/designing\_lesson\_plans\_using\_backward\_design.pdf