DISCUSSION QUESTIONS

QUESTIONS

Take this ACS PIB Event to the next level with these discussion questions to engage your group further!

1) **Why is Diamond so much harder than Graphite of a "lead" pencil? Aren't they both Carbon?**

2) **What's the difference between Diamonds and Coal? Aren't they also just Carbon?**

3) **What's the difference between Opal and Quartz?**

4) **How many rocks have you eaten today?**

5) **You've just listened to a video about taking waste CO_2 and converting that to $CaCO_3$ and using it in concrete. This is a great example of turning a waste into a useful product (waste valorization).**

- **Have you heard about other options for capturing CO_2 and using it for other things?**
- **What are some of the challenges in doing this?**
- **Can you see any barriers or constraints on the proposed Blue Planet process?**

6) **Green chemistry incorporates 3 main ideas, how does the Blue Planet process meet/address these 3 ideas?**

- **Using energy and materials (mass) efficiently and only in amounts that are needed (little waste)**
- **Reducing or eliminating toxic substances**
- **Thinking about impacts of our process from a holistic or systems-wide perspective; i.e., thinking about where things come from and where they end up.**

7) **The basic chemistry problems you solved as part of this exercise asked you to calculate the number of kg of $CaCl_2$ required for conversion of the CO_2 to $CaCO_3$.**

- **Where does CaCl2 come from industrially?**
- **Is this where Blue Planet gets their Ca^{2+}?**
- **Why would the use of industrial $CaCl_2$ not be desirable for Blue Planet?**
- **Where else might Blue Planet source Ca2+?**

QUESTIONS ANSWER KEY

QUESTIONS

Take this ACS PIB Event to the next level with these discussion questions to engage your group further!

1) **Why is Diamond so much harder than Graphite of a "lead" pencil? Aren't they both Carbon?** ***Diamond has carbon atoms bonded in a three-dimensional cubic arrangement, with equally strong atomic bonds in a tetragonal arrangement. In contrast, Graphite has sheets of carbon-bonded atoms, with weak bonds between adjacent carbon sheets.***

2) **What's the difference between Diamonds and Coal? Aren't they also just Carbon?** ***Diamonds are metamorphic minerals – Carbon atoms which are recrystallized at higher temperature and pressure conditions than those found at Earth's surface. Coal is also recrystallized carbon, formed by burial alteration of plant materials at shallower depths (3-5 km) in the Earth's Crust. However, Diamonds form in the Earth's Mantle, at depths of 150 km or deeper, and are carried to shallower depths by explosive volcanic activity. Diamond-bearing Kimberlite pipes occur in South Africa, Canada, Siberia, and Arkansas.***

3) **What's the difference between Opal and Quartz?** ***Opal is a hydrated silicate, with an amorphous non-crystalline arrangement of Silicon atoms. In contrast, crystalline quartz has a hexagonal arrangement of chemical bonds connecting adjacent Silicon atoms.***

4) **How many rocks have you eaten today?** ***How about table salt? Halite (NaCl) On a "low-salt" diet? Sylvite (KCl) Is this giving you acid indigestions? Tums are Calcite ($CaCO_3$) Still not enough? Kaopectate has Kaolinite ($Al_2Si_2O_5(OH)_4$ clay. Since Kaolinite can absorb water between its tetrahedral and octahedral layers, it can also "bind to excess water" in the human digestive tract.***

5) **You've just listened to a video about taking waste CO_2 and converting that to $CaCO_3$ and using it in concrete. This is a great example of turning a waste into a useful product (waste valorization). Have you heard about other options for capturing CO_2 and using it for other things?** ***Examples: Non-conventional oil and gas recovery, direct conversion to CH4, formic acid, MeOH, etc., polyols, urethanes, etc.*** **What are some of the challenges in doing this?** ***CO_2 is highly stable chemically and requires a lot of energy or unique catalysts that use rare precious metals to convert it to something else.*** **Can you see any barriers or constraints on the proposed Blue Planet process?**

6) **Green chemistry incorporates 3 main ideas: 1) Using energy and materials (mass) efficiently and only in amounts that are needed (little waste) 2) Reducing or eliminating toxic substances 3) Thinking about impacts of our process from a holistic or systems-wide perspective; i.e., thinking about where things come from and where they end up. How does the Blue Planet process meet/address these 3 ideas?**

7) **The basic chemistry problems you solved as part of this exercise asked you to calculate the number of kg of $CaCl_2$ required for conversion of the CO_2 to $CaCO_3$. Where does CaCl2 come from industrially? Solvay process converting $CaCO_3$ to $CaCl_2$ Is this where Blue Planet gets their Ca^{2+}?** ***No, it is part of the naturally occurring brines they are using.*** **Why would the use of industrial $CaCl_2$ not be desirable for Blue Planet?** ***Significant energy use to make $CaCl_2$ would cancel the extraction of from the power plant or industrial process Blue Planet is extracting CO_2 from. This is a great example of why systems thinking is so important to understanding green chemistry opportunities and challenges.*** **Where else might Blue Planet source Ca2+?**