**Guidelines for developing good seminar discussion questions**

Developing good questions is a fundamental critical thinking skill. The best seminars and lectures are often focussed on addressing a clearly articulated high quality thematic question. Likewise, good writing is often based around synthesising your thoughts into a clear focussed question which then becomes the basis for the argument or thesis statement or specific research questions or hypotheses. Thus, being able to develop good questions is a fundamental component of learning how to ‘think like a scientist’, but more widely, it is an important life skill for any citizen.

Seminar questions should be constructed so that they will likely lead to focussed, intelligent discussion that will move the seminar group toward some potential answer, or toward a more refined perspective on the issue/theme, or toward an even more refined question.

Study the reading material carefully. What really interests you about it, and why? Develop questions that would take you (and your audience) *beyond* the reading’s text. Good questions are:

* Challenging – contain ideas that are new and indicate an advance on what is stated in the text
* Original – indicate clear deep thinking by the questioner, often including his/her specific ideas
* Focussed/specific – contain enough detail that they will narrow the discussion and constrain it from vague generalisations

**Some examples of really good questions based on the course readings**

**(At the end of the course, the class ranked all the questions below and rated #28, 2, 26, 25, 12 as being best.)**

What can Biology tell us about our Future – Grogan, 2012.

1. In the passage “*What Biology Can Tell Us”*, it was mentioned that our current civilization now embodies the genes for denial, distraction, and escapism which draws our attention away from the impending crash of the Earth and the human population. It is also commonly brought up that we heavily rely on Science to solve our world problems. We spend so much time trying to change the course of environmental change, perhaps we should change humans themselves. Why is it ethical to change the living breathing things around us (genetically modified crops) but unethical to genetically modify humans to no longer possess traits of denial, and distraction? Is it still unethical if it is for the greater good of humanity and our long-term survival?
2. Should we avoid an inevitable crash? Humanity has evolved to become egocentric, greedy, and in turn wasteful. To change the course of evolution, and thus our ancestral instincts takes millions of years – unless of course there is a bottleneck. If there was a population crash, we can essentially start over and carve a more favorable path of evolution where those who conserve resources and live sustainable lives will prosper. Is this precisely what humanity needs?
3. Is our genetically engrained compassion for others ultimately the cause of Earth’s impending doom? If we imposed laws restricting reproduction (which we consider immoral and unethical), then a large majority of Earth’s problems in relation to overpopulation would be relaxed. Likewise, if we simply were not compassionate to those in other countries perishing from diseases irrelevant to us then perhaps this too would contribute to a more manageable population size. Is it more unethical to deny some of our overpopulated race equal rights, or to give equal rights and thus neglect the scientific facts that 10% of species on Earth are at risk of perishing if we do not change?
4. If there are other civilisations out there on other planets in the Universe, and they are developing according to the principles of evolution by natural selection, what factors might make it not inevitable that they will all ultimately reach the same global environmental crisis point as our current civilisation?

Human Behaviour and Sustainability – Fischer et al. 2012.

1. “Here, we argue that the primary barrier to sustainability no longer lies in a lack of knowledge about biophysical or social problems. Instead, the main challenge now is to act on existing knowledge and to actively work toward a sustainable future (Ehrlich and Kennedy 2005; Fischer *et al*. 2007).”

I disagree with this statement, and agree more with *Earth Stewardship*’s argument “that biophysical knowledge has to be coupled with insights into how, when, and why humans act on knowledge and deliberately adopt appropriate new behaviors”. I don’t believe we have solved the mystery of human actions and decision-making. The statement that says, “the primary barrier to sustainability no longer lies in the lack of knowledge about biophysical or social problems” can’t be true if we have not yet solved the issue of sustainability. If we understood why humans act the way they do and why we are not pushed towards living in a sustainable way, then we should be well on our way to fixing the issue (-which is not the case). As humans, will we be able to understand what makes us change and adopt new behaviors? If so, how will we take this knowledge and use it to make changes toward sustainability? What if we discover that humans make changes only when they are personally affected by the issue and when the solution is a lot better than their current living situation? Is there a way to come up with a solution for Westernized communities that are not being personally affected by sustainability issues that will give them a better, more luxurious life than they already have? If the answer is no, then how will we convince people to make changes when the changes that have to be made mean living a less luxurious life?

1. Social media (for example Twitter, Facebook and blogs) most certainly provides a way for global change news stories to be easily accessed, circulated, and discussed amongst audiences. These sources provide an opportunity to engage individuals and for them to be active participants because they can often leave comments to criticize, scrutinize, support and offer diverse perspectives on the issue. As mentioned in the paper, Human behaviour and sustainability, engaging individuals could affect social change by enabling people to join together and shape their own governance. Yet, with the abundance of social media outlets available, it can become so easy for an individual’s opinion to get lost or ignored so they no longer remain invested in the issue. If social media can keep people informed about global change issues, what is it that is limiting institutions from using it more vigilantly to capture AND hold the attention of users? So many people are willing to support and advocate for sustainable behaviours on social media, yet beyond the “tweet”, “blog”, “status”, etc., they don’t necessarily follow through. What is constraining people from practicing what they preach?
2. The paper gives a variety of reasons of why lowering population growth would be beneficial to societies such as how it is correlated with improved gender equity and economic development. However, it neglected to reflect on the negative factors of lowering population. For example, the way our work force-retirement planning operates is that there is a larger work force to care for our retired (through family assistance, retirement plans, and government taxing). In Eastern Asia, it is common for retired parents to live with their working children to be provided for. So should we, as a society, have to change our cultural expectations so that families stay together as larger units, move past our biological impulses to have as many children as we can, and even accept that people dying is healthy for our communities?
3. The idea of looking at non-Western value and belief systems to teach us how to better live is a commendable challenge, but I believe is a half-measure and unethical in some ways. This “buffet style pick and choose” method of looking at certain spiritual lifestyles in a way fetishizes the non-Western world and does not actually engage the world to address what is essentially a global problem. Often, countries will trade resources with one another to aid each other, but what about intellectual people as well? So instead of finding a few fortune-cookie style proverbs, would it be beneficial for governments to hold positions in their decision-making bodies that are reserved for foreign politicians or philosophers to, not only advise, but to have actual decision-making power in the country they are working with?

Nuclear Energy - What are the implications of following the status quo of current energy use versus using nuclear energy as a sustainable resource?

1. In my Selected Topics in Psychology: Decision and Choice class last semester, we learned there were four key principles involved in making a rational decision. According to these principles, decisions should be i) based on the decision maker’s current assets; ii) based on the consequences of the choice, not past choices; iii) if the consequences are uncertain, probability theory should be used to evaluate their likelihood; and, iv) the choice should be adaptable within the constraints of probability and the consequences. As Han (2014) has noted, we must bring the discussion of nuclear energy back into the realm of rational discourse in order to achieve progress. It essential that we consider these key principles in order to make a rational decision about the future of nuclear energy. How can we use these principles as a guide to alleviate the fear of nuclear energy that has been promoted by history?
2. According to the EPPM there are two audience reactions: danger control (high perceived threat and high perceived efficacy) and fear control (high perceived threat and low perceived efficacy). The apparent dominant reaction to nuclear energy is one of fear control with threats of nuclear energy being high and feasibility of its implementation being low. The model suggests that for the public to shift towards a danger control reactions which leads to adaptive behaviour we must only increase the perceived efficacy of nuclear energy as a recommendation. In this context, is it really possible to separate the threats from the efficacy of nuclear energy and can the public enter into a danger control reaction without reducing the perceived threats and dangers associated with it?
3. Nuclear energy is a viable alternative energy source, but it has a negative reputation and perception when it comes to public opinion. This negative view of nuclear energy has been exacerbated by the incidents at Chernobyl and Fukushima, as well as fear of health detriments due to radiation effects. What is the most important obstacle to overcome in order to change people’s perception of nuclear energy? What would be the most effective tactic to put this in motion? Government support of research and nuclear plants? More exposure of the topic on TV and other media? Educational approaches?
4. Fear is introduced as a potent motivator for controlling behaviour. Currently, the paper presents fear being used in an anti-nuclear sentiment and how to dispel those fears. However, if we really wanted to convince the public, we should also use fear, that without nuclear energy, our society as we know it will collapse. The question then is, is it ethical to manipulate people on a large scale in order to do what is best for them, or to let nature run its course and if catastrophic events occur, accept them as evolution at work?
5. Just as we could not predict the global changes associated with the use of fossil fuels until large consumption had occurred, how can we be sure that nuclear power will not impact our environment in some negative way over time?

Biofuels - Is biofuel a realistic alternative energy source to sustain our current way of living?

1. I imagine money has a huge impact on biodiesel production. Biodiesel only occupies a small portion of the fuel market and companies involved are likely competitive. Thus, the economics of biodiesel poses a threat because companies want to make the most money, which sometimes involves reducing their costs and producing the biodiesel as cheaply as possible. If the companies want to produce cheaper biodiesel, what prevents them from misusing (or avoiding) additives and creating impure products that may damage vehicles? Like alluded to in the article, impurities are already common. They would likely become more common as cheaper options are explored. How can this constraint on biodiesel quality be monitored and regulated so that the economy and the consumers (and also the environment) all benefit?
2. Biodiesel fuel is an option that would be less harmful to the atmosphere than petroleum diesel. However the world at this time may not be able to support this particular alternative because of negative environmental and social consequences. For example, large scale farming practices to provide enough fuel to meet human needs would require nutrients and pesticides and the runoff would affect the surrounding environments. Growth of a single crop in a large area would drain the soils which is a problem with arable land being so scarce in the world. Lastly, it would divert agricultural land to producing biodiesel crops over food crops especially in areas where food is needed the most – an issue involving the food crisis. It is obvious there are negative aspects to biodiesel fuels. Is it worth it to focus our energy into fixing these problems or looking for other options to solve our needs for fuel?
3. The impression I received from the comparison of the liquid fuels is that while emissions from biofuel is more environmentally friendly, there are more issues with the fuel itself than there are with petroleum. This being the case, I'm not sure if it would be worth the switch from petroleum-fueled vehicles to those running on biofuel, as a whole host of new issues must be faced, leading me to believe that maybe searching for another form of liquid fuel is not the right idea. As the technology and infrastructure will have to change with any switch in fuel, should the idea of liquid fuel be scrapped and potentially consider completely new ways of running vehicles? As the current engine was designed to run on petroleum, is it time for a completely new engine designed for a completely novel energy source?
4. Greenwashing? How green are biofuels? In “What’s so different about biodiesel fuel”, the authors mention that “some of the properties of biodiesel fuels are not ideal from an engine point of view”. They follow this statement with list of additives that can be used to counteract these problems and improve the overall quality of the fuel. If biofuels were expected to be used on a global scale, these additives, which are all petroleum-based, would have to be produced in mass quantities therefore the benefits of using biofuels may be cancelled out by the need for these petroleum-based additives. Another worry is that when you factor in all of the energy (which is generated by burning fossil fuels) needed to drive the machinery to farm and process the fuels and the petroleum based fertilizers that are needed to keep the crops growing, biofuels may not actually lower the overall greenhouse gas emission output. One estimate from a study done in 2005 suggests that using current farming and production technology, it takes anywhere from 27-118% more energy to produce a gallon of biodiesel than the energy it contains. With these numbers in mind, why has biodiesel been advertised as the clear ‘green alternative’ to fossil fuels? I have no doubt that biofuels do offer some advantages over fossil fuels but I wonder if the advantages associated with biofuels are being accurately conveyed to the public. This gets at the bigger issue of companies using buzzwords like ‘bio’ and ‘green’ to convince consumers that their products are environmentally friendly. Are biodiesels another example of ‘green washing’ whereby we are made to feel better by buying them because there is a green symbol on the fuel sign, when in fact they offer little relief from the greenhouse gas problem? Is there a way that we can better inform the public of the issues surrounding biofuels so that they can make an informed decision and prevent any greenwashing that might be surrounding biofuels?
5. As new environmentally friendly alternatives of petroleum enter the scene, conventional environmental authorities are limited when it comes to effectively regulating their use and enforcement. Regarding biofuel regulation, different groups have popped up to tackle the issues at a faster rate than governments will/can – they include private market environmental authorities, moral environmental authorities and other variations of environmental authorities. How should the changing structure of environmental authority be handled and treated by the government and public? Should they be deemed ineffective and not democratic, or is this the answer necessary for tackling the ever growing issue of climate change?

Fisheries - Can we prevent the entire depletion of our oceanic resources by harvesting aquatic products in a more conscientious way?

1. Another argument for why catch does not reflect abundance is due to discards. Fish that are unwanted are thrown back into the sea when fishermen catch more than their quota or because they catch species that they don't need. Not only is this a wasteful practice as many fish are dead by the time they are thrown back, but it skews the data in favour of large/particular fish since certain large sizes/certain fish are more desirable to sell. What would the implications be of putting a ban on discarding? Fishermen would likely oppose because they would be forced to keep small fish that don't earn them any profit. On the plus side, it would eliminate the amount of dead fish thrown back to the sea and result in more accurate data for fish stock assessment. How else would a discard ban favour sustainable fishing, and what needed behavioural/technological changes towards fishing would be a constraint to implementing this ban?
2. There is no doubt that we need a more robust way to measure how many fish are in the sea. A large part of the problem, as this article mentioned, is under-reporting. Although under-reporting occurs in developed countries it is much more prevalent in developing nations. I think that under-reporting is a bigger problem in developing countries because more people are struggling to make a living; therefore, they are tempted to fish illegally and sell the fish on the market without reporting. This article also mentioned that collecting catch data is very costly. In light of this, I wonder if the money that would normally be put towards collecting catch data, might be better spent if it were distributed as subsidies to be given to fishermen in developing nations to encourage them to fish within the legal limits whilst still allowing them to maintain their livelihood. Do you think that this ‘upstream’ approach might be more cost-effective than trying to track what is left after the fishermen are done? If not, can you think of another way that international leaders could specifically address the problem of under-reporting in developing nations since it seems to be a major contributing factor to the overall problem?
3. The ocean is far bigger than the land, and the ocean has volume where as land has surface area. The article finishes off talking about how many fish truly live in the sea and it really highlights how difficult it could be to assess fish stock health. It’s the most difficult area on earth to conduct studies on biological organisms because of their vast migration patterns. We can see based on meta-studies of reports that many abundance data disagree with catch data. Is it possible that fish behaviour is learned as many types are social creatures and they are learning cues and sounds that indicate a troller’s net is coming around? You would think that natural selection pressure would be quite strong for the fish that could learn to avoid such things, perhaps it is just a “scaredy fish” who avoids any and all movement. Much like HIV evolves rapidly based on selection pressures from anti-retrovirals, could the fish population be facing a similar selection pressure based on avoidance of man-made structures and the noises they make? Keep in mind sound does move faster in water then air, giving them an advantage.
4. It is undeniably argued in this article that catch data is valuable in monitoring fish populations. However, perhaps it is only valuable because there is no better alternative. From a biologist’s perspective, numbers aren't everything. We may be causing a drastic bottleneck in many species’ populations in our ocean - and although we may not be directly fishing them into extinction, we are making them more susceptible to things like disease and inbreeding depression. When these sort of scientific discoveries have already been made and applied to conservation work on many animals such as rhinos, why are they not being applied to fish? Are we in a state of denial, considering our lifestyles are so dependent on the bounty of our oceans?

Household waste - Are consumer-based societies able to alter their wasteful behaviours to help sustainably manage and reduce the amount of municipal solid waste?

1. What would happen if the entire world's waste disappeared tomorrow?  Let's assume that at the next G8 or G20 Summit, a plan to safely extract all of the world's waste will be created that is 100% affordable and effective.  All of the world's waste would be transported to the nearest space station (American, Russian, etc.) and would be blasted into space.  What would the true costs and benefits be to losing this material?  Would we realize all the potential environmental benefits if all the waste just disappeared, or would contamination of surface and groundwater sources take several decades to recover on its own?  Is it so crucial that we make use of this waste material, or would humanity be alright on its own without these materials?
2. Many people in North America are blind to the consequences landfills have on the planet, let alone on their own health. One way to make this common knowledge is to introduce it as a topic of study in our schools. Like volunteer hours to graduate, a tour of the waste accumulation centre is necessary in order to receive a high school diploma. Is it possible that this is merely a case of people being undereducated, and perhaps by educating the masses of the dangers posed to our world and our health, it will be incentive to change?
3. Is the collection of vast resources an instinctual behaviour of *Homo* *sapiens*? In the earliest of human societies, the more resources you had at your disposal, the better equipped you were to survive harsh conditions. How is a reduction in consumerism ever going to occur if we are inherently structured for the mass consumption and collection of resources?
4. In your focal article, there was some mention of exciting advancements in the realm of energy recovery from waste. For example, incineration of waste can reduce the volume of disposed waste by 90% (World Bank, 2012). The gases that are recovered from this thermal treatment are then used to create steam, which can be fed into a steam turbine to generate electricity. This is a very innovative and promising way of minimizing waste. However I am worried that these and other similar advancements in energy recovery will take away from the main issue of overconsumption and waste production. The notion that people often look to technology to solve environmental issues instead of addressing the underlying behavioural problems at hand, has been discussed at great length in our class. In light of this, I worry that articles like this one will allow readers to blindly put their faith in technology to come to the rescue while ignoring what is really needed: behavioural changes (i.e. consuming less). In light of this, do you think that publicizing the discovery of new energy recovery technologies does more harm than good? Or do you think that the public should be led to believe that technology can solve our world’s environmental problems?

Overpopulation - Should we restrict access to medicine and limit medical advances to counterbalance the issue of overpopulation?

1. Medicine has had the ultimate goal of prolonging and ameliorating life, and this has especially become realized with modern medicine. Medicine has contributed to overpopulation, which has led to many problems and will continue to wreak havoc worldwide. It may be difficult to find someone that has completely eliminated all medicines in their lives, but surely not all medicine contributes to overpopulation. Medicines that cure widespread and harmful pathogens are different compared to over-the-counter anti-inflammatories because of their effects on overpopulation. If we ever become able to overcome the social and ethical barriers in reducing our tolerance on medicine, which forms of medicine could still continue to operate and be considered good and not evil (overpopulation) for the future? Where do we draw the line between ‘good’ or ‘evil’ medicines?
2. Scientists talk about the emergence of a "superbug" as virus' and bacteria evolve to combat the antibiotics and vaccinations we pose to them. Is it possible, that like a virus, humans will evolve with the changes and challenges posed by overpopulation? Could natural selection create virus- and disease-resistant and temperature-tolerant humans? A "superhuman"?
3. Numerous medical advances have taken place in the past century alone. For example people with organ failure can receive organs from others and still survive; vaccinations before flu seasons have reduced the number of people falling ill (or worse dying) during so-called flu seasons and there are many more examples. It is important to note that many of these medical advances are very common among developed nations but they are not so very common among developing nations. Hence haven't we already imposed this limitation of medical access to certain parts of human population (i.e. developing nation) because of technological and economic constraints? How would further limiting medical access positively impact humans?
4. In Canada alone we have observed the number of reported cases of cancer has been steadily increasing (females- lung, thyroid and breasts cancers; males- prostate cancer) between 1984 and 2013. If there are no medical advances taking place that much of the population would die. This not only brings a major constraint on population but also on economy. If people who are sick do not receive proper care then they will be taking more days of absence (I remember learning that individuals from developing world take more days off than their counterparts from developed world because of illnesses). In an economically driven society, how could not providing sufficient health care support sustainable growth?
5. One form of population control could be (and has been) compulsory sterilization. This would make having children/giving birth a privilege that one must earn. If you are not deemed "worthy" you would be sterilized. However, this would require quantifying and evaluating the value of each human, whether based on their character, genes, achievements, etc. This would go against the fundamental belief that all people are born equal. So do we change this fundamental global belief in the name of population control, or do we proceed as we are, knowing that all populations will someday crash and just like how everything dies, all populations must "die" as well?"
6. Given that increased longevity is a major component of the overpopulation problem, should we stop science funding for further lifespan extension research and redirect those funds toward other priorities?

Acid Deposition - What are the implications of acidification by industrial smoke on freshwater ecosystems, and how do we ensure that developing nations do not follow the same path?

1. When I sat down at the table and put my earphones in to watch the video that was sent to us, my housemate asked me what I was watching. When I told her that I was watching a video on acid deposition, she said "Oh" and kind of shrugged it off. I feel as though this would be the reaction of any member of the general public if you brought up this issue. Would it be seen as a global change issue in their eyes? Would this be something of concern to someone who is unaware of what exactly acid deposition is? In the article, it was said that the commission was more comfortable with the term acid deposition than acid rain. Why is this? In what sense are they using the word 'comfortable' in this situation?
2. Air pollution has become an issue of increasing importance since the start of the Anthropocene. Also during the Anthropocene and prior to this, populations have been moving towards the cities. This makes me believe that even though acid rain may be more prevalent, because humans are living more densely and may be occupying less land, they could be less exposed to acid rain and its occurrence in nature. Could an industrialized society leading to urbanization be a contributor to acid deposition, while also lessening our exposure to it? Acid deposition is very difficult to track and monitor because air pollution is fluid and can pass political borders. This likely makes monitoring and implementing action by countries difficult. What do you think is a more important contributor to our slow action on air pollution and acid deposition? (1) Our lack of daily exposure (NIMBY) to acid deposition, or (2) the trans-border and fluid nature of air pollution and the associated difficulties of monitoring and policy implementation.
3. Bacteria grow with a characteristic sigmoidal curve. First there is a lag phase followed by a short exponential growth and then eventual decline. The steep decline occurs as bacteria use up the resources around them and have nothing left to survive on. Humans are currently in a similar phase where we continue to grow exponentially and deplete the resources around us. We are able to recognize that this growth cannot continue, but it has continued for years. Can we really differentiate ourselves from simple organisms if we continue along this growth curve?
4. Although the majority of us science students have a reasonable understanding of acid rain, a portion of society may have a skewed grasp on the phenomenon that has stemmed from fictional media. When many people hear 'acid rain' they think of precipitation that would burn our skin on contact and perhaps cause it to melt off. While we know this isn't currently happening, is it possible that a lack of attention to the problem could result in something similar? What would happen to society if we were unable to go outside when it rained or snow? How else would acid rain with a pH close to battery acid affect our planet and everything on it?
5. While reading your focal paper, I found it interesting that in February of 1984, the Reagan Administration refused to authorize funds for the action plans needed to address acid rain despite the growing evidence of its negative effects BUT they did authorize $55 million for research on the subject. I find this particularly interesting because a similar situation is unfolding in Canada currently whereby a huge amount of research is being done to understand the effects of the tar sands but there is no funding to implement programs to curb the negative effects. With this in mind, what do you think needs to be done to make this change from funding purely devoted to research to funding spent on enacting change based on that research? I realize that this is a very tough question but try to give specific examples of how you think this switch could be made in the case of the tar sands in Canada. Who would be the major stakeholders involved and what role would they play in making this change? Be specific.