

**CoRe: Content Representation Tool
(Loughran, Mulhall, & Berry, 2004)**

Big Ideas/Concept:	Science is Socio-culturally Embedded.
1. What you intend students to learn about this idea	<p>The students should view science as a social enterprise. Science for All Americans (2008) states that “Science Is a Complex Social Activity” (2008, p. 5). Students have little awareness of the ways that society influences scientific community. According to Science for All Americans (2008) students should realize that scientific work is not carried out in isolation but involves many people which may belong to different national backgrounds. Thus the students should be taught that scientific work is socially and culturally embedded.</p> <p>Another important aspect that students should be taught about under this bigger idea is “awareness of the possible influence of social commitments and values on the choices and interpretations that scientists make, and of the influence on the wider culture of scientific ideas and artifacts” are all parts of social organization of science. (Driver et al., 1996, p. 14).</p> <p>Standard ‘F’ from College Pathways to the Science Education Standards emphasizes that student should understand the interrelationship of humans and science at the personal, community and global level (2001 p. 107). Thus, understanding of this idea will help the students to develop the ability to make right decisions at the personal and societal level (College Pathways to the Science Education Standards, 2001, p.107).</p> <p>Thomas and Durant (1987) in the literature for public understanding of science provided an overview of arguments in which ‘cultural argument is provided which the students should understand so that they can “appreciate science as a major element of contemporary culture” (Driver et al. 1996, p. 19).</p>
2. Why is it important for students to know this	<p>It is important for the students to understand that science is socio-culturally embedded because they are not much aware of the social processes of the scientific community. Driver et al. also support this fact that, “students have little awareness of the ways that society influences decisions about research agendas and priorities for particular science research programmes” (1996, p.140).</p> <p>Students do not understand how scientific knowledge is developed and how internal social relations within science functions. Driver et al. also states that students do not understand the reasons for disagreement between scientists and often think them as arising due to lack of knowledge or their difference in opinion. (1996, p. 67). Thus unknowingly they carry misconceptions about how scientists work and how science progress. These misconceptions will not make them understand how the different groups are involved in decision making process.</p> <p>Another important aspect which the students should know is that science and technology can help in</p>

	<p>resolving social problems which is also indicated in the College Pathways to the Science Education Standards as Standard E (2001, p. 104). The importance of students’ understanding of this idea also reflects from Driver et al. stating that “cultural approach to science education would seek to communicate an appreciation of the elegant and powerful structure of ideas we have developed for understanding natural phenomenon and events” (1996, p. 19).</p>
<p>3. What else you know about this idea (that you do not intend students to know yet).</p>	<p>The whole idea of decision making process in scientific community is not what the students need to know before they understand how science and society are interdependent. Driver et al. supports that, “ Decisions are made at various levels – from local to national which are of broad social interest” and called these issues as socio-scientific (1996, p. 18). But taking about these issues before they understand the ‘big idea’ will be of no help to students.</p> <p>Students do not need to know at this point about the steps involved “from the work of single scientist to the acceptance of knowledge claim as a part of the public knowledge of science” (Driver, Leach, Millar, Scott, 1996, p. 143).</p> <p>I do not intend students to know yet that sometimes politics influence scientific processes. For example as stated in Driver et al. about the issue of people demanding unequivocal statements on eating certain vegetables in the issue regarding ‘aftermath of Chernobyl (1996, p. 19).</p> <p>As science influences society, in the same way society also influences scientific procedures. Example: funding some areas of interest and not others show how society influences science.</p>
<p>4. Difficulties/limitations connected with teaching this idea</p>	<p>There are some of the limitations connected with teaching of this idea because sometimes society and cultural issues and their relation to science are sensitive to deal with students.</p> <ol style="list-style-type: none"> 1. Ideas about science among students differ due to difference in socio- cultural background. Jegede and Okebukola (2008) strongly support the fact that, “ A learner who is not positively disposed to, or has a socio-cultural background that is indifferent to, learning science would find it hard to learn science effectively (2008, p. 1). Thus prior knowledge of students from different background matters a lot. 2. Lack of systematic effort to make students aware of this aspect of science is yet another limitation. Jegede and Okebukola believe that not much has been done to solve the problem regarding teaching of how science and society are related (2008, p. 1). This is also in close agreement to what Driver et al. says that students “lack of knowledge of the social processes of science is largely the result of a lack of ant systematic attempt to make them aware of this dimension of the scientific work” (1996, p. 150). 3. Another difficulty is that curriculum does not emphasize science as a social enterprise. This is due to the fact that for making curriculum where this big idea could be embedded needs expertise and a lot of planning.

	<p>The idea could only be taught effectively if curriculum is developed such that it guarantees best outcome.</p> <p>4. Also making such a curriculum require lot of time and sometimes the teachers are bounded by lesson plans and are unable to teach this aspect to the satisfaction of the learner. Driver et al. agrees that, “pressures of time and a curriculum represented in national policy documents or in textbooks as a body of established knowledge militates against teachers portraying the epistemological and sociological dimensions of science in an elaborated way (1996, p.150).</p> <p>5. Lack of training among teachers who have knowledge about this aspect of science. For teaching the students, the teachers should be experts in this area too. There should be good teaching materials and clear guidelines for the teachers to teach this concept effectively and not much attention has been given even though there are dedicated teachers who realize the importance of this concept.</p>
<p>5. Knowledge about students’ thinking which influences your teaching of this idea</p>	<p>Students have their own views about science and how society and culture influence science. Some of the factors which do influence teaching of this concept are :</p> <p>1. Students have their own view about how science progresses. As stated in Driver et al. that students rarely understand the internal relations of science and thus it is unlikely for them to “appreciate the steps that are taken from the work of a single scientist to the acceptance of a knowledge claim as a part of the public understanding of science” (1996, p. 143).</p> <p>2. They have some awareness about how society influences scientific decisions but students sometimes do not always believe that science is for benefit of society. In one of the interview conducted by Driver et al. the students claimed that science and technology are creating problems in society for example, “ computers causes unemployment” (1996, p.68).</p> <p>3. Also students tend to believe that all of the social problems cannot be solved by scientific knowledge and technological expertise only. (Driver et al. 1996, p. 68). Students believe that scientists like any other common men are also biased in their decision making.</p> <p>4. Students make their own conclusions regarding the disputes occurring in scientific community. They believe that scientists have disagreement on certain issues because of lack of evidence or poor communication or there might be personal rivalries as well. This is in agreement with the example given by Driver et al. in the case of ‘Wegener’ dispute that “scientists may be unwilling to change their position on an issue for personal reasons” because they do not want people to think that they were wrong (Driver et al. 1996, p. 131).</p> <p>5. Students also have their own views about how society can control science. In another interview Driver et al. mentioned that students suggest that funding should be given to only those projects which can guarantee improvement in the quality of life or can generate new knowledge for the benefit of society (1996, p. 68).</p>

<p>6. Other factors that influence your teaching of this idea</p>	<p>There are some other factors which influence teaching science as a social enterprise. These factors may vary in the level of influencing teaching of the concept, some of them may directly influence whole others may have indirect impact on teaching.</p> <ol style="list-style-type: none"> 1. Knowledge of various philosophies as suggested by different philosophers belonging to different socio-cultural background. For example: John Horgan (1996) writes that, “Popper viewed criticism, and even conflict as essential for progress of all kinds thus when one scientists ventures a proposal then others try to bat it down with contrary arguments or experimental evidence” (1996, p. 34). Feyerabend believed that people should not have blind faith on science as scientists also disagree among themselves on many issues (Horgan, 1996, p. 52). 2. Different societies follow different religions and have diverse culture thus their beliefs on scientific issues are influence by religion to a certain extent. Thus scientific discoveries are not always be welcomed equally by all societies. For example many countries now have permission on irradiation of selected items of food but in UK it is prohibited by Law except in hospitals. (Driver et al., 1996, p. 128). 3. Knowledge about history of science- where history of discovery of scientific law (the process) makes clear how much influence does society and culture has on science. For example: The study of history of Ohm’s Law gives us the idea that it took long time when scientists agreed to this Law. History of drift hypothesis is another example where controversial views existed. 4. Knowledge about sociology of science also helps me to focus on my bigger idea. Science for All Americans agrees that, “Because of the social nature of science, the dissemination of scientific information is crucial to its process” (2008, p. 6).
<p>7. Teaching procedures (and particular reasons for using these to engage with this idea)</p>	<p>Although teaching of this idea is not an easy task because of individual differences and students belonging to different socio-cultural background, but some of these procedures will help them in understanding of this idea.</p> <ol style="list-style-type: none"> 1. To motivate the students and to know their prior knowledge about this concept, I will use popular images of science. This will help me to get the idea about students’ interpretation in these images which are related to the big idea (science as a social enterprise). (Refer to Appendix # 1) 2. Conceptual cartoons to help me where the misconceptions lie about socio-cultural aspect of science will be useful. As stated by Keogh et al. (1999) that conceptual cartoons “present learners with a set of alternative ideas about a scientific concept in visual form” (1999, p.1). (Refer to Appendix # 2) 3. Concept based questions are very helpful in initiating thought process. The questions will make students to think about his idea and they will start getting idea about how science and society are related. (Appendix # 3) 4. I might also use a questionnaire like VNOS-C but questions will focus on the bigger idea I have. (See

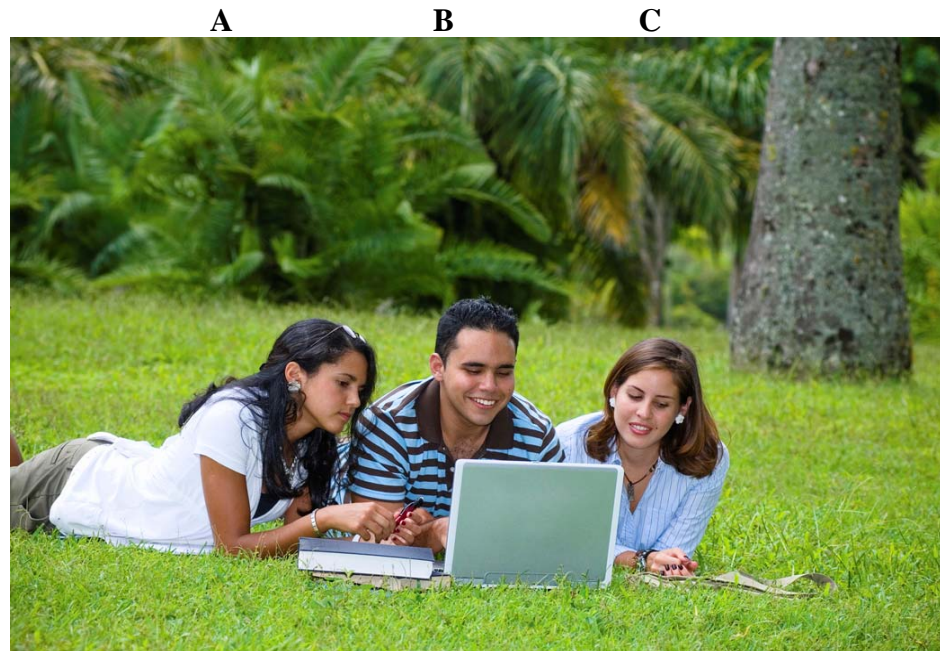
	<p>Appendix # 4). The responses to these questions will help the teacher to understand social dimension of science.</p> <p>5. Debate in class will be one teaching strategy- Like on paper “How to Defend Society Against Science” by Paul Feyerabend. The students can read the paper and then the debate can be there. Through this debate the students will be able to participate actively in class discussion which will help them to bring their ideas in the class.</p> <p>6. Case study about scientific issue. (Refer to Appendix #5)</p> <p>7. Students will be asked to choose a socio-scientific issue (from any article online or paper media) and write a short paper critically analyzing it. (Appendix # 6)</p>
<p>8. Specific ways of ascertaining students’ understanding or confusion around this idea (including likely range of responses).</p>	<p>1. Conceptual cartoons will also help me know about their confusion on this aspect of science being socio-culturally embedded. (Appendix# 7)</p> <p>2. Activity would be carried out in class as described by Cavallo (2008) on page 12. This activity will help them understand how research process is carried out as a large team and not by a single scientist. (Appendix # 8)</p> <p>3. Minute paper with specific questions will also help to ascertain students’ understanding of this concept. Questions will be focused on central idea about what they have learnt in class, what they are confused about and what they want to know more about this idea.</p>

Appendices

1. The power point has 7 slides which have popular images of science brought to the class C& I 8710 by students. The slides will be displayed one by one and the students will be asked to first talk about their interpretation in groups. The slides will help students to think about how society and science are related. The students will come up with different interpretation as a whole class discussion. As an instructor the student's ideas will help me to know their misconceptions (if they have) on the bigger idea (science is socio-culturally embedded). (Power point is in the form of attachment). However, all the 7 slides will not be discussed on one day but it will be flexible based on which concept is to be focused next.
2. This conceptual cartoon will help the students to think how society gets influenced by science. Since it contains alternative views about the magnetic therapy, it will help students to enhance their thinking about how people should have belief about scientific processes. This cartoon was developed by one of the student of C& I 8710 which will help me in teaching this bigger idea. Students will discuss among groups and their interpretation will help the instructor to understand their knowledge about this concept (science influences society).



3. There are three students having discussion on social nature of scientific communities. Each of them presents their own view. Comment on each of them and give reasons for agreement/disagreement with each student and why?



Students views about social nature of scientific communities.

Student A: Research funding should only be approved when scientists can show, in advance that the return on the investment will be in terms of improved quality of life. (Driver et al., 1996)

Student B: Well, although science aims at quality improvement but how it can be possible for scientists to predict this in advance? I believe that science should be funded because it aims at developing explanations and understanding rather than of improving the quality of life. (Driver et al., 1996)

Student C: I am confused. I believe that science adds to knowledge and that increased knowledge would automatically lead to improvements in the quality of life. So, science should be funded anyways. (Driver et al., 1996)

4. Question 1. Do you expect scientists to have arguments? Give reasons?

Question 2. Does government play role in determining what topics scientists should do research on? Why or why not?

Question 3. Does science and technology resolve social problems like unemployment, crime, overpopulation, crime, threat of nuclear war etc completely? Justify your answer.

Question 4. Scientific knowledge is to some influenced by social and cultural context of the scientist or biased to some extent. Justify with examples?

5. The students will be provided background knowledge about the case of the safety of food irradiation (Driver et al., 1996, p. 128). Students will get chance to first study the case and then discuss the points within their groups. They will also get a chance to discuss with scientists working in food science department and from food and industry research department. After having interviewed them the students will discuss the points first in groups and then as a class about whom out of them they agree or disagree with. The discussion will be focused on the following points :
 - What might be the possible reasons for the two scientists having different views?
 - How can this issue be resolved?
 - How will you decide whom you should agree with if scientists are having different views?
6. Students are required to choose any socio-scientific topic such as global warming, safety of food irradiation, AIDS, bird flu, energy shortage etc. Critical analysis of these topics will help the students to understand how science is communicated. Also this will help students to understand science “so future citizenry may be well situated with respect to society’s changing scientific discoveries on a global scale” (Cavallo, 2008, p. 14).
7. This cartoon will help me to understand how they think about science being socio-culturally embedded. They will share their ideas in the class once they have discussed that as a group.



Whom do you agree with and why? Share your ideas within your groups.

8. This link takes us to the activity I would try in class.
<http://web.missouri.edu/~hanuscind/8710/cavalloJCST.pdf>

References

- AAAS (1989, 1990). *Science for all Americans*, DC: American Association for the Advancement of Science.
- Cavallo, A. (2008). Experiencing the nature of science: An interactive, beginning of semester activity. *Journal of College science teaching*, May/June, 13-16.
- Driver, R., Leach, J., Millar, R., & Scott, P. (1996). *Young people's images of science*. Buckingham: Open University Press.
- Feyerabend, P.K. (1975) "How to Defend Society Against Science." *Radical Philosophy*, 11, 3-8.
- Horgan, J., (1996). The End of Philosophy. In John Horgan (Ed.), *The End of Science* (pp. 53-66). New York, NY: Broadway Books
- Jegede, O.J., & Okebukola, P. *Journal of Research in Science Teaching*, 28(3), 1-3.
- Keogh, B., Naylor, S., Boo, M., Feasey, R., (1999). *Formative assessment using Concept Cartoons: initial teacher training in the UK*, Retrieved August 1999 from 2nd Conference of European Science Education Research Association Conference, Keil, Germany.
Web site: <http://www.conceptcartoons.com/resources/Keil%20final%20paper.doc>
- McIntosh, W.J., & Siebert, E.D., (2001). *College Pathways to the Science Education Standards*: NSTA Press Book.