

Table 1

Activity/Aspect	Interest for students	Outcome	Science Knowledge
Animal house	Animal welfare and fuel costs	Model selected for a more fuel efficient animal house	Transfer of energy Homeostasis
Sugary drink dispenser	Health aspects of high-sugar drinks	Alternative means of raising money through healthier drinks; increased political participation	Diabetes; effects of sugar on body

Table 2

	Politics (ideology)	Social (collective)	Self (subjectivity)	Praxis (engagement)
Knowledge	<p>Knowledge and understanding of political systems and power structures. (understands where authority lies, e.g. that school student council, governing body and Principal, will need to be influenced to effect change)</p>	<p>Knowledge of interconnections between culture, power and transformations; knowledge of non-dominant as well as dominant discourses. (appreciates that there are a variety of opinions and to look out for marginal voices, e.g. ‘silent’ third world egg donors)</p>	<p>Sense of identity (understands how they are positioned in relation to a particular issue, e.g. right to buy fertility treatment)</p>	<p>Knowledge of how to collectively effect change for social justice. (knows how to garner support to effect change, e.g. campaigning against, sugary drink dispenser)</p>
Skills	<p>Critical political analysis. (Understands relationships between power, culture and knowledge; hence ideas of status of knowledge – the relationship between expert, anecdotal and communal knowledge)</p>	<p>Capacity to engage in dialogue and deliberation. (e.g. take part constructively in classroom discussions, both face to face and online)</p>	<p>Reflect on own status in society. (can place themselves in others’ shoes while aware of their own position)</p>	<p>Imagining a better world; active participation in acting collectively to change status quo. (Articulates a vision of a better world and how to implement that aspiration)</p>

practically)

Values	Commitment to values opposing injustice and oppression. (Advances an understanding of causes of injustice and how it relates to their own value system)	Inclusive dialogical relationship with others; ability to reflect others' values and commitments. (Can articulate viewpoints of others even where there is disagreement)	Consideration of self-worth. (Expresses why they have a particular perspective and its meaning to them)	Informed responsible, reflective ethical action. (Action taken is thoughtful and reflects underpinning values)
Dispositions	Actively questioning social injustice and oppression. (Raises critical questions about acts of injustice which can then generate questions for enquiry)	Responsible towards self and others. (keeps social responsibility foremost in thinking)	Autonomous and critical (Can listen to others' perspectives but maintains their own view, albeit self-critically)	Commitment and motivation to change society responsibly. (Communicates reasons for actions to others)

Assisted Reproduction	Interest in new reproduction technologies	New teaching resource	Reproduction; ivf
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Table 3: Examples of SSIBL questions

Question	Level	Scientific knowledge	Other knowledge	Personal to social
Sun-tanning parlours should be banned for young people under the age of 18	Upper secondary	Radiation Structure of the skin	Risk and uncertainty; Human Rights	Relevant for young people in colder climates but raises broader questions about freedom of choice, global warming and damage to the ozone layer.
Selection against certain disabling genetic conditions is the thin edge of the wedge for wholesale genetic selection.	Upper secondary	Genetics; Ivf techniques	Social justice; Rights; Culture	Personal questions about attitudes to disability but broader questions about access to fertility treatment.
Is it possible to avoid resistance to antibiotics?	Upper secondary	Bacteria Antibiotics Infectious diseases Evolution Selection pressure	Risk; Legislation; Personal and social decision-making	How do different legislation scenarios across the world influence individual decision-making about the rational use of antibiotics?
Does recycling paper do	Lower	Manufacture of paper;	Process of paper production and	Personal attitudes to waste as against

more harm than good?	secondary	Chemical structure of paper; Solvent chemistry	recycling; Cost-benefit analysis; Local recycling legislation; Interest groups	economic interests of those who pulp wood and produce paper.
What's the best way to feed small birds?	Primary	Bird nutrition; Food webs; Sampling; techniques	Conservation	Local aesthetic pleasures of birdlife in the context of broader species competition and interaction.
How can we reduce car pollution outside our school?	Primary and Lower Secondary	Fuel combustion; Sampling; Measuring particulates	Use of secondary data; Pros and cons of car use	Local concerns about pollution related to global use of fossil fuels and alternatives

Table 4: Example of assessment framework using school animal house project as exemplar

Didactic approach	Knowledge	Skills	Values	Dispositions
Authoritative (mainly structured)	Focus on learning substantive theoretical scientific knowledge and inquiry skills. (learn principles of heat transfer and experiments to measure them)	Follow through procedures as taught and relate findings to science knowledge. Explicate learned procedures. (Investigates conductivity of different materials using given experimental procedures and makes conclusions based on evidence.)	Learning that the applications of science are not value-free. (Principles of heat transfer can be applied and associated with improvement of wellbeing at personal and social level).	Discusses problem in groups.
Problematising (mainly guided)	Applying scientific and transdisciplinary knowledge into new contexts (explain how principles of heat	Devises procedures as taught for carrying out inquiry. This can be done with some	Articulating that an inquiry is based on a range of value judgments. (Can articulate values associated with inquiry such	Recognises when to collaborate in groups and when to be autonomous. Participates

	transfer apply to the construction of an animal house, and reflect on human responsibilities to non-human species)	guidance, if appropriate. Demonstrates awareness of uncertainty in considering empirical and second hand data. (Devises a method for investigating appropriate materials to build animal house. Takes into account concepts of accuracy, validity, precision and so forth in making and interpreting data).	as importance of fuel conservation, its local and global implications, and non-human wellbeing).	fully.
Critical and pragmatic (mainly open)	Recontextualising and scrutinizing relevant scientific knowledge and research in the light of contingencies of specific contexts.	Suggests and collaborates as group to generate questions or hypotheses for building animal house	Inquiry driven by value considerations recognizing various aspects such as inter-relationships between personal and social values.	Can operate between full autonomy and collaboration. Recognises importance of inclusivity and how to

	<p>(Recontextualise and adapt knowledge of heat transfer in the light of constraints of constructing an animal house, e.g. use of composite materials, ventilation factors, humidity. Research on habits of small mammals to reflect design constraints. Reflect on ethical relations between humans and non-humans in terms of concepts such as rights and responsibilities, and process of fuel conservation).</p>	<p>using research material, scientific and other knowledge, reports and surveys. Follows through inquiry. Adapts knowledge and understanding depending on circumstances. (Develops inquiry and outcome, eg working model of animal house, and evaluates process and product).</p>	<p>Recognises interconnectedness. Identifies political nature of action where necessary. (Construction of animal house driven by awareness of need and knows how to take action to meet that need.)</p>	<p>negotiate consensus.</p>
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