# Planning SSIBL lessons

| | |
|---|---|
| **Authenticity (ASK)**<br>What questions can you pose that are going to be interesting, relevant to the students? How will you introduce your lesson (or series of lessons) to make it authentic, relevant to your pupils? | |
| | |
| **Enacting SSIBL (FIND OUT)** | |
| What type of inquiry are you using?<br>What is the socio-scientific context you are using? | **Resources:** what will you need? Will you include a practical investigation? How will you organise students in order to manage discussions? |
| How are you going to address **personal/social/global** dimension of topic? | |
| What are the (a) subject knowledge and (b) skills (practical, working scientifically skills, social skills) you aim to address? | |
| Assessment: what will you do to assess progress and outcomes (e.g. what questions will you ask? What tasks will you include?) | |
| **Taking action (ACT)** | |
| What possible actions could you ask students to take (on a personal/social/global level)? | |

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# Testing drugs on animals resources

## Would *you* sign a petition for a ban on using animals to test new drugs?

Some people think that the benefits of using animals to advance science and medicine outweigh the welfare of the animals. Others think that the welfare of the animal is important when testing new medicines on them and this should be taken into account when deciding what is acceptable testing.

- What do *you* think?

## Mapping the controversy

Create a concept map identifying as many factors / ideas /stakeholders as possible in relation to the animal testing controversy

What do you consider are the arguments for and against using animals for drug trials?

## Debating the use of animals in medical research

You are each assigned a role. Use the worksheet to collect information to support your group's position. Be ready to discuss and debate your view!

- Drugs company representative
- Animal owner
- Research scientist
- Patient
- Medical student

## Would *you* sign a petition for a ban on using animals to test new drugs?

Have you changed your mind in any way?

Would you sign the petition?

What three points do you consider to be the most effective in backing up your personal view?

What *action* would you take to promote your position on this issue?

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## Argument template for each group/role

| |
|---|
| Our position is that… |

| |
|---|
| The evidence to support our position is…. |

| |
|---|
| This evidence supports our position because…. |

| |
|---|
| Arguments against our position are…. |

| |
|---|
| I would convince someone who doesn't believe us by… |

(adapted from IDEAS Resources Pack,
https://www.stem.org.uk/elibrary/collection/3308/ideas-evidence-and-argument-in-science-ideas-pack)

## Expressing individual views

**1. Would *you* sign a petition for a ban on using animals to test new drugs?**
(make sure you provide reasons to support your view)

**2. What extra information might you need to help you make an informed decision?**

What questions would you like to ask before making a decision?

**3.** Look at your answer for question 1; **Have you changed your mind in any way?**

**What three points do you consider to be the most effective in backing up your personal view?**

**4. What *action* would you take to promote your position on this issue?**

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## Websites for finding information on using animals in medical research

- http://www.aboutanimaltesting.co.uk/using-animals-testing-pros-versus-cons.html
- http://www.bbc.co.uk/ethics/animals/using/experiments_1.shtml
- http://www.bbc.co.uk/ethics/animals/using/facts.shtml
- http://www.nature.com/news/2006/061211/full/news061211-9.html
- https://www.gov.uk/guidance/research-and-testing-using-animals
- http://www.pro-test.org.uk/2006/04/why-animal-research-is-important-and.html
- http://www.understandinganimalresearch.org.uk/about-us/science-action-network/forty-reasons-why-we-need-animals-in-research
- http://www.understandinganimalresearch.org.uk/how/myths-and-facts
- http://www.understandinganimalresearch.org.uk/how/understanding-animal-procedures/reducing-suffering/
- http://www.understandinganimalresearch.org.uk/about-us/science-action-network/forty-reasons-why-we-need-animals-in-research/
- http://scienceblog.cancerresearchuk.org/2011/06/21/animal-research-is-helping-us-beat-cancer/

## Possible roles to assign to groups of students

- Drugs company representative
- Animal owner
- Research scientist
- Patient
- Medical student

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## An example of a case study based on a research scientist

Katie is a biomedical research scientist. She has a background in genetics and her work focuses on cancer research. Her work involves investigating genes that are faulty, reasons that cause abnormalities in genes, which can then cause cancer, and how to treat them. As part of her work, she has to carry out tests using animals. This is because new treatments that Katie and her team develop are dangerous to test on humans directly. In fact, in the UK it's required by law that all new drugs, including those for cancer, are tested in animals before given to patients. Katie and her colleagues in the lab she is working have to follow very strict procedures and rules when designing experiments that involve animals to make sure that pain is minimised and the animals feel comfortable in their surroundings. The researchers also try to make sure that this testing is absolutely necessary, and Katie always tries to explore alternatives like making tests on cells taken from human patients, or using computer models to test what happens to cancer cells when a new drug is used.

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## Climate change scenario

# Climate change: It's not really happening, is it?

More than 97% of scientists working in the disciplines contributing to studies of our climate, accept that climate change is almost certainly being caused by human activities.


➢ What do *you* think?

http://tiki.oneworld.net/global_warming/climate7.html


Pope Francis: Climate change mostly man-made



**Climate change is human-made**



https://www.youtube.com/watch?v=rL-qX2GI7dc

**The sun is the main driver of climate change. Not you. Not CO2.**

http://youtu.be/ImsWXqM1jNo

# Is it our fault that our planet is getting warmer?

In groups of 2/3

1. Sort the evidence into four categories:
   - for/against human-made climate change
   - For/against naturally occurring climate change
2. Consider the nature of the evidence: *can you make a decision about who is causing global warming?*
   - *Does this affect your decision on whether to take action?*

## Is it our fault that our planet is getting hotter?

3. Consider solutions and critique these
4. Make a group decision
5. Review your personal view – do you still agree or have you changed your mind? Why?

- What investigation *questions* could you or the students ask on this topic?
- What *actions* would you encourage your pupils to take individually or as a class?
- What science do you need?
- What aspects of Working Scientifically does this align with?

Table 1 Certainties and uncertainties in climate change science

| More certain ⟵ | | ⟶ Less certain |
|---|---|---|
| • The global surface temperature has increased 0.8 °C since measurements began in 1850.<br>• Each decade since 1970 has been warmer than the previous.<br>• In the past 30 years, there has been an overall decline in sea ice in the Arctic Ocean.<br>• Global average $CO_2$ concentrations have increased from 280 ppm in 1850 to 398 ppm today.<br>• The concentration of methane in the atmosphere has doubled in the last 150 years.<br>• Changes in the composition of the atmosphere have caused an enhanced greenhouse effect.<br>• Ice cores show a correlation between $CO_2$ concentration and global temperature. | • Even if we stopped emitting $CO_2$ today, the $CO_2$ currently in the atmosphere would stay for a very long time.<br>• There are a large number of other variables (both natural and human-made) involved in the climate of which we do not know the effects (e.g. volcanic eruptions, water vapour).<br>• Climate models have difficulty in simulating the overall effects of numerous variables.<br>• Current temperature change can only be matched by models if both natural and human-caused variables are included.<br>• Projection of future climate change depends on a number of unknown factors such as mitigation efforts to reduce $CO_2$.<br>• Projected temperature increases using several $CO_2$ emission scenarios is 1.5–4.8 °C by 2100.<br>• Ocean temperatures will continue to rise and sea levels will continue to rise even if emissions were stopped today. | • Some aspects of the climate are not as well understood and are difficult to model (e.g. clouds).<br>• The future uptake of $CO_2$ by the land (vegetation and soil) and the ocean is poorly understood.<br>• The effects of land ice melting (Greenland and West Antarctica) are uncertain.<br>• The circulation changes in the North Atlantic Ocean are not well predicted.<br>• Models have difficulty modelling regional effects (current models are at the continental scale). |

Adapted from Royal Society (2010) and IPCC (2013).

28 SSR September 2014, 96(354)

Busch, K. C., & Osborne, J. (2014). Effective strategies for talking about climate change in the classroom. *School Science Review, 96*(354), 25-32.

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| Climate change is… | Evidence to support… | Evidence against… |
|---|---|---|
| **human-made (anthropogenic)** | | |
| **naturally happening** | | |

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## Renewable resources scenario

### Is the UK government's decision to invest in new nuclear power plants short-sighted?

On 20 October 2015, The Guardian reported that work on the first new nuclear power plant in the UK for 20 years was set to begin within weeks, after the French energy company EDF and China's main nuclear operator agreed a deal on building the £18bn project.

Ownership of Hinkley will be shared between the state-owned China General Nuclear Power (CGN) and EDF, in what critics claim to be the most expensive power plant ever built. EDF said it expected to take a final investment decision and start mobilising engineers for the plant, by the middle of November 2015. The companies also announced preliminary agreements to work together on two more nuclear power stations: Sizewell C in Suffolk and Bradwell in Essex.

➢ What do *you* think?

- What questions do you have as a result of reading the 'Power Struggle article'?
- What else would you like to know to be able to make a decision?
- What do you consider are the arguments for and against using nuclear power plants?

2

### Here are some claims put forward by different groups...

1. Both nuclear power plants and the radioactive waste they produce are not safe enough to justify building new plants
2. Nuclear power is the most economically viable low-carbon electricity resource for long term supply
3. We can reduce consumption so that current sources of electricity are sufficient
4. We can produce enough extra electricity for our needs by building new sources of renewable energy
5. We can only produce enough extra electricity for our needs by having nuclear power in the mix

3

### Is the UK government's decision to invest in new nuclear power plants short-sighted?

➢ Have you changed your mind in any way?

➢ What three points do you consider to be the most effective in backing up your personal view?

➢ What *action* would you take to promote your position on this issue?

5

| Energy Resources | What evidence is there *to support* this? | What evidence is there *against* this? |
|---|---|---|
| **We have enough sources of electrical energy to maintain our current consumption without the need for nuclear power plants** | | |
| **We must build new nuclear power plants, whatever the cost** | | |

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## A SSIBL pledge

**For myself:**


**For my teaching:**

**For myself:**


**For my teaching:**

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# An introduction to Socioscientific Inquiry-Based Learning

Andri Christodoulou, Marcus Grace

## Key ideas and terms

**Responsible Research and Innovation (RRI)**
RRI engages the public and stakeholders with scientists in scientific enterprises aiming to create products and advance scientific fields based on the principles of ethical acceptability, social desirability of products, and sustainability. In this context, science is done *with* and *for* society. The processes adopted to promote RRI include (a) diversity and inclusion, (b) openness and transparency, (c) anticipation and reflection, and (d) responsiveness and adaptive change.

**Inquiry-based learning (IBL)**
IBL involves an authentic open-ended question or hypothesis formulated by students or teachers. Inquiry is about seeking knowledge through evidence to answer authentic questions, and it is underpinned by: student interest, research, questioning and the collection and interpretation of evidence. Students need to feel empowered to direct their own learning, but this needs teacher support (scaffolding). The level of support provided can vary depending on the context, topic and pupils (e.g. open inquiry, guided inquiry, structured inquiry, confirmation inquiry). Within science classrooms, IBL can take different forms (e.g. controlling variables investigations, identification and classification, using secondary sources, surveys and correlations, using experimental models and analogies to explore an explanation)

**Citizenship Education (CE)**
Citizenship education aims to create citizens that are able to make informed decisions about and within their societies/communities. Citizenship can be considered on a continuum from citizens that are *personally responsible* (e.g. behaving responsibly without questioning why), to *participative citizens*, who are those that behave responsibly within their community and take action, and finally, *socially responsible citizens* that critically consider and reflect on issues of social justice and take action accordingly.

**Socioscientific Issues (SSIs)**
SSIs issues which have a basis in science but also have a potentially large impact on society. So SSIs are closely linked to scientific literacy and citizenship. They involve values and ethical reasoning, forming opinions and making decisions at personal or societal level. SSIs are controversial in nature, as there is often not a definitive answer or solution to them. Instead different views or possible explanations might be put forward. This means that students need to be able to evaluate risk and consider the uncertain nature of knowledge in their decision-making process about SSIs, and understand the role and use of evidence in scientific practices.

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**The overall aims of SSIBL are to:**

- **encourage young people to participate in research and innovation issues influenced by science and technology**
- **promote interest in science, mathematics and technology so they can become scientific researchers of tomorrow**
- **encourage young people to act as informed social agents through scientific inquiry informing responsible research and innovation**

**So what is SSIBL?**

Socio-Scientific Inquiry Based Learning operationalises RRI in the context of education. It is learning through asking authentic questions about controversial issues arising from the impacts of science and technology in society. These questions are open-ended, involve participation by concerned parties, and are aimed at solutions which help to enact change. An important end point of SSIBL is to promote action. SSIBL inquiries can be short term or long term. Short term inquiries can complete the outcomes in one or two lessons. Examples of SSIBL inquiries in school might be: situating a feeder for nesting birds; designing a poster to reduce school energy consumption; organising a system for building the school compost heap; bringing in plants for a community garden; producing a leaflet to show how to estimate maximum salt intakes.

## How do we create SSIBL environments?

**A. Identifying authentic questions (ASK)**

SSIBL issues should be 'authentic', i.e. problems and issues relevant to students in the 'real world', which students want to engage with and solve. Authentic situations are often complex and controversial, as there might not be overall agreement about solutions. It is important to tap into students' interests but also generate scenarios in which students can position themselves and hence invoke interest. When students have polar views this can often stimulate interest in other students because they can reflect on where they stand in relation to extreme positions.

**B. ENACTION – using socio-scientific inquiry based learning activities (ACT)**

At this stage, students work on identifying the best way to provide an answer to the question posed, and then carry out their investigations. Some important aspects to consider during this stage are:

Nature of Science (NOS)

Teachers need to encourage relevant experiences for students to appreciate:

- science in a social context
- science as human endeavour and as a human construct with its checks, constraints and opportunities
- how scientists work, and how they co-operate with each other and with lay stakeholders in achieving ends in research and development
- scientific procedures such as asking scientific questions, making hypotheses and predictions, collecting and interpreting data and communicating results
- the uncertainties in how science is modelled, produced and applied
- scientific and technological outcomes are governed by a certain amount of risk and unpredictability and include social factors such as experience, trust and scientist-lay dialogue.

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Scaffolding inquiry

Scaffolding is a central part of social constructivist learning. It is the process of giving appropriate support to students to help them learn something which they could not achieve on their own. Support is given at a stage when the student is ready for it and can then be phased out when the student has acquired the required competence. The nature of the support depends on the students' existing knowledge, skills, experience of the context, etc., in science and in non-scientific things. So the teacher will have to find this out for students in each class (e.g. by questioning pupils or giving them a test, etc.). It is, for example, unlikely that students can pursue an inquiry if they lack the necessary knowledge and skills. You can think about scaffolding at the design phase (how can you differentiate the way in which you have designed your lesson and resources to support students during their inquiries?) or the implementation phase (what questions are you going to ask different groups? How is your questioning going to scaffold students in constructing, justifying and evaluating their ideas, investigations, conclusions?).

Mapping the controversy

Mapping is to help students in identifying precisely what the controversy or problem is. It includes: identifying the nature of the controversy (the focus of the question, evidence, values, interest positions, priorities); the main stakeholders (which individuals, campaigning groups or national/international organisations are prominent players); the affected parties (who or what stands to gain or lose by the outcome of the controversy); considering the links between personal and social, local and global, the present and the future.

Promoting deliberation, reflection and collaboration

SSIBL is participative. If students have little experience of constructive dialogue in school (or at home) then these interactions need to be built up carefully - maybe by starting with small activities such as brainstorming together in class, small well-defined group activities in which students learn procedures such as listening respectfully, feeding back, ensuring everyone in the group has a chance to speak. Concept cartoons are useful for promoting discussion. Appropriate teaching approaches include: supporting exploratory class and group discussions; encouraging openness, honesty, willingness to listen, respect for others, criticality; sensitivity to emotions and strong feeling; willingness to challenge and promote discussion of controversy without injecting own biases; ability to reflect present alternative viewpoints where necessary; encouraging students to discuss what they have and have not achieved throughout the inquiry and to evaluate how they might change strategies in the future; ensuring all students participate meaningfully.

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**C. Taking Action**

A distinguishing feature of SSIBL is the ability to produce opportunities for action as a component of inquiry. However, actions in themselves are only authentic if they emerge from the inquiry through deliberation and reflection. Action can be seen in a broad sense. It could include such outcomes as: making something (e.g. healthy drinks, a school vegetable plot, a poster encouraging fellow students to walk to school rather than drive); writing to an MP; generating a petition; information, such as you tube clips, to support improving personal actions (e.g. avoiding disposal of plastic cups); providing services (e.g. recycling mobile phones). Teacher support can facilitate appropriate action through promoting active links with agencies in and beyond school and identifying appropriate opportunities for action.

**The SSIBL approach begins with real scenarios and all SSIBL scenarios have the following in common:**

i. Identification of a problem which can be solved to improve a situation through research.
ii. The solution to the problem is genuinely open.
iii. Draws on different funds of knowledge.
iv. Connections to relevant science knowledge in the curriculum.
v. Democratic deliberation of different perspectives.
vi. Liaison with different agencies or networks either within or outside the school
vii. Action taken based on research.


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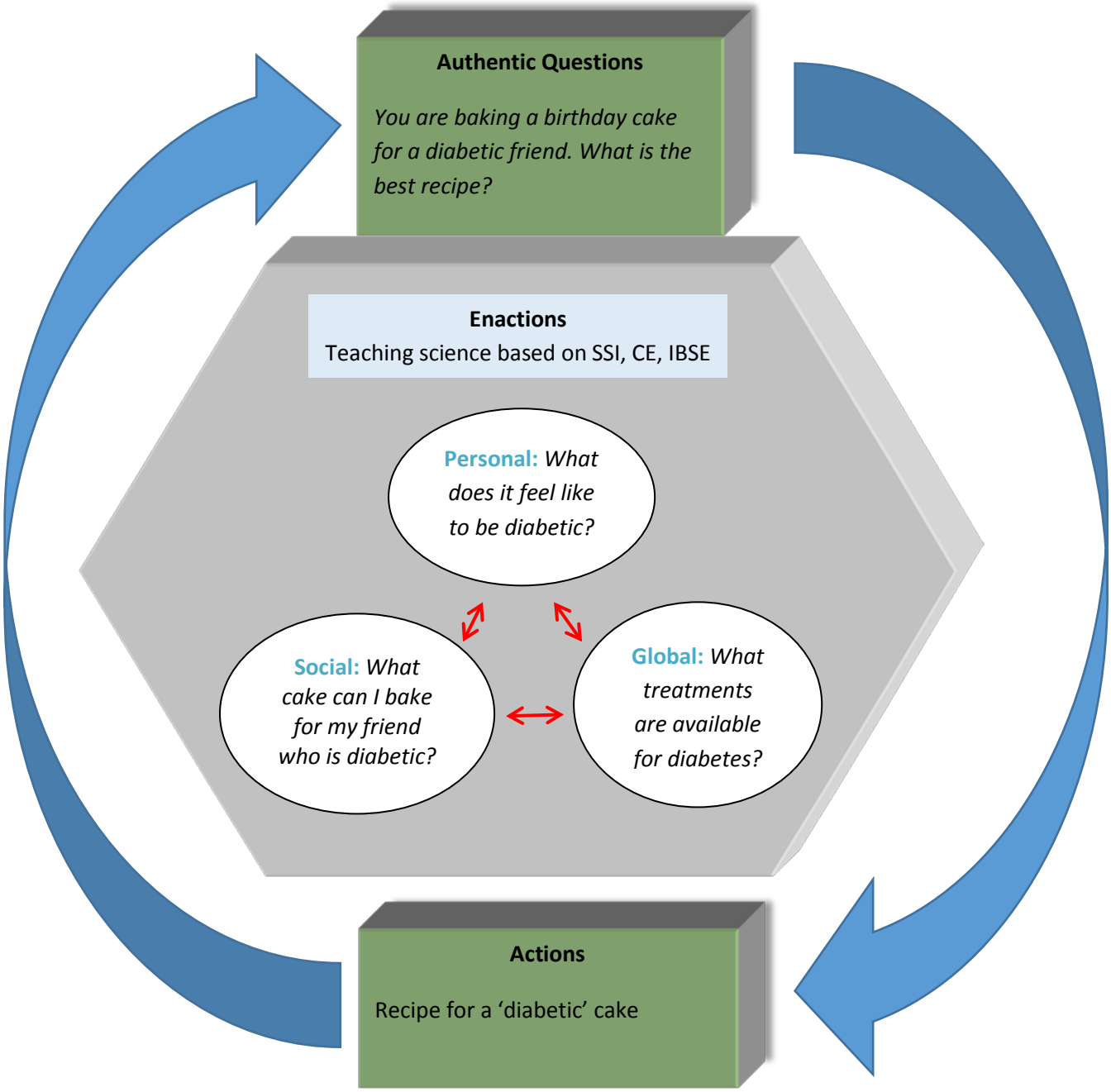
This is an example of a SSIBL scenario based on the process of *authentic questioning – enaction – action*, taking into account personal, social and global dimensions of the same topic.




Levinson, R., & PARRISE Consortium. (2017). Socio-scientific Inquiry-Based Learning: Taking off from STEPWISE. In *Science and Technology Education Promoting Wellbeing for Individuals, Societies and Environments* (pp. 477-502). Springer, Cham. Available at: https://link.springer.com/chapter/10.1007/978-3-319-55505-8_22
Promoting Attainment of Responsible Research and Innovation in Science Education (2016) Our approach. Available at: http://www.parrise.eu/About-PARRISE/ssibl-framework (Accessed: 20 October 2016).

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