

Synthetic Biology Topic Guides

JN: 45109004



1. Stakeholder Interviews: Topic Guide

Researcher Introduction

- About TNS-BMRB
- Nature of research; study for BBSRC and EPSRC
- Emphasise confidentiality
- Interviews will be audio recorded and transcribed as an aide memoir [gain verbal consent].
- Length: approx 45mins -1 hour
- Interview will focus on three areas: overall views on synthetic biology, social and ethical issues in relation to the synthetic biology in general; and issues concerning potential applications.
- [For non technical specialists] We are not expecting you to have a detailed knowledge of synthetic biology – so feel free to pass on some answers if needs be

Background on respondent and their organisation

- To start, how would you describe your organisational /professional /research interests?
- What does synthetic biology mean to you?
- What is the relative importance of synthetic biology research to you/your research/ your organisation as a whole?
- How well informed would you say you are about synthetic biology and its applications?
- [For scientists only] Would you consider yourself to be a synthetic biologist?
 - If yes, what aspect of your work involves synthetic biology
 - If no, how would you define your role?

Drivers for synthetic biology

- What forces are driving synthetic biology? [economic/ technical/ social]
 - Where has it come from – who or what have been the key actors driving the field?
 - Where is it going?
 - How do you feel about the direction that synthetic biology is going in?
 - Probe: benefits and concerns in the future

- In terms of synthetic biology research, how do you feel the UK is doing relative to other countries?
 - Probe: technical
 - Research funding
 - Industry
 - Regulation
- How do you see the future of synthetic biology?
 - How would you describe it?
 - What do you hope synthetic biology will achieve in the future?
- What role, if any, do you see the use of engagement with the public in the governance of synthetic biology?

Social and ethical issues

I want now to talk in more depth around some of the social and ethical issues around synthetic biology

- What in your opinion are the key social and ethical issues for synthetic biology?
- What responsibilities should scientists have when developing synthetic biology research?
- In your opinion, who and/or what may potentially benefit from synthetic biology? Which of these do you consider most significant?
- In your opinion, who and/or what may potentially suffer/ be harmed from synthetic biology? Which of these do you consider most significant?
- What are your views on open source synthetic biology?
 - Probe on issues around IP and open source synthetic biology.
- What are your views on synthetic biology's potential to modify and design new biological parts or life forms?
- What are your views on the potential to patent biological parts or life forms?
- How should synthetic biology be regulated?
 - Do you think the current systems of regulation are adequate?
- Do you think research developments in synthetic biology can be controlled?
 - If so should it be controlled?
 - What needs to be put in place to achieve effective control?
- What are your views on the potential for synthetic micro-organisms to reproduce and evolve?
 - Do you think the organisms produced by synthetic biology can be controlled?
 - Do you think hazard and risk assessment models are adequate for this novel area of science?

- What are your views on garage synthetic biology?
- How should the area be funded?
 - What is the role of private and public investment?
 - How do you view the issues of openness in relation to funding?
 - Where does accountability lie in relation to funding?
 - Should the research organisation be accountable to the public or the funder?

Wider Issues

- Do you have any thoughts on wider social and ethical issues that may come to be associated with synthetic biology?
 - How would you respond to public concerns about 'creating life from scratch' or 'engineering life' for example?
- Do you have any views on the potential impacts of synthetic biology on developing countries?
- Probe: access to technology and IP
- Probe impact on indigenous or local communities
- What are your views on the use of synthetic biology for bioterrorism?

Applications

I now want to consider the potential use of synthetic biology in particular areas, which have begun to be associated with synthetic biology, especially in the policy literature. The three areas are agri-environmental uses; for medical purposes; and for energy.

Agri-environment

- What are your initial thoughts about the potential use of synthetic biology for agri-environmental purposes?
 - Probe: engineered crops (for food and feedstock's)
 - Biosynthetic pesticides
 - Biosensors
 - Climate change (e.g. a biosynthetic pathway to mimic photo synthesis)
 - Bioremediation
- Do you have any views on whether this application area is driving research in synthetic biology?
- [For scientists only] Is this application area important for your research? [If yes]
- [For scientists only] How does your research relate to the promise that synthetic biology offers for new applications in this areas?

- What timescale do you think it will take before agri-environmental applications reach the market? What will facilitate this? What are the barriers?
- What do you feel are the benefits of these applications?
- What would you consider the most significant benefit?
- What do you consider are the potential negative impacts of these applications? PROBE: human or animal health and safety; environmental impact? What would you consider the most significant negative impact?
- Are there any wider impacts in this area – such as social or ethical impacts?

Medical

- What are your initial thoughts about the potential use of synthetic biology for medical purposes?
 - Probe: artemisinin/ other biosynthetic drugs
 - Vaccines
- Do you have any views on whether this application area is driving research in synthetic biology?
- [For scientists only] Is this application area important for your research? [If yes]
- [For scientists only] How does your research relate to the promise that synthetic biology offers for new applications in this areas?
- What timescale do you think it will take before medical applications reach the market? What will facilitate this? What are the barriers?
- What do you feel are the benefits of these applications?
- What would you consider the most significant benefit?
- What do you consider are the potential negative impacts of these applications? PROBE: human or animal health and safety; environmental impact? What would you consider the most significant negative impact?
- Are there any wider impacts in this area – such as social or ethical impacts?

Energy

- What are your initial thoughts about the potential use of synthetic biology for energy purposes?
 - Probe: biodiesel
 - Hydrogen fuel cells
 - Cellulose/carbohydrate derived fuel

- Do you have any views on whether this application area is driving research in synthetic biology?
 - [For scientists only] Is this application area important for your research? [If yes]
 - [For scientists only] How does your research relate to the promise that synthetic biology offers for new applications in this areas?
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- What timescale do you think it will take before energy applications reach the market? What will facilitate this? What are the barriers?
 - What do you feel are the benefits of these applications?
 - What would you consider the most significant benefit?
 - What do you consider are the potential negative impacts of these applications? PROBE: human or animal health and safety; environmental impact?
 - What would you consider the most significant negative impact?
 - Are there any wider impacts in this area – such as social or ethical impacts?

Lessons from GM

Finally, I want to ask you to reflect on the issues around GM crops (in the UK and wider context) and their relevance to the development of this field

- It can be argued that genetic modification was met by substantial public opposition that altered the course of the research programme. Can you see any possibilities for the same thing happening for synthetic biology?
- What do you think the main lessons are from the attempts to commercialise transgenic crops and transgenic food in the UK?
- Would you say those lessons have been learned in relation to the development and assessment of novel technologies, such as synthetic biology?
- What do these lessons mean for public policy and wider relations between science and broader society?

That concludes my questions.

- Are there any other comments you would like to make that you feel are of relevance to this project
- As noted in the beginning we are going to be speaking to a number of representatives from [insert relevant stakeholder group] and combining their views on Synthetic Biology with other stakeholders. Would you like to see a copy of the analysis from [insert stakeholder group].

Thank and close

2. Workshop 1: Topic Guide

The **overall aim** of workshop 1 is to focus the on the views of the public around technologies in general, before reviewing synthetic biology and its governance in workshop 2.

W1: 2.5 hours: To discuss technology in general, help bond the group and to introduce synthetic biology.

- General perceptions surrounding science and technology
- How developments in science and technology have impacted on the respondents world
- Consideration of medical, agricultural and environmental applications
- Brief overview of synthetic biology

Arrival and registration

18:00 – 18:30: 30 mins

- Name badges and registration with recruiter
- Table allocation by recruiter
- Coffee / tea / refreshments in reception area

Note to recruiter: Lead in participants at 18:30 for prompt start

Note to moderators: Assist with lead in of participants

SESSION1: Introduction and welcome

18:30 – 18:55: 25 mins

Note to moderator: Introduce yourself and briefly explain ground rules:

Want to hear from everyone

No right/wrong answers; important to respect all views

Not expected to be experts; informal discussion

Explain that the research is sponsored by research councils who fund science and technology in the UK

Give a brief overview of the research; do not mention synthetic biology at this point. Note that we are interested in their views around the impact of science and technology on everyday life.

These views will in turn be used to inform decisions around the regulation and development of a new area of science and technology

Will be exploring a new area of S&T in some depth – will introduce later.

Do not have to be a specialist in science and technology to take part in this discussion; we are more interested personal views and experiences of science and technology in your everyday life

Session and aims	Topic areas	Tools/Stimulus material
Session 1: Welcome	Participant introductions	Ice breaker: participants

<p><i>and introduction</i></p> <p><i>Introduce study aims</i></p> <p><i>Participant introductions</i></p> <p><i>Introductory views on science and technology</i></p>	<p>Ice-breaker: talk through newspaper clipping.</p> <p>Thinking about the newspaper clippings, what changes has science and technology made to these areas?</p> <p>How has science and technology impacted on everyday life</p> <p>Working in 3s - Using the diagram (stimulus 1), create a collage of images and views associated with developments in S&T that are relevant to you personally; your friends and family; and the world/ society more generally.</p> <p>Probe: positive and negative views to the different layers/ impacts of science and technology.</p>	<p>asked to bring in a newspaper clipping from the past week about S&T that has meant something to them personally.</p> <p>Additional newspaper clippings will be provided by BMRB to stimulate discussion</p> <p>Stimulus 1: My world; our world; the world diagram.</p> <p>Please collect collage afterwards and send back to BMRB</p>
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SESSION 2: Medical Applications**18:55 – 19:30: 35 mins**

Note to moderator: *this session focuses on medical applications of science and technology in general. The activity involves the moderator writing onto the post it notes and grouping issues on the flip chart that are brought up by the group concerning where the area is going, who is driving it and how it has shaped their world while going through this session.*

18.55	<p><i>Session 2: Medical applications</i></p>	<p>In light of what we have just talked about, I would now like you to think about health and medicine</p> <p>Do you think science and new technologies have had an impact on changes in medicine/healthcare?</p> <p>What changes have you seen in this area? Probe: positive, negative and most significant change.</p> <p>How do you see changes in the medical</p>	<p>Stimulus 2:</p> <p>Cluster of key factors: Green post-it notes for where its going; blue post-it notes for who is driving it; yellow post-it notes for how it has shaped society/ their relationships with</p>
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		<p>sciences impacting on you/ society more generally?</p> <p>Probe: changes between patients and doctors; 'medicalisation' of health; empowerment; uncertainties</p> <p>Do you think that the area is safe? Are the controls adequate?</p> <p>Where do you think advances in the medical sciences are going?</p> <p>What things, people or organisations do you think are driving innovation/changes in the medical sciences?</p> <p>How do you feel about the direction it's going in?</p> <p>Probe: areas of hope; areas concerned about?</p> <p>How do these changes make you feel?</p>	world
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BREAK**19:30 – 19:40: 10 mins****SESSION 3: Agricultural Applications****19:40 – 20:15: 35 mins**

Note to moderator: *this session focuses on medical applications of science and technology in general. The activity involves the moderator writing onto the post it notes and grouping issues on the flip chart that are brought up by the group concerning where the area is going, who is driving it and how it has shaped their world while going through this session.*

19.40	<p>Session 3: <i>Agricultural applications</i></p>	<p>I would now like you to think about agriculture and how we produce food</p> <p>Do you think science and new technologies have had an impact on changes in agriculture and the</p>	<p>Cluster of key factors: Green post-it notes for where its going; blue post-it notes for who is driving</p>
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		<p>environment? For instance changes to food we eat, how it is produced and the impacts of these technologies on the environment</p> <p>What changes have you seen in this area? Probe: most significant change.</p> <p>How have these changes impacted on you/ society more generally? Probe: Relationships to food; relationships to nature and the idea of naturalness; views on sustainability</p> <p>Do you feel advances in sciences within this area are safe? Are current controls adequate?</p> <p>Where do you think advances in agricultural sciences are going?</p> <p>What things, people or organisations do you think are driving innovation/changes?</p> <p>How do you feel about the direction it's going in?</p> <p>Probe: areas of hope; areas concerned about?</p> <p>How do these changes make you feel?</p>	<p>it;</p> <p>yellow post-it notes for how it has shaped society/ their relationships with world</p>
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SESSION 4: Pulling it all together**20:15 – 20:30: 15 mins**

Note to moderator: *this session is intended to bring all of the issues surrounding where the relevant areas of science and technology are going, who is driving it and how it is shaped together.*

20.15	<i>Session 4: Pulling it all together</i>	<p>What are the similarities and differences between medical and agricultural applications in relation to:</p> <p>Where it is going Who is driving it How it has shaped society/their relationship with the world?</p>	Cluster the cards from previous sessions
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SESSION 5: Introduction to Synthetic Biology 20:30 – 20:45: 20 mins

Note to moderator: *Ensure that you are familiar with the basic notion of synthetic biology before completing this section.*

20.30	<i>Session 5: Introduction to synthetic biology</i>	<p>Participants given handout on synthetic biology</p> <p>Discuss the handout and what it means to the participants</p> <p>Probe: what do you understand by the terms, microbe, metabolism and DNA?</p> <p>What are your initial thoughts about synthetic biology?</p> <p>Given what we have just discussed, what type of things would you like to know more about in relation to synthetic biology?</p> <p>Unprompted then probe:</p> <p>Its direction Who is driving the research Uncertainties Funding and commercialisation Its safety Potential impacts on environment How it may impact on society/ you personally?</p>	Stimulus 2: Handout on synthetic biology
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SESSION 6: Conclusion**20:50 – 21:00: 10 mins**

Note to moderator: *Be sure to remind the respondents of the second workshop and the dates:*

27/02/10 in London

20/02/10 in North Wales

27/02/10 in Newcastle

27/02/10 in Edinburgh

20.50	Session 6: Wrap up	<p>Do you have any further questions about what we have discussed tonight?</p> <p>Highlight aims/date for Workshop 2 and that we will be discussing synthetic biology in more detail and will present different people's views on the subject.</p> <p>Between now and Workshop 2, ask the group to think about synthetic biology and discuss it with their friends and family. They may want to think about how it relates to other sciences and technologies and how it may impact on their world.</p> <p>For the next session, we want you to come up with 1 thing that you think is important when beginning to consider synthetic biology. This might be a question you would like to ask or a principle that should be thought about when exploring new technologies</p> <p>Thank, payment and close</p>	
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3. Workshop 2: Topic Guide

Aims of Workshop 2

The **overall aim** of workshop 2 is to focus the on the views of the public around the social and ethical issues surrounding synthetic biology in general, and then moving on to issues surrounding the governance, regulation and funding of synthetic biology. This workshop should last for 6 hours and cover the following:

- General perceptions surrounding synthetic biology and science
- Exploring different visions around synthetic biology
- Exploration of how science gets done
- Regulation of synthetic biology
- Funding of synthetic biology

Topic Guide: Workshop 2

Arrival and Registration

09:30 – 10:00: 30 min

- Name badges and registration
- Group allocation
- Data cards / equipment distributed for polling
- Coffee / tea / refreshments in reception area

MORNING: VISIONS FOR SYN BIO

Note to moderators: Assist with lead in of participants at 09:50 for prompt start at 10.00am

SESSION 1 (Plenary, whole group together): Welcome and introductions

10.00 – 10.20: 20 min

- CHAIR (BMRB) to welcome participants
 - Re-introduce TNS-BMRB – independent research company, research carried out on behalf of research councils
 - Introduce research councils, scientists and social scientists
 - Welcome from Research Councils (RC) – (If present)member of RC or Oversight Group (OG) to say a few words of welcome, the value of the dialogue and how used
 - Briefly reiterate deliberative nature of event; including ground rules, role of the moderator.
 - Also highlight that experts are there as a resource. We encourage participants to ask them questions. Experts are also there to hear participant's views and reflect on them for their own work.
 - Housekeeping
 - Fire exits/security

- Toilets
- Smoking
- Refreshments
- Voting devices
- Introduce agenda for the day
- Outline aims for the research
- CHAIR reflection back from groups conducted in workshop 1
 - Open Discussion on word clouds. Explain to participants that the word clouds have been designed to draw out some of the key words/issues brought forward in the first workshop discussing new development in science and technology.
 - Ask if they agree with some of the words/issues that have been summarised in the word cloud.
 - Do they have any to add?

SESSION 2 (Plenary, whole group together): Interactive Voting Session
10.20 – 10.35: 15min

- CHAIR to introduce polling and explain process, remind group that we know they have only had limited information, we will ask them to vote again at the end of the session.
- Chair to talk through each polling question in turn (suggested polling questions outlined below)

Questions

How much do you agree or disagree with the following statements about science

- Q1-5
- Britain needs to develop its science to enhance its international competitiveness
 - Scientists seem to be trying new things without stopping to think about the risks
 - I trust scientists to tell the truth
 - The media sensationalises science
 - Science is driven by business – at the end of the day it is all about money

- Agree strongly
- Agree
- Neither agree nor disagree
- Disagree
- Disagree strongly
- Don't know

Which of the following statements are true or false?

Q6: Synthetic biology aims to design or engineer new living parts or systems to perform new tasks (TRUE)

- True
- False

Flash up: TRUE. Synthetic biology aims to design and engineer biologically based parts, novel devices and systems as well as redesign existing systems. As noted at the last workshop, it can be used to make things like fuels and medicines; but also for military or other uses

Q7: There are a number of synthetic biology products on the market? (FALSE)

- True
- False

Flash up: FALSE. Research is at a very early stage. There are only a few applications that are currently in development – such as an anti malarial drugs and biofuels.

Q8: One aim of synthetic biology is to standardize biological parts – so that they can be used to build things? (TRUE)

- True
- False

Flash up: TRUE. Certain scientists are attempting to develop a “tool box” of standardized genetic parts from which people can build functional devices and, someday, synthetic micro-organisms. A university in the US has begun this process through the Bio bricks initiative – a repository of over 2000 standardised biological parts which anyone can use.

Q9-13: How much you agree or disagree with the following statements

- Synthetic biology is a very exciting area of work
- I am concerned about the unintended consequences of synthetic biology
- Synthetic biology can be safely regulated
- Synthetic biology can address some of the worlds major resource problems – such as producing cheaper fuels
- It is likely that synthetic biology applications will be driven by profit rather than social needs

Q14: Do you think synthetic biology has the potential to impact on you personally in the future?

- (1) Yes
- (2) No
- (3) Don't know

SESSION 3 (Plenary): Presentation and Questions**10.35 – 11.00: 25 min**

- CHAIR to introduce scientist and social scientists
- Scientist presentation on synthetic biology [10 mins max] [will feedback the Qs from the public]
 - Outline synthetic biology and what it is trying to achieve, technical explanation
 - Uncertainties, challenges and wider risks
 - Challenges posed by coming together of different disciplines with varied research cultures and ways of framing the issues.
 - Highlight hopes and potential concerns
- Social scientist presentation on synthetic biology [10 mins max] [will feedback the Qs from the public]
 - Outline social and ethical issues surrounding synthetic biology, what has been learnt from other developments in science and technology
 - Uncertainties and challenges; reflect on risks – again drawing on the Nature paper as above
 - Highlight hopes and potential concerns
- Q&A session - this is for points of clarification only. The main Questions will be developed in the group.
 - Moderated by CHAIR
- CHAIR: allocate rooms to groups to certain rooms and moderators for the breakout session, explain that we may be coming in and out of the break out rooms for discussions throughout the day.

SESSION 4 (Break out rooms): Discussion of key issues surrounding synthetic biology**– experts to rove between groups for all break out sessions****11.00 – 11.40: 40 min**

Note to moderator: *Introduce yourself and briefly explain ground rules:*

- *Want to hear from everyone*
- *No right/wrong answers; important to respect all views*
- *Not expected to be experts; informal discussion*
- *Scientists, social scientists and research council may come in to the group occasionally*

- **Group introductions:** Participants to briefly reintroduce themselves to the group
- **Discussion of presentations**
- Ask participants to focus on the scientists presentation first and what they understood about the science of synthetic biology

Note to moderator: Use handout A: 'overview of synthetic biology' to stimulate discussion here. The intention is to discuss understanding around synthetic biology and draw out any misunderstandings. Scientists will be available for questions/roaming between groups.

- **Key Question:** Explore initial reactions to the scientists presentations
- **Key Question:** What did they understand from it and what questions do they have for the scientist? [note down for when scientist joins the group]

Probes:

- How did it make them feel
 - Did the presentation make them change their minds or reconsider their initial views on synthetic biology?
 - What would they like more information on?
 - Briefly read through handout A with group as a summary of key point/overview of synthetic biology
 - Ensure that people understand the handout
 - Ask if anyone has any further questions
- Ask participants to focus on the social scientists presentation secondly and what they thought of the social and ethical issues surrounding synthetic biology.

Note to moderator: Use handout B: 'overview of social and ethical issues' to stimulate discussion here. The intention is to discuss some of the hopes and concerns raised by the social scientists

- **Key Question:** Explore initial reactions to the social scientists presentations
- **Key Question:** What did they understand from it and what questions do they have for the social scientist? [note down for when social scientist joins the group]

Probes:

- How did it make them feel
 - Did the presentation make them change their minds or reconsider their initial views on synthetic biology?
 - What would they like more information on?
 - Briefly read through handout B with group as a summary of key point/overview of wider issues in synthetic biology
 - Ensure that people understand the handout
 - Ask if anyone has any further questions
- **Discussion of hopes, fears and uncertainties around synthetic biology**

Note to moderator: Plot out hopes, concerns and uncertainties on flipchart

- Given what you have heard from the presentation
- Explore:
 - Initial concerns, hopes and fears
 - Views around uncertainties and which are the most significant

- How they feel about where the science is going and why
- Whether they feel that it is safe and why

**SESSION 5 (Plenary): Hearing different views and responses to synthetic biology
[ACTORS SESSION]**

11.40 – 11.55: 15 min

Chair: Introduce actors session as presenting views selected from several interviews with different stakeholders – not exhaustive or representative – summarised from a great deal of material from interviews with stakeholders of widely differing views, etc Intended to bring the views to life and stimulate discussion.

- Actors to perform 4 views from the following areas:
 - Scientist/ Engineer
 - Social scientist/ ethics
 - Ethicist/NGO
 - Industry/ commercial

SESSION 6 (Break out rooms): Discussion of stakeholder perspective

11:55 – 12.40: 45 min

- Discuss the different visions presented

Note to moderator: Use the handouts which are the scripts of the stakeholder visions presented by the actors. Hand it out for each discussion. It would be best to ask the sessions in the same order that they were acted out.

- Scientist vision

Note to moderator: Use science handout to stimulate discussion

- **Key Question:** What do you think is good about the view presented
- **Key Question:** What are you concerned about?
- **Key Question:** What do you think is driving the scientist?

Probes:

- Is he hyping the benefits?
- Do you think it is important that we invest in synthetic biology?
- Is he over confident about safety?
- What are your thoughts on accidental release of organisms into ecosystem?
- Do the public need reassurance?
- Do you trust scientists to act responsibly?
- What responsibility should scientists in the developments of synthetic biology?
- If you could alter this view in any way, what would you say to him?

- Social scientist vision

Note to moderator: Use social scientists handout to stimulate discussion

- **Key Question:** What do you think is good about the view presented?
- **Key Question:** What are you concerned about?
- **Key Question:** What do you think of the social scientists view of the drivers of synthetic biology? (Probe: Pursuit of knowledge by scientists/ Large corporations)

Probes:

- Is this just a price we have to pay for the development of technology?
- What do you think about the pace at which synthetic biology is progressing and the factors that are driving development.
- Should we be able to 'redesign' parts of an organism?
- Do people think there is a difference between synthetic micro organisms and more complex organisms?
- Do you think we should be able to patent the development of synthetic biology?
- Do you think her view of scientists is true?
- If you could alter this view in any way, what would you say to her?

- Ethical/NGO vision

Note to moderator: Use ethical/NGO handout to stimulate discussion

- **Key Question:** What do you think is good about the view presented
- **Key Question:** What are you concerned about
- **Key Question:** Who do you see benefiting/being harmed by the potential applications of synthetic biology?

Probes:

- Should we be cautious or does such an approach hinder development?
- Do you trust NGOs to monitor emerging science and technology?
- What are your views on voluntary regulation?
- What do you think of applying engineering principles to biology?

What needs to be in place to build trust in regulation?

- Industry vision

Note to moderator: Use industry handout to stimulate discussion

- **Key Question:** What do you think is good about the view presented
- **Key Question:** What are you concerned about
- **Key Question:** What role should industry play in the development of synthetic biology? Probe funding/transparency in developments?

Probes:

- Do you think any social or ethical issues lie in not using synthetic biology?
- Are the risks you heard earlier over stated?
- Is there too much red tape?

- **Moderators:** Ask group for a key thought/question/ concern/observation from the morning session to feed back after lunch.

LUNCH**12.40 – 13.30: 50 min****SESSION 7 (Plenary then Break out rooms): Views from the scientists****13.30 – 14.10: 40 min**

- Plenary-Chair: welcome everyone back ask for feedback from the moderators on the morning session. One key point from each group fed back by moderator. (5 min)
- Show video diary on screen. (10min)
- Plenary-Chair: ask groups to proceed to breakout rooms

- **Break out-General views on the cultures and practices of research, presentation of video diary**

General views on the video diaries presented and the working life of scientists.

Probes:

- were they surprised by the video? Did they think of science differently?
- What did they think about the average day in the life of a scientist? Probe: Would it be a life they would like to live? Why?
- Explore hopes expressed by scientists and where they see their science in the future?
- Explore uncertainties and frustrations expressed by scientists
- Explore the pressures faced in being a scientist
- What responsibilities do scientists have when researching synthetic biology?
- Has this changed any of your opinions on synthetic biology?

SESSION 8 (breakout): How science gets funded.**14.10 – 14.50: 40 min**

Give participant's handout C: Research council funding. [READ OUT]

- **Key Question:** Where does responsibility lie for thinking about the wider implications of the science – is it with the funder or the researchers?
- **Key Question:** Thinking about the information Councils ask for in applications?
 - Is stating impacts and ethics sufficient?
 - Would risks be adequately picked up?
 - Should there be any additional responsibilities for researchers?

Probes:

- Thinking back to the video diaries, is it fair to ask scientists to consider these the wider implications of their work?
- Does asking scientists to consider wider implications stifle innovation?

- An argument made against placing wider conditions on researchers is that they may not be best placed to think through implications – or that the best science may not get funded. How do you feel about this?
- When the Council directs funding – should greater conditions be placed around the grant other than good science? If so. What should they be?
- What do you think about the scale of research council investment in synthetic biology?

Note to moderator: Use the handout D in this discussion

- READ OUT HANDOUT D
 - **Key Question:** Are you concerned about conflicts of interests of academic scientists working with industry?
 - Would you trust a scientist less if they sell their ideas to industry?
 - **Key Question:** What could be done to improve promote transparency
 - What is the role of scientists in this process?
 - What is the role of the research councils?
 - What is the role of industry

Probes:

- Does openness and transparency matter in synthetic biology
- Is it realistic to expect industry to invest large some of money if they can't protect their investments?

TEA BREAK

14.50 – 15.00: 10 min

SESSION 9 (Break out rooms): Regulation and control of synthetic biology

15.00 – 15.30: 30 min

Note to moderator: Use the handout E in this discussion

- Handout E and discussion around regulation
 - **Key Question:** Do you believe synthetic biology hazards can be predicted and controlled
 - **Key Question:** Do people think there should be specific regulations for synthetic biology, based on what they have heard today?

Probes:

Do you think industrial processes can be contained? [Note that risk assessment for use in the lab includes an assessment of the implications should accidental release occur]

- - Does this matter?
- Can environmental releases be controlled or managed?
 - Does this matter?
- Who should be responsible for regulation

- Can science be regulated in a globalised economy (garage biology; developments in other countries etc)

SESSION 10 Reflections on day (Break out rooms):

15.30 – 15.45: 15 min

- What have you learnt from the day
- Has anything made you change your mind or challenged your opinions
- Highlight we will be exploring potential synthetic biology applications of next time in detail
- Are there any issues they would like to hear more about
- Are there any stakeholders they would like to hear more from – and in particular meet [tell them we will invite then but cant guarantee attendance]
- What three things would you like to feedback to the Research Councils after today
- highlight the use of 6DTV between this event and W3
 - Interactive forum, participants will be invited to attend a discussion session online
 - Opportunity to quiz other scientists on some of issues emerging from the day
 - Will involve people listening and typing responses
 - Ask whether anyone does not have access to a computer
 - Ask if anyone has a webcam/ is willing to present during a live web session to feed back the views from the group to the scientist
 - We will contact the with a date and details of the session shortly
 - NB get details (e-mail address) of individuals that would like to take part in the session

SESSION 11 (Plenary, whole group together): Interactive Voting Session

15.45 – 16.00: 15 min

- CHAIR to introduce polling and explain process.
- Chair to talk through each polling question in turn and comment on results

How much do you agree or disagree with the following statements about science

- Q1-5:
- Britain needs to develop its science to enhance its international competitiveness
 - Scientists seem to be trying new things without stopping to think about the risks
 - I trust scientists to tell the truth
 - The media sensationalises science
 - Science is driven by business – at the end of the day it is all about money

- Agree strongly
- Agree
- Neither agree nor disagree
- Disagree
- Disagree strongly

- Don't know

Q6-10: How much you agree or disagree with the following statements

- Synthetic biology is a very exciting area of work
- I am concerned about the unintended consequences of synthetic biology
- Synthetic biology can be safely regulated
- Synthetic biology can address some of the worlds major resource problems – such as producing cheaper fuels
- It is likely that synthetic biology applications will be driven by profit rather than social needs

Q11: Do you think synthetic biology has the potential to impact you personally in the future?

- (1) Yes
- (2) No

SESSION 11 (Plenary, in main room): Wrap up and next steps
16.00 – 16.10: 10 min

- CHAIR to outline next steps and dates for next workshop
 - Highlight topics for next event
 - Highlight dates for next event (will be held in the same venue)

Event	Date
London Workshop 3	20.03.10
North Wales Workshop 3	20.03.10
Edinburgh Workshop 3	27.03.10
Newcastle Workshop 3	27.03.10

- CHAIR to thank participants and close event
 - Ask participants to complete evaluation sheet
 - Thank and end

4. Workshop 3: Newcastle Topic Guide

Aims of Workshop 3

The **overall aim** of workshop 3 is to look at potential application areas in synthetic biology. Specifically we will:

- Explore synthetic biology in relation to the following application areas
 - medical applications
 - energy applications
 - environmental applications
 - Crop/food applications
- It should be noted that only three applications will be explored in each area – in Newcastle the focus is on medicine, energy and environmental applications.

Topic Guide: Workshop 3

Arrival and Registration

09:30 – 10:00: 30 min

- Name badges and registration
- Group allocation
- Data cards / equipment distributed for polling
- Coffee / tea / refreshments in reception area

Note to moderators: Assist with lead in of participants at 09:50 for prompt start at 10.00am

SESSION 1 (Plenary, whole group together): Welcome and introductions

10:00-10:20: 20min

- CHAIR (BMRB) to welcome participants
 - Re-introduce TNS-BMRB – independent research company, research carried out on behalf of research councils
 - Introduce research councils, scientists and social scientists
 - Welcome from Research Councils – (If present) member of RC or OG to say a few words of welcome and the intention of this final workshop. Highlight the participant's role and purpose of this work.
 - Briefly reiterate deliberative nature of event; including ground rules, role of the moderator.
 - Also highlight that experts are there as a resource. We encourage participants to ask them questions. Experts are also there to hear participant's views and reflect on them for their own work.
 - Housekeeping
 - Fire exits/security

- Toilets
 - Smoking
 - Refreshments
 - Voting devices
 - Introduce agenda for the day
 - Outline aims for the research
- CHAIR reflection back from groups conducted in workshop 2
 - Key questions raised
 - Overview of issues raised
 - Overview of how opinions may have changed over workshop 2

SESSION 2 (Plenary, whole group together): Interactive Voting Session
10:20-10:35: 15min

Chair: introduce voting session and demonstrate how the voting pads should be used. Remind participants to enter their pin before voting (printed on their nametag). Note that the pin will be used to link the results we get back to different demographic groups in the research not individuals.

How much do you agree or disagree with the following statements about synthetic biology

Q1-5 Synthetic biology is a very exciting area of work

I am concerned about the unintended consequences of synthetic biology

Synthetic biology can be safely regulated

Synthetic biology may be able to address some of the world's major resource problems – such as producing more sustainable fuels

It is likely that synthetic biology applications will be driven by profit rather than social needs

- Agree strongly
- Agree
- Neither agree nor disagree
- Disagree
- Disagree strongly
- Don't know

We are now going to highlight a number of potential applications of synthetic biology. For each tell me if you agree or disagree with following statements

USING SYNTHETIC BIOLOGY TO...

b. Develop bio-fuels for transportation

6. is morally acceptable
7. is a risk to the environment
8. is useful for society
9. should be encouraged
10. is not how we should be addressing fuel needs

USING SYNTHETIC BIOLOGY TO...

c. Engineer bacteria to help clean up pollutants in the environment

11. is morally acceptable
12. is a risk to the environment
13. is useful for society
14. should be encouraged
15. is not how we should be addressing pollution problems

USING SYNTHETIC BIOLOGY TO...

d. Develop medical drugs...

16. is morally acceptable
17. is a risk to the environment
18. is useful for society
19. should be encouraged
20. is not how we should be producing drugs

For all:

- Agree strongly
- Agree
- Neither agree nor disagree
- Disagree
- Disagree strongly
- Don't know

Q 21. How concerned or unconcerned are you about the potential misuses of synthetic biology?

Very concerned

Quite concerned

A little concerned

Not at all concerned

Q22: Do you think synthetic biology has the potential to impact on you personally in the future?

- (1) Yes
- (2) No
- (3) Don't know

SESSION 3 (Plenary): Overview of Regulation

10:35-10:50: 15 min

CHAIR to note that a number of participants highlighted they would like to hear more about regulation. Before we discuss application areas in more depth – which will include a review of regulations in more depth, will see a brief video clip which outlines regulation with regards to two broad areas – namely contained use and deliberate release. This overview will be used to inform discussions of the different application areas in synthetic biology. (2min)

CHAIR to introduce video clip of regulator

- Presentation: Regulation of synthetic biology applications (10min)
 - Explain most synthetic biology applications will be regulated through existing provisions on GMOs
 - Comment on how current regulations work in terms of contained use and deliberate release
 - Comment on how regulation may apply to different application areas

SESSION 4 (Plenary): Presentation on Medical Applications

10:50-11:05: 15 min

Chair: Explain that three applications will be discussed in total, one before lunch and two after lunch. We are going to show a video and use discussions to demonstrate areas of research in synthetic biology and then ask our experts to comment on the content/take some questions.

Note that these are examples of application some of which are current and some that may form a focus in the future; there are a number of potential application areas which will be discussed in detail when we break out into the different rooms.

In this area we will be discussing:

Newcastle: Medical, Energy, Environmental,

Stimulus Material: Show the medical video stimulus and allow time for feedback from the scientist/social scientist

Medical: Show a clip demonstrating development of artemisinin (5 min).

Chair: Introduce scientist and social scientist and develop the conversation around the application. It would be worth asking the scientist/social scientists what their take is on the video to start the discussion, alternate between them and ensure both have time to speak and give their opinions. They may do a joint discussion upfront instead of treating it as a presentation.

Chair NB: Please ask the scientists to give a brief overview of how genetic engineering differs from synthetic biology before they start talking to the application.

- Commentary from scientist and social scientist (10min)
 - Take questions from the group
- CHAIR: allocate rooms to groups to certain rooms and moderators for the breakout session; explain that we may be coming in and out of the break out rooms for discussions throughout the day.

SESSION 5 (break out): Introduction and discussion of Medical Applications

11:05-12:00 55 min

Note to moderator. Please use the **main questions to drive discussion** and only refer to the additional probes if conversation runs dry.

- **Group introductions:** Participants to briefly reintroduce themselves to the group
 - Want to hear from everyone
 - No right/wrong answers; important to respect all views
 - Not expected to be experts; informal discussion
 - Scientist, social scientist and research council may come into the group occasionally
 - Permission to record discussion

Note to moderator: For each area we will print out a large overview card summarising key words/views from W2 to stimulate discussion across applications. Stick it up so it is visible throughout the discussions and explain it to the group. This is to enable groups to refer back to the previous issues raised. If the room does not allow you to stick this up close to the respondents please write it out on the flipchart and stick up.

Note to moderator:

Stimulus material: for each application area you will have 5 cards to hand out.

Discussion of presentations/stimulus

HAND OUT RED CARD A: *Current Medical Research: Artemisinin*

- Ask participants to focus on the presentations and what they understood about the application of synthetic biology for medicine
 - **Key Question:** Explore initial reactions to the presentations and use of synthetic biology for medical applications (use research card after obtaining initial spontaneous views).

Probes:

- What do you like about the application/what are your concerns?
- Who do you see benefiting from this research? Who should benefit from it?
- Who might suffer from it?
- Would you use artemisinin if you needed to?
- Is this a good area for synthetic biology to be focusing on?

Discussion of alternative approaches

HAND OUT RED CARD B: *Other ways to treat Malaria*

- **Key Question:** how does synthetic biology and artemisinin compare to the alternatives for malaria treatment

Probes:

- What are the benefits/drawbacks of the alternatives?
- Is it worth the investment/risk
 - o Probe the fact that malaria parasites can become drug resistant
 - o Probe the ability of synthetic biology to produce the drug cheaply and in large quantities
- If you had to invest in a treatment for malaria, which would you select and why?

Regulation Discussion

HAND OUT RED CARD C: *Medical Applications: Regulation*

- **Key Question:** What do you think about the current regulation?
- **Key Question:** What is required to promote trust in regulation?
- **Key Question:** Should regulation decisions be made by weighing up risks and measures to mitigate the risks?
- **Key Question:** Should regulation for synthetic biology differ from other technologies that could be used? Why?

Discussion of future scenario

HAND OUT RED CARD D: *Possible Future Scenarios*

- Ask participants to read through the future scenario, stress that these are possibilities for synthetic biology, not current applications
 - **Key Question:** Initial reaction to possible future applications, hopes/concerns
 - **Key Question:** what applications are you comfortable with? What are you less so? Why

Discussion of environmental, social and ethical issues

HAND OUT RED CARD E - *Medical Applications: Environmental, Social and Ethical considerations*

Note to moderator: Wait for a spontaneous response to the top of mind issues before handing out CARD E. Use the flipchart to map out issues and stick up for future discussions

- Ask participants to reflect back on all the current applications and future scenarios discussed.
 - **Key Question:** Think about all of the discussions we have had, what do you think are the important issues in applying synthetic biology to medicine? Which is the most important?
 - **Key Question:** Are any of these issues specific to synthetic biology or would they also apply to other alternative approaches?

Probes:

- Thinking about artemisinin, synthetic biology could undercut traditional ways of making the drug in developing countries. Does this matter if we can make enough?
- Who should control the rights to medical developments?
- Who do they think should benefit from this research? Does anyone lose?
 - Probe people with specific genetic profiles
 - Probe the possibility of human enhancements
 - Probe personal responsibility, should people be encouraged to look after their own health
- Who should fund it?
- What are the risks of these applications?
 - Probe inserting biosensors/micro-organisms into the human body
 - Probe misuse and development of organisms that could be hostile to humans
- What are the risks of not investing in this area?

Note to moderator: Put the risk benefit matrix in front of the participants and ask them to plot out where they think the applications in synthetic biology lie. Each application area will be represented by a different colour sticker (medical-red, environmental-green, energy-blue, food/crops-yellow), hand out the appropriate sticker to the participants and ask them to plot where they think the application should lie on the matrix. At the end of this process you should have a dot on the matrix from each respondent.

- **Complete this risk benefit matrix** - map out where this application lies on the scale by placing a dot on the table provided. Once mapped out discuss why the group placed the dots where they are.
- **Sum up**- plot out the key issues for this area on a flip chart and stick up in the room.
 - **Key Question:** Under what conditions should research into this area be permitted?

Lunch 12:00-12:45 (45min)

SESSION 6 (Plenary, whole group together): Presentation on Energy Applications
12:45-13:00 15min

Chair: Welcome everyone back and explain that we will be looking at two more application areas in the afternoon, one now and one after tea.

Newcastle: Medical, Energy, Environmental,

Stimulus Material: Show Energy video stimulus and allow time for feedback from the scientist/social scientist

Bio-Fuels: A video describing a scientist's current project and interest in converting cellulose into sugars to be used for bio fuels. (5 min)

Chair: Introduce scientist and social scientist and develop the conversation around the application. It would be worth asking the scientist/social scientists what their take is on the video to start the discussion, alternate between them and ensure both have time to speak and give their opinions. They may do a joint discussion upfront instead of treating it as a presentation.

- Commentary from scientist and social scientist (10min)
 - Take questions from the group

SESSION 7(Break out): Discussion on Energy Applications
13:00-13:55 55min

Discussion of presentations/stimulus

HAND OUT BLUE CARD A: *Current Energy Research: Bio fuels*]

- Ask participants to focus on the presentations and what they understood about the application of synthetic biology in energy production
 - **Key Question:** Explore initial reactions to the presentations and use of synthetic biology in energy production (use current research card after obtaining initial spontaneous views).
 - **Key Question:** What did they think about the current research being done on cellulose conversion to sugar for bio-fuels

Probes:

- What do you like about the application/what are your concerns?
 - Thoughts on the timescales before application is realised
- Who do you see benefiting from this research? Who should benefit from it?
- Is this a good area for synthetic biology to be focusing on?

Discussion of alternative approaches

[HAND OUT BLUE CARD B: *Other ways to address energy needs*]

- **Key Question:** how does synthetic biology compare to other ways of addressing energy needs

Probes:

- What are the benefits/drawbacks of the alternatives?
- Is it worth the investment/risk
 - Probe low tech alternatives, less dependence on cars for transport, increasing efficiency of vehicles, more public transport use
- If you had to invest in an alternative energy source, which would you select and why?

Regulation Discussion[HAND OUT BLUE CARD C: *Energy Applications: Regulation*]

- **Key Question:** What do you think about the current regulation?
- **Key Question:** What is required to promote trust in regulation?
- **Key Question:** Should regulation decisions be made by weighing up risks and benefits?
- **Key Question:** Should regulation for synthetic biology differ from other technologies that could be used? Why?

Discussion of future scenario[HAND OUT BLUE CARD D: *Possible Future Energy Scenario*]

- Ask participants to read through the future scenario, stress that these are possibilities for synthetic biology, not current applications
 - **Key Question:** Initial reaction to possible future applications, hopes/concerns

Discussion of environmental, social and ethical issuesHAND OUT BLUE CARD E: *Energy Applications: Environmental Social and Ethical considerations*]

Note to moderator: Wait for a spontaneous response to the top of mind issues before handing out CARD E. Use the flipchart to map out issues and stick up for future discussions

- Ask participants to reflect back on all the current applications and future scenarios discussed.
 - **Key Question:** Think about all of the discussions we have had, what do you think are the important issues in applying synthetic biology to the energy production? What is the most important issue in your mind
 - **Key Question:** Are any of these issues specific to synthetic biology or would they also apply to other alternative approaches?

Probes:

- Who do they think should benefit from this research? Does anyone lose?
- Who should fund it?
- What are the risks of these applications?
 - Probe new pollutant to environments, greenhouse gasses
 - Organisms could have unexpected interactions with the environment e.g. modified seeds could spread beyond energy farms
 - Water shortages
 - Planting fuel crops instead of food crops
- What are your view on the impacts on land from large scale monoculture
- Loss of traditional farming
- What are the risks of not investing in this area?

- Probe fuel security and job production

Note to moderator: Put the risk benefit matrix in front of the participants and ask them to plot out where they think the applications in synthetic biology lie. Each application area will be represented by a different colour sticker (medical-red, environmental-green, energy-blue, food/crops-yellow), hand out the appropriate sticker to the participants and ask them to plot where they think the application should lie on the matrix. At the end of this process you should have a dot on the matrix from each respondent.

- **Complete this risk benefit matrix** - map out where this application lies on the scale by placing a dot on the table provided. Once mapped out discuss why the group placed the dots where they are.
- **Sum up**- plot out the key issues for this area on a flip chart and stick up in the room.
 - **Key Question:** Under what conditions should research into this area be permitted?

Tea 13:55-14:10 (15min) head to plenary

SESSION 8 (Plenary): Presentations on Environmental Applications
14:10-14:15 15min

Chair: Welcome everyone back and explain that we will be looking at one more application areas

Newcastle: Medical, Energy, Environmental,

Stimulus Material: Show the environment video stimulus and allow time for feedback from the scientist/social scientist

Environment: A video describing bioremediation. (5 min)

Chair: Introduce scientist and social scientist and develop the conversation around the application. It would be worth asking the scientist/social scientists what their take is on the video to start the discussion, alternate between them and ensure both have time to speak and give their opinions. They may do a joint discussion upfront instead of treating it as a presentation.

- Commentary from scientist and social scientist (10min)
 - Take questions from the group
- CHAIR: allocate rooms to groups to certain rooms and moderators for the breakout session; explain that we may be coming in and out of the break out rooms for discussions throughout the day.

SESSION 9 (Break out): Discussion on Environmental Applications
14:25-15:20 55min

Discussion of presentations/stimulus

HAND OUT GREEN CARD A: *Current Environmental Research: Bioremediation*

- Ask participants to focus on the presentations and what they understood about the application of synthetic biology in the environment
 - **Key Question:** Explore initial reactions to the presentations and use of synthetic biology in the environment (use research card after obtaining initial spontaneous views).
 - **Key Question:** What did they think about the current research being done on bioremediation

Probes:

- What do you like about the application/what are your concerns?
- Who do you see benefiting from this research? Who should benefit from it?
- Is this a good area for synthetic biology to be focusing on?
- Should we deliberately release synthetic biology into the environment, as would be necessary in this case?

Discussion of alternative approaches(HAND OUT GREEN CARD B - *Other ways to clean up pollution*)

- **Key Question:** how does synthetic biology and compare to other ways of cleaning up pollution

Probes:

- What are the benefits/drawbacks of the alternatives?
- Is it worth the investment/risk
 - Probe the notion of releasing the organism into the environment
- If you had to back an approach to cleaning up pollution, which would you select and why?

Regulation Discussion(HAND OUT GREEN CARD C - *Environmental Applications: Regulation*)

- **Key Question:** What do you think about the current regulation?
- **Key Question:** What is required to promote trust in regulation?
- **Key Question:** Should regulation decisions be made by weighing up risks and measures to mitigate the risks?
- **Key Question:** Should regulation for synthetic biology differ from other technologies that could be used? Why?

Discussion of future scenario(HAND OUT GREEN CARD D - *Possible Future Environment scenario*)

- Ask participants to read through the future scenario, **stress that these are possibilities for synthetic biology, not current applications**
 - **Key Question:** Initial reaction to possible future applications, hopes/concerns
 - **Key Question:** what applications are you comfortable with? What are you less so? Why

Discussion of environmental, social and ethical issues

- HAND OUT GREEN CARD E - *Environmental Applications: Environmental, Social and Ethical considerations*

Note to moderator: Wait for a spontaneous response to the top of mind issues before handing out CARD E. Use the flipchart to map out issues and stick up for future discussions

- Ask participants to reflect back on all the current applications and future scenarios discussed.
 - **Key Question:** Think about all of the discussions we have had, what do you think are the important issues in applying synthetic biology to the environment? Which is the most important?
 - **Key Question:** Are any of these issues specific to synthetic biology or would they also apply to other alternative approaches?

Probes:

- Who do they think should benefit from this research? Does anyone lose?
- Who should fund it?
- What are the risks of these applications?
 - Probe new pollutant to environments
 - Organisms could mutate and change
 - Diminished responsibilities in terms of producing pollutants
- What are the risks of not investing in this area?
- The potential to use similar processes for cosmetic purposes

Note to moderator: Put the risk benefit matrix in front of the participants and ask them to plot out where they think the applications in synthetic biology lie. Each application area will be represented by a different colour sticker (medical-red, environmental-green, energy-blue, food/crops-yellow), hand out the appropriate sticker to the participants and ask them to plot where they think the application should lie on the matrix. At the end of this process you should have a dot on the matrix from each respondent.

- **Complete this risk benefit matrix** - map out where this application lies on the scale by placing a dot on the table provided. Once mapped out discuss why the group placed the dots where they are.
- **Sum up**- plot out the key issues for this area on a flip chart and stick up in the room.
 - **Key Question:** Under what conditions should research into this area be permitted?

SESSION 10 (Break out): Summing up and looking forward

15:20-16:00 40min

- Discussing the future
 - **Key Question:** How do you feel about the possibilities for synthetic biology? What makes synthetic biology different from other areas of science and technology?
 - **Key Question:** If you had control over decisions in this area, what would synthetic biology look like?

- **Key Question:** If you had control over decisions in this area, how would you regulate synthetic biology? How would this differ from regulation of other technologies?

Note to moderator: Plot out the final summing up on a flipchart

- **Summing up**
 - **Key Question:** What are your recommendations to the research councils?
 - **Key Question:** What areas should be covered by future dialogue?
 - What do you want to know more about
 - Who should be involved in the dialogues
 - Consent form, reminder to the participants to sign it if they want to (i.e. to ensure that if we want to involve public participants in the future BBSRC can hold their data)
 - 6DTV participation details: ask participants if they would be interested in participating in an online discussion of the findings from these workshops to further the debate and ensure that we have reflected their ideas. Take down their full name and e-mail details on the information form, hand back to BMRB representative.
- Moderator sum up the points to feed back to the group at the end of the session.

Note to moderator: Summaries key points from the group for feedback in final session

SESSION 11 (Plenary): Interactive Voting Session

16:00-16:15 15min

Chair: Thank participants; get brief feedback from moderators

Chair: introduce voting session, remember to ask participants to enter their pin before voting.

How much do you agree or disagree with the following statements about synthetic biology

Q1-5 Synthetic biology is a very exciting area of work

I am concerned about the unintended consequences of synthetic biology

Synthetic biology can be safely regulated

Synthetic biology may be able to address some of the world's major resource problems – such as producing more sustainable fuels

It is likely that synthetic biology applications will be driven by profit rather than social needs

- Agree strongly
- Agree
- Neither agree nor disagree
- Disagree
- Disagree strongly
- Don't know

We are now going to highlight a number of potential applications of synthetic biology. For each tell me if you agree or disagree with following statements

USING SYNTHETIC BIOLOGY TO...

b. Develop bio-fuels for transportation

6. is morally acceptable
7. is a risk to the environment
8. is useful for society
9. should be encouraged
10. is not how we should be addressing fuel needs

USING SYNTHETIC BIOLOGY TO...

c. Engineer bacteria to help clean up pollutants in the environment

11. is morally acceptable
12. is a risk to the environment
13. is useful for society
14. should be encouraged
15. is not how we should be addressing pollution problems

USING SYNTHETIC BIOLOGY TO...

d. Develop medical drugs...

16. is morally acceptable
17. is a risk to the environment
18. is useful for society
19. should be encouraged
20. is not how we should be producing drugs

For all:

- Agree strongly
- Agree
- Neither agree nor disagree
- Disagree
- Disagree strongly
- Don't know

Q 21. How concerned or unconcerned are you about the potential misuses of synthetic biology?

Very concerned

Quite concerned

A little concerned

Not at all concerned

Q22: Do you think synthetic biology has the potential to impact on you personally in the future?

(1) Yes

(2) No

(3) Don't know

SESSION 12 (Plenary): Wrap Up

16:15-16:30 15min

Chair: Thank participants, summarise the next steps and reporting process

Potentially ask the Research Council to say a few words on what is going to happen with the information that has been fed back to them, talk through the launch event

Ask the evaluator to briefly explain the evaluation process and ask them to fill in the forms

Make sure everyone gives in their voting pad and fills in the evaluation form

5. Workshop 3: North Wales Topic Guide

Aims of Workshop 3

The **overall aim** of workshop 3 is to look at potential application areas in synthetic biology. Specifically we will:

- Explore synthetic biology in relation to the following application areas
 - medical applications
 - energy applications
 - environmental applications
 - Crop/food applications
- It should be noted that only three applications will be explored in each area – in North Wales the focus is on medicine, energy and food/crops

Topic Guide: Workshop 3

Arrival and Registration**09:30 – 10:00: 30 min**

- Name badges and registration
- Group allocation
- Data cards / equipment distributed for polling
- Coffee / tea / refreshments in reception area

Note to moderators: Assist with lead in of participants at 09:50 for prompt start at 10.00am

SESSION 1 (Plenary, whole group together): Welcome and introductions**10:00-10:20: 20min**

- CHAIR (BMRB) to welcome participants
 - Re-introduce TNS-BMRB – independent research company, research carried out on behalf of research councils
 - Introduce research councils, scientists and social scientists
 - Welcome from Research Councils – (If present) member of RC or OG to say a few words of welcome and the intention of this final workshop. Highlight the participant's role and purpose of this work.
 - Briefly reiterate deliberative nature of event; including ground rules, role of the moderator.
 - Also highlight that experts are there as a resource. We encourage participants to ask them questions. Experts are also there to hear participant's views and reflect on them for their own work.
 - Housekeeping
 - Fire exits/security
 - Toilets
 - Smoking
 - Refreshments
 - Voting devices
 - Introduce agenda for the day
 - Outline aims for the research
- CHAIR reflection back from groups conducted in workshop 2
 - Key questions raised
 - Overview of issues raised
 - Overview of how opinions may have changed over workshop 2

SESSION 2 (Plenary, whole group together): Interactive Voting Session**10:20-10:35: 15min**

Chair: introduce voting session and demonstrate how the voting pads should be used. Remind participants to enter their pin before voting (printed on their nametag). Note that the

pin will be used to link the results we get back to different demographic groups in the research not individuals.

How much do you agree or disagree with the following statements about synthetic biology

Q1-5 Synthetic biology is a very exciting area of work

I am concerned about the unintended consequences of synthetic biology

Synthetic biology can be safely regulated

Synthetic biology may be able to address some of the world's major resource problems – such as producing more sustainable fuels

It is likely that synthetic biology applications will be driven by profit rather than social needs

- Agree strongly
- Agree
- Neither agree nor disagree
- Disagree
- Disagree strongly
- Don't know

We are now going to highlight a number of potential applications of synthetic biology. For each tell me if you agree or disagree with following statements

USING SYNTHETIC BIOLOGY TO...

a. Develop crops with different genetic traits to increase food production in the future

6. is morally acceptable
7. is a risk to the environment
8. is useful for society
9. should be encouraged
10. is not how we should be increasing food production

USING SYNTHETIC BIOLOGY TO...

b. Develop bio-fuels for transportation

11. is morally acceptable
12. is a risk to the environment
13. is useful for society
14. should be encouraged

15. is not how we should be addressing fuel needs

USING SYNTHETIC BIOLOGY TO...

c. Engineer bacteria to help clean up pollutants in the environment

16. is morally acceptable

17. is a risk to the environment

18. is useful for society

19. should be encouraged

20. is not how we should be addressing pollution problems

USING SYNTHETIC BIOLOGY TO...

d. Develop medical drugs...

21. is morally acceptable

22. is a risk to the environment

23. is useful for society

24. should be encouraged

25. is not how we should be producing drugs

For all:

- Agree strongly
- Agree
- Neither agree nor disagree
- Disagree
- Disagree strongly
- Don't know

Q 26. How concerned or unconcerned are you about the potential misuses of synthetic biology?

Very concerned

Quite concerned

A little concerned

Not at all concerned

Q27: Do you think synthetic biology has the potential to impact on you personally in the future?

(1) Yes

(2) No

(3) Don't know

SESSION 3 (Plenary): Overview of Regulation

10:35-10:50: 15 min

CHAIR to note that a number of participants highlighted they would like to hear more about regulation. Before we discuss application areas in more depth – which will include a review of regulations in more depth, will see a brief video clip which outlines regulation with regards to two broad areas – namely contained use and deliberate release. This overview will be used to inform discussions of the different application areas in synthetic biology. (2min)

CHAIR to introduce video clip of regulator

- Presentation: Regulation of synthetic biology applications (10min)
 - Explain most synthetic biology applications will be regulated through existing provisions on GMOs
 - Comment on how current regulations work in terms of contained use and deliberate release
 - Comment on how regulation may apply to different application areas
- Q&A session - this is for points of clarification only. The main Questions will be developed in the group.
 - Moderated by CHAIR (3 min)

SESSION 4 (Plenary): Presentation on Medical Applications

10:50-11:05: 15 min

Chair: Explain that three applications will be discussed in total, one before lunch and two after lunch. We are going to show a video and use discussions to demonstrate areas of research in synthetic biology and then ask our experts to comment on the content/take some questions.

Note that these are examples of application some of which are current and some that may form a focus in the future; there are a number of potential application areas which will be discussed in detail when we break out into the different rooms.

In this area we will be discussing:

North Wales: Medical, Energy, Food/Crop

Stimulus Material: Show the medical video stimulus and allow time for feedback from the scientist/social scientist

Medical: Show a clip demonstrating development of artemisinin (5 min).

Chair: Introduce scientist and social scientist and develop the conversation around the application. It would be worth asking the scientist/social scientists what their take is on the

video to start the discussion, alternate between them and ensure both have time to speak and give their opinions. They may do a joint discussion upfront instead of treating it as a presentation.

- Commentary from scientist and social scientist (10min)
 - Take questions from the group
- CHAIR: allocate rooms to groups to certain rooms and moderators for the breakout session; explain that we may be coming in and out of the break out rooms for discussions throughout the day.

SESSION 5 (break out): Introduction and discussion of Medical Applications
11:05-12:00 55 min

Note to moderator. Please use the **main questions to drive discussion** and only refer to the additional probes if conversation runs dry.

- **Group introductions:** Participants to briefly reintroduce themselves to the group
 - Want to hear from everyone
 - No right/wrong answers; important to respect all views
 - Not expected to be experts; informal discussion
 - Scientist, social scientist and research council may come into the group occasionally
 - Permission to record discussion

Note to moderator: For each area we will print out a large overview card summarising key words/views from W2 to stimulate discussion across applications. Stick it up so it is visible throughout the discussions and explain it to the group. This is to enable groups to refer back to the previous issues raised.

Note to moderator:
 Stimulus material: for each application area you will have 5 cards to hand out.

Discussion of presentations/stimulus

HAND OUT RED CARD A: *Current Medical Research: Artemisinin*

- Ask participants to focus on the presentations and what they understood about the application of synthetic biology for medicine
 - **Key Question:** Explore initial reactions to the presentations and use of synthetic biology for medical applications (use research card after obtaining initial spontaneous views).

Probes:

- What do you like about the application/what are your concerns?
- Who do you see benefiting from this research? Who should benefit from it?
- Who might suffer from it?
- Would you use artemisinin if you needed to?
- Is this a good area for synthetic biology to be focusing on?

Discussion of alternative approaches

HAND OUT RED CARD B: *Other ways to treat Malaria*

- **Key Question:** how does synthetic biology and artemisinin compare to the alternatives for malaria treatment

Probes:

- What are the benefits/drawbacks of the alternatives?
- Is it worth the investment/risk
 - Probe the fact that malaria parasites can become drug resistant
 - Probe the ability of synthetic biology to produce the drug cheaply and in large quantities
- If you had to invest in a treatment for malaria, which would you select and why?

Regulation Discussion

HAND OUT RED CARD C: *Medical Applications: Regulation*

- **Key Question:** What do you think about the current regulation?
- **Key Question:** What is required to promote trust in regulation?
- **Key Question:** Should regulation decisions be made by weighing up risks and measures to mitigate the risks?
- **Key Question:** Should regulation for synthetic biology differ from other technologies that could be used? Why?

Note to moderator: Read through and hand out future scenario card to stimulate discussion

Discussion of future scenario

HAND OUT RED CARD D: *Possible Future Scenarios*

- Ask participants to read through the future scenario, stress that these are possibilities for synthetic biology, not current applications
 - **Key Question:** Initial reaction to possible future applications, hopes/concerns
 - **Key Question:** what applications are you comfortable with? What are you less so? Why

Note to moderator: You could use the environmental, social and ethical issue card here, (Red Card E) wait for a spontaneous response to the top of mind issues before handing it out. Use the flipchart to map out issues and stick up for future discussions

Discussion of environmental, social and ethical issues

HAND OUT RED CARD E - *Medical Applications: Environmental, Social and Ethical considerations*

- Ask participants to reflect back on all the current applications and future scenarios discussed.

- **Key Question:** Think about all of the discussions we have had, what do you think are the important issues in applying synthetic biology to medicine? Which is the most important?
- **Key Question:** Are any of these issues specific to synthetic biology or would they also apply to other alternative approaches?

Probes:

- Thinking about artemisinin, synthetic biology could undercut traditional ways of making the drug in developing countries. Does this matter if we can make enough?
- Who should control the rights to medical developments?
- Who do they think should benefit from this research? Does anyone lose?
 - Probe people with specific genetic profiles
 - Probe the possibility of human enhancements
 - Probe personal responsibility, should people be encouraged to look after their own health
- Who should fund it?
- What are the risks of these applications?
 - Probe inserting biosensors/micro-organisms into the human body
 - Probe misuse and development of organisms that could be hostile to humans
- What are the risks of not investing in this area?

Note to moderator: Put the risk benefit matrix in front of the participants and ask them to plot out where they think the food/crop applications in synthetic biology lie. Each application area will be represented by a different colour sticker (medical-red, environmental-green, energy-blue, food/crops-yellow), hand out the appropriate sticker to the participants and ask them to plot where they think the application should lie on the matrix. At the end of this process you should have a dot on the matrix from each respondent.

- **Complete this risk benefit matrix** - map out where this application lies on the scale by placing a dot on the table provided. Once mapped out discuss why the group placed the dots where they are.
- **Sum up**- plot out the key issues for this area on a flip chart and stick up in the room.
 - **Key Question:** Under what conditions should research into this area be permitted?

Lunch 12:00-12:45 (45min)

SESSION 6 (Plenary, whole group together): Presentation on Energy Applications
12:45-13:00 15min

Chair: Welcome everyone back and explain that we will be looking at two more application areas in the afternoon, one now and one after tea.

North Wales: Medical, Energy, Food/Crop

Stimulus Material: Show Energy video stimulus and allow time for feedback from the scientist/social scientist

Bio-Fuels: A video describing a scientist's current project and interest in converting cellulose into sugars to be used for bio fuels. (5 min)

Chair: Introduce scientist and social scientist and develop the conversation around the application. It would be worth asking the scientist/social scientists what their take is on the video to start the discussion, alternate between them and ensure both have time to speak and give their opinions. They may do a joint discussion upfront instead of treating it as a presentation.

- Commentary from scientist and social scientist (10min)
 - Take questions from the group

SESSION 7(Break out): Discussion on Energy Applications
13:00-13:55 55min

Discussion of presentations/stimulus

HAND OUT BLUE CARD A: *Current Energy Research: Bio fuels*

- Ask participants to focus on the presentations and what they understood about the application of synthetic biology in energy production
 - **Key Question:** Explore initial reactions to the presentations and use of synthetic biology in energy production (use current research card after obtaining initial spontaneous views).
 - **Key Question:** What did they think about the current research being done on cellulose conversion to sugar for bio-fuels

Probes:

- What do you like about the application/what are your concerns?
 - Thoughts on the timescales before application is realised
- Who do you see benefiting from this research? Who should benefit from it?
- Is this a good area for synthetic biology to be focusing on?

Discussion of alternative approaches

[HAND OUT BLUE CARD B: *Other ways to address energy needs*]

- **Key Question:** how does synthetic biology compare to other ways of addressing energy needs

Probes:

- What are the benefits/drawbacks of the alternatives?
- Is it worth the investment/risk
 - Probe low tech alternatives, less dependence on cars for transport, increasing efficiency of vehicles, more public transport use
- If you had to invest in an alternative energy source, which would you select and why?

Regulation Discussion

[HAND OUT BLUE CARD C: *Energy Applications: Regulation*]

- **Key Question:** What do you think about the current regulation?
- **Key Question:** What is required to promote trust in regulation?
- **Key Question:** Should regulation decisions be made by weighing up risks and benefits?
- **Key Question:** Should regulation for synthetic biology differ from other technologies that could be used? Why?

Discussion of future scenario

[HAND OUT BLUE CARD D: *Possible Future Energy Scenario*]

- Ask participants to read through the future scenario, stress that these are possibilities for synthetic biology, not current applications
 - **Key Question:** Initial reaction to possible future applications, hopes/concerns

Note to moderator: Wait for a spontaneous response to the top of mind issues before handing out CARD E. Use the flipchart to map out issues and stick up for future discussions

Discussion of environmental, social and ethical issues

HAND OUT BLUE CARD E: *Energy Applications: Environmental Social and Ethical considerations*]

- Ask participants to reflect back on all the current applications and future scenarios discussed.
 - **Key Question:** Think about all of the discussions we have had, what do you think are the important issues in applying synthetic biology to the energy production? What is the most important issue in your mind
 - **Key Question:** Are any of these issues specific to synthetic biology or would they also apply to other alternative approaches?

Probes:

- Who do they think should benefit from this research? Does anyone lose?
- Who should fund it?
- What are the risks of these applications?
 - Probe new pollutant to environments, greenhouse gasses
 - Organisms could have unexpected interactions with the environment e.g. modified seeds could spread beyond energy farms
 - Water shortages
- What are your view on the impacts on land from large scale monoculture
- Loss of traditional farming
- What are the risks of not investing in this area?
 - Probe fuel security and job production

Note to moderator: Put the risk benefit matrix in front of the participants and ask them to plot out where they think the food/crop applications in synthetic biology lie. Each application area will be represented by a different colour sticker (medical-red, environmental-green, energy-blue, food/crops-yellow), hand out the appropriate sticker to the participants and ask them to plot where they think the application should lie on the matrix. At the end of this process you should have a dot on the matrix from each respondent.

- **Complete this risk benefit matrix** - map out where this application lies on the scale by placing a dot on the table provided. Once mapped out discuss why the group placed the dots where they are.
- **Sum up**- plot out the key issues for this area on a flip chart and stick up in the room.
 - **Key Question:** Under what conditions should research into this area be permitted?

Tea 13:55-14:10 (15min) head to plenary

SESSION 8 (Plenary): Presentations on Food/Crop applications
14:10-14:15 15min

Chair: Welcome everyone back and explain that we will be looking at one more application areas

North Wales: Medical, Energy, Food/Crop

Stimulus Material: Show Food/Crop video stimulus and allow time for feedback from the scientist/social scientist

Food/Crops: A video describing applications in plants/crops (5 min)

Chair: Introduce scientist and social scientist and develop the conversation around the application. It would be worth asking the scientist/social scientists what their take is on the video to start the discussion, alternate between them and ensure both have time to speak and give their opinions. They may do a joint discussion upfront instead of treating it as a presentation.

- Commentary from scientist and social scientist (10min)
 - Take questions from the group

SESSION 9 (Break out): Discussion on Food/Crop applications
14:25-15:20 55min

Discussion of presentations/stimulus

HAND OUT PINK CARD A: *Current Crop Research: Crop modification*

- Ask participants to focus on the presentations and what they understood about the application of synthetic biology in crop and food applications

- **Key Question:** Explore initial reactions to the presentations and use of synthetic biology in crop production (use research card after obtaining initial spontaneous views).
- **Key Question:** What did they think about the potential research into crop production?

Probes:

- What do you like about the application/what are your concerns?
- Who do you see benefiting from this research? Who should benefit from it?
- Is this a good area for synthetic biology to be focusing on?

Discussion of alternative approaches

HAND OUT PINK CARD B: *Other ways to increase crop yields and nutritional value*

- **Key Question:** how does synthetic biology and compare to other ways of addressing energy needs

Probes:

- What are the benefits/drawbacks of the alternatives?
- Is it worth the investment/risk
 - Probe low tech alternatives, crop selection for improved yield
 - Probe changes in investment/distribution to address food production issues
- If you had to back an alternative approach to addressing crop yields/food concerns, which would you select and why?

Regulation Discussion

HAND OUT PINK CARD C: *Crop/Food Applications: Regulation*

- **Key Question:** What do you think about the current regulation?
- **Key Question:** What is required to promote trust in regulation?
- **Key Question:** Should regulation decisions be made by weighing up risks and benefits?
- **Key Question:** Should regulation for synthetic biology differ from other technologies that could be used? Why?

Discussion of future scenario

HAND OUT PINK CARD D: *Possible Future Food scenario*

- Ask participants to read through the future scenario, stress that these are possibilities for synthetic biology, not current applications
 - **Key Question:** Initial reaction to possible future applications, hopes/concerns

Note to moderator: Wait for a spontaneous response to the top of mind issues before handing out CARD E. Use the flipchart to map out issues and stick up for future discussions

Discussion of environmental, social and ethical issues

HAND OUT PINK CARD E: *Crop/Food Applications: Environmental, Social and Ethical considerations*

- Ask participants to reflect back on all the applications and future scenarios discussed.
 - **Key Question:** Think about all of the discussions we have had, what do you think are the important issues in applying synthetic biology to crop production? What is the most important issue in your mind
 - **Key Question:** Are any of these issues specific to synthetic biology or would they also apply to other alternative approaches?

Probes:

- Who should control the rights to crop developments?
- Who do they think should benefit from this research? Does anyone lose?
- Who should fund it?
- What are the risks of these applications?
 - Modified crops could have unexpected interactions with the other plants e.g. transfer genes to other plants
 - Could have unexpected impacts on eco-systems e.g. harming species that are not targeted
- Loss of traditional farming and breeding methods/skills
- What are the risks of not investing in this area?
- Should food be engineered to have greater nutritional value in the future (moderator: emphasise that this has not been done yet)
- Should food be engineered to have other functions – such as health or ‘enhancement’ properties

Note to moderator: Put the risk benefit matrix in front of the participants and ask them to plot out where they think the food/crop applications in synthetic biology lie. Each application area will be represented by a different colour sticker (medical-red, environmental-green, energy-blue, food/crops-yellow), hand out the appropriate sticker to the participants and ask them to plot where they think the application should lie on the matrix. At the end of this process you should have a dot on the matrix from each respondent.

- **Complete this risk benefit matrix** - map out where this application lies on the scale by placing a dot on the table provided. Once mapped out discuss why the group placed the dots where they are.
- **Sum up**- plot out the key issues for this area on a flip chart and stick up in the room.
 - **Key Question:** Under what conditions should research into this area be permitted?

SESSION 10 (Break out): Summing up and looking forward

15:20-16:00 40min

- Discussing the future
 - **Key Question:** How do you feel about the possibilities for synthetic biology? What makes synthetic biology different from other areas of science and technology?

- **Key Question:** If you had control over decisions in this area, what would synthetic biology look like?
- **Key Question:** If you had control over decisions in this area, how would you regulate synthetic biology? How would this differ from regulation of other technologies?

Note to moderator: Plot out the final summing up on a flipchart

- **Summing up**
 - **Key Question:** What are your recommendations to the research councils?
 - **Key Question:** What areas should be covered by future dialogue?
 - What do you want to know more about
 - Who should be involved in the dialogues
 - Consent form, reminder to the participants to sign it if they want to (i.e. to ensure that if we want to involve public participants in the future BBSRC can hold their data)
 - 6DTV participation details: ask participants if they would be interested in participating in an online discussion of the findings from these workshops to further the debate and ensure that we have reflected their ideas. Take down their full name and e-mail details on the information form, hand back to BMRB representative.
- Moderator sum up the points to feed back to the group at the end of the session.

Note to moderator: Summaries key points from the group for feedback in final session

SESSION 11 (Plenary): Interactive Voting Session

16:00-16:15 15min

Chair: Thank participants; get brief feedback from moderators

Chair: introduce voting session, remember to ask participants to enter their pin before voting.

How much do you agree or disagree with the following statements about synthetic biology

Q1-5 Synthetic biology is a very exciting area of work

I am concerned about the unintended consequences of synthetic biology

Synthetic biology can be safely regulated

Synthetic biology may be able to address some of the world's major resource problems – such as producing more sustainable fuels

It is likely that synthetic biology applications will be driven by profit rather than social needs

- Agree strongly
- Agree
- Neither agree nor disagree
- Disagree
- Disagree strongly

- Don't know

We are now going to highlight a number of potential applications of synthetic biology. For each tell me if you agree or disagree with following statements

USING SYNTHETIC BIOLOGY TO...

a. Develop crops with different genetic traits to increase food production in the future

6. is morally acceptable
7. is a risk to the environment
8. is useful for society
9. should be encouraged
10. is not how we should be increasing food production

USING SYNTHETIC BIOLOGY TO...

b. Develop bio-fuels for transportation

11. is morally acceptable
12. is a risk to the environment
13. is useful for society
14. should be encouraged
15. is not how we should be addressing fuel needs

USING SYNTHETIC BIOLOGY TO...

c. Engineer bacteria to help clean up pollutants in the environment

16. is morally acceptable
17. is a risk to the environment
18. is useful for society
19. should be encouraged
20. is not how we should be addressing pollution problems

USING SYNTHETIC BIOLOGY TO...

d. Develop medical drugs...

21. is morally acceptable
22. is a risk to the environment
23. is useful for society

- 24. should be encouraged
- 25. is not how we should be producing drugs

For all:

- Agree strongly
- Agree
- Neither agree nor disagree
- Disagree
- Disagree strongly
- Don't know

Q 26. How concerned or unconcerned are you about the potential misuses of synthetic biology?

Very concerned

Quite concerned

A little concerned

Not at all concerned

Q27: Do you think synthetic biology has the potential to impact on you personally in the future?

(1) Yes

(2) No

(3) Don't know

SESSION 12 (Plenary): Wrap Up

16:15-16:30 15min

Chair: Thank participants, summarise the next steps and reporting process

Potentially ask the Research Council to say a few words on what is going to happen with the information that has been fed back to them, talk through the launch event

Ask the evaluator to briefly explain the evaluation process and ask them to fill in the forms

Make sure everyone gives in their voting pad and fills in the evaluation form

6. Workshop 3: London Topic Guide

Aims of Workshop 3

The **overall aim** of workshop 3 is to look at potential application areas in synthetic biology. Specifically we will:

- Explore synthetic biology in relation to the following application areas
 - medical applications
 - energy applications
 - environmental applications
 - Crop/food applications
- It should be noted that only three applications will be explored in each area – in London the focus is on energy, the environment and food

Topic Guide: Workshop 3

Arrival and Registration

09:30 – 10:00: 30 min

- Name badges and registration
- Group allocation
- Data cards / equipment distributed for polling
- Coffee / tea / refreshments in reception area

Note to moderators: Assist with lead in of participants at 09:50 for prompt start at 10.00am

SESSION 1 (Plenary, whole group together): Welcome and introductions

10:00-10:20: 20min

- CHAIR (BMRB) to welcome participants
 - Re-introduce TNS-BMRB – independent research company, research carried out on behalf of research councils
 - Introduce research councils, scientists and social scientists
 - Welcome from Research Councils – (If present) member of RC or OG to say a few words of welcome and the intention of this final workshop. Highlight the participant's role and purpose of this work.
 - Briefly reiterate deliberative nature of event; including ground rules, role of the moderator.
 - Also highlight that experts are there as a resource. We encourage participants to ask them questions. Experts are also there to hear participant's views and reflect on them for their own work.
 - Housekeeping
 - Fire exits/security
 - Toilets
 - Smoking
 - Refreshments
 - Voting devices
 - Introduce agenda for the day

- Outline aims for the research
- CHAIR reflection back from groups conducted in workshop 2
 - Key questions raised
 - Overview of issues raised
 - Overview of how opinions may have changed over workshop 2

SESSION 2 (Plenary, whole group together): Interactive Voting Session
10:20-10:35: 15min

Chair: introduce voting session and demonstrate how the voting pads should be used. Remind participants to enter their pin before voting (printed on their nametag). Note that the pin will be used to link the results we get back to different demographic groups in the research not individuals.

How much do you agree or disagree with the following statements about synthetic biology

Q1-5 Synthetic biology is a very exciting area of work

I am concerned about the unintended consequences of synthetic biology

Synthetic biology can be safely regulated

Synthetic biology may be able to address some of the world's major resource problems – such as producing more sustainable fuels

It is likely that synthetic biology applications will be driven by profit rather than social needs

- Agree strongly
- Agree
- Neither agree nor disagree
- Disagree
- Disagree strongly
- Don't know

We are now going to highlight a number of potential applications of synthetic biology. For each tell me if you agree or disagree with following statements

USING SYNTHETIC BIOLOGY TO...

a. Develop crops with different genetic traits to increase food production in the future

- 6. is morally acceptable
- 7. is a risk to the environment

8. is useful for society
9. should be encouraged
10. is not how we should be increasing food production

USING SYNTHETIC BIOLOGY TO...

b. Develop bio-fuels for transportation

11. is morally acceptable
12. is a risk to the environment
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14. should be encouraged
15. is not how we should be addressing fuel needs

USING SYNTHETIC BIOLOGY TO...

c. Engineer bacteria to help clean up pollutants in the environment

16. is morally acceptable
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20. is not how we should be addressing pollution problems

USING SYNTHETIC BIOLOGY TO...

d. Develop medical drugs...

21. is morally acceptable
22. is a risk to the environment
23. is useful for society
24. should be encouraged
25. is not how we should be producing drugs

For all:

- Agree strongly
- Agree
- Neither agree nor disagree
- Disagree
- Disagree strongly
- Don't know

Q 26. How concerned or unconcerned are you about the potential misuses of synthetic biology?

Very concerned

Quite concerned

A little concerned

Not at all concerned

Q27: Do you think synthetic biology has the potential to impact on you personally in the future?

(1) Yes

(2) No

(3) Don't know

SESSION 3 (Plenary): Overview of Regulation

10:35-10:50: 15 min

CHAIR to note that a number of participants highlighted they would like to hear more about regulation. Before we discuss application areas in more depth – which will include a review of regulations in more depth, will see a brief video clip which outlines regulation with regards to two broad areas – namely contained use and deliberate release. This overview will be used to inform discussions of the different application areas in synthetic biology. (2min)

CHAIR to introduce video clip of regulator

- Presentation: Regulation of synthetic biology applications (10min)
 - Explain most synthetic biology applications will be regulated through existing provisions on GMOs
 - Comment on how current regulations work in terms of contained use and deliberate release
 - Comment on how regulation may apply to different application areas
- Q&A session - this is for points of clarification only. The main Questions will be developed in the group.
 - Moderated by CHAIR (3 min)

SESSION 4 (Plenary): Presentation on Environmental Applications

10:50-11:05: 15 min

Chair: Explain that three applications will be discussed in total, one before lunch and two after lunch. We are going to show a video and use discussions to demonstrate areas of research in synthetic biology and then ask our experts to comment on the content/take some questions.

Note that these are examples of application some of which are current and some that may form a focus in the future; there are a number of potential application areas which will be discussed in detail when we break out into the different rooms.

In this area we will be discussing:

London: Environmental, Energy, Food/Crop

Stimulus Material: Show the environment video stimulus and allow time for feedback from the scientist/social scientist

Environment: A video describing bioremediation. (5 min)

Chair: Introduce scientist and social scientist and develop the conversation around the application. It would be worth asking the scientist/social scientists what their take is on the video to start the discussion, alternate between them and ensure both have time to speak and give their opinions. They may do a joint discussion upfront instead of treating it as a presentation.

- Commentary from scientist and social scientist (10min)
 - Take questions from the group
- CHAIR: allocate rooms to groups to certain rooms and moderators for the breakout session; explain that we may be coming in and out of the break out rooms for discussions throughout the day.

SESSION 5 (break out): Introduction and discussion of Environmental Applications
11:05-12:00 55 min

Note to moderator: Please use the **main questions to drive discussion** and only refer to the additional probes if conversation runs dry.

- **Group introductions:** Participants to briefly reintroduce themselves to the group
 - Want to hear from everyone
 - No right/wrong answers; important to respect all views
 - Not expected to be experts; informal discussion
 - Scientist, social scientist and research council may come into the group occasionally
 - Permission to record discussion

Note to moderator: For each area we will print out a large overview card summarising key words/views from W2 to stimulate discussion across applications. Stick it up so it is visible throughout the discussions and explain it to the group. This is to enable groups to refer back to the previous issues raised.

Note to moderator:
Stimulus material: for each application area you will have 5 cards to hand out

Discussion of presentations/stimulus

HAND OUT GREEN CARD A: *Current Environmental Research: Bioremediation*

- Ask participants to focus on the presentations and what they understood about the application of synthetic biology in the environment
 - **Key Question:** Explore initial reactions to the presentations and use of synthetic biology in the environment (use research card after obtaining initial spontaneous views).
 - **Key Question:** What did they think about the current research being done on bioremediation

Probes:

- What do you like about the application/what are your concerns?
- Who do you see benefiting from this research? Who should benefit from it?
- Is this a good area for synthetic biology to be focusing on?
- Should we deliberately release synthetic biology into the environment, as would be necessary in this case?

Discussion of alternative approaches

(HAND OUT GREEN CARD B - *Other ways to clean up pollution*)

- **Key Question:** how does synthetic biology and compare to other ways of cleaning up pollution

Probes:

- What are the benefits/drawbacks of the alternatives?
 - Is it worth the investment/risk
 - Probe the notion of releasing the organism into the environment
 - If you had to back an approach to cleaning up pollution, which would you select and why?
- **Regulation Discussion** (use regulations card, hand out to group)
(HAND OUT GREEN CARD C - *Environmental Applications: Regulation*)
 - **Key Question:** What do you think about the current regulation?
 - **Key Question:** What is required to promote trust in regulation?
 - **Key Question:** Should regulation decisions be made by weighing up risks and measures to mitigate the risks?
 - **Key Question:** Should regulation for synthetic biology differ from other technologies that could be used? Why?

Discussion of future scenario

(HAND OUT GREEN CARD D - *Possible Future Environment scenario*)

- Ask participants to read through the future scenario, **stress that these are possibilities for synthetic biology, not current applications**
 - **Key Question:** Initial reaction to possible future applications, hopes/concerns

- **Key Question:** what applications are you comfortable with? What are you less so? Why

Note to moderator: Wait for a spontaneous response to the top of mind issues before handing it out CARD E. Use the flipchart to map out issues and stick up for future discussions

Discussion of environmental, social and ethical issues

- HAND OUT GREEN CARD E - Environmental Applications: Environmental, Social and Ethical considerations
- Ask participants to reflect back on all the current applications and future scenarios discussed.
 - **Key Question:** Think about all of the discussions we have had, what do you think are the important issues in applying synthetic biology to the environment? Which is the most important?
 - **Key Question:** Are any of these issues specific to synthetic biology or would they also apply to other alternative approaches?

Probes:

- Who do they think should benefit from this research? Does anyone lose?
- Who should fund it?
- What are the risks of these applications?
 - Probe new pollutant to environments
 - Organisms could mutate an change
 - Diminished responsibilities in terms of producing pollutants
- What are the risks of not investing in this area?
- The potential to use similar processes for cosmetic purposes

Note to moderator: Put the risk benefit matrix in front of the participants and ask them to plot out where they think the food/crop applications in synthetic biology lie. Each application area will be represented by a different colour sticker (medical-red, environmental-green, energy-blue, food/crops-yellow), hand out the appropriate sticker to the participants and ask them to plot where they think the application should lie on the matrix. At the end of this process you should have a dot on the matrix from each respondent.

- **Complete this risk benefit matrix** - map out where this application lies on the scale by placing a dot on the table provided. Once mapped out discuss why the group placed the dots where they are.
- **Sum up-** plot out the key issues for this area on a flip chart and stick up in the room.
 - **Key Question:** Under what conditions should research into this area be permitted?

Lunch 12:00-12:45 (45min)

SESSION 6 (Plenary, whole group together): Video Presentation Energy Applications
12:45-13:00 15min

Chair: Welcome everyone back and explain that we will be looking at two more application areas in the afternoon, one now and one after tea.

London: Environmental, Energy, Food/Crop

Stimulus Material: Show Energy video stimulus and allow time for feedback from the scientist/social scientist

Bio-Fuels: A video describing a scientist's current project and interest in converting cellulose into sugars to be used for bio fuels. (5 min)

Chair: Introduce scientist and social scientist and develop the conversation around the application. It would be worth asking the scientist/social scientists what their take is on the video to start the discussion, alternate between them and ensure both have time to speak and give their opinions. They may do a joint discussion upfront instead of treating it as a presentation.

- Commentary from scientist and social scientist (10min)
 - Take questions from the group

SESSION 7(Break out): Discussion on Energy Applications
13:00-13:55 55min

Discussion of presentations/stimulus

HAND OUT BLUE CARD A: *Current Energy Research: Bio fuels*]

- Ask participants to focus on the presentations and what they understood about the application of synthetic biology in energy production
 - **Key Question:** Explore initial reactions to the presentations and use of synthetic biology in energy production (use current research card after obtaining initial spontaneous views).
 - **Key Question:** What did they think about the current research being done on cellulose conversion to sugar for bio-fuels

Probes:

- What do you like about the application/what are your concerns?
 - Thoughts on the timescales before application is realised
- Who do you see benefiting from this research? Who should benefit from it?
- Is this a good area for synthetic biology to be focusing on?

Discussion of alternative approaches

[HAND OUT BLUE CARD B: *Other ways to address energy needs*]

- **Key Question:** how does synthetic biology compare to other ways of addressing energy needs

Probes:

- What are the benefits/drawbacks of the alternatives?
- Is it worth the investment/risk
 - Probe low tech alternatives, less dependence on cars for transport, increasing efficiency of vehicles, more public transport use
- If you had to invest in an alternative energy source, which would you select and why?

Regulation Discussion

[HAND OUT BLUE CARD C: *Energy Applications: Regulation*]

- **Key Question:** What do you think about the current regulation?
- **Key Question:** What is required to promote trust in regulation?
- **Key Question:** Should regulation decisions be made by weighing up risks and benefits?
- **Key Question:** Should regulation for synthetic biology differ from other technologies that could be used? Why?

Discussion of future scenario

[HAND OUT BLUE CARD D: *Possible Future Energy Scenario*]

- Ask participants to read through the future scenario, stress that these are possibilities for synthetic biology, not current applications
 - **Key Question:** Initial reaction to possible future applications, hopes/concerns

Note to moderator: Wait for a spontaneous response to the top of mind issues before handing out CARD E. Use the flipchart to map out issues and stick up for future discussions

Discussion of environmental, social and ethical issues

HAND OUT BLUE CARD E: *Energy Applications: Environmental Social and Ethical considerations*]

- Ask participants to reflect back on all the current applications and future scenarios discussed.
 - **Key Question:** Think about all of the discussions we have had, what do you think are the important issues in applying synthetic biology to the energy production? What is the most important issue in your mind
 - **Key Question:** Are any of these issues specific to synthetic biology or would they also apply to other alternative approaches?

Probes:

- Who do they think should benefit from this research? Does anyone lose?
- Who should fund it?
- What are the risks of these applications?
 - Probe new pollutant to environments, greenhouse gasses

- Organisms could have unexpected interactions with the environment e.g. modified seeds could spread beyond energy farms
- Water shortages
- What are your view on the impacts on land from large scale monoculture
- Loss of traditional farming
- What are the risks of not investing in this area?
 - Probe fuel security and job production

Note to moderator: Put the risk benefit matrix in front of the participants and ask them to plot out where they think the food/crop applications in synthetic biology lie. Each application area will be represented by a different colour sticker (medical-red, environmental-green, energy-blue, food/crops-yellow), hand out the appropriate sticker to the participants and ask them to plot where they think the application should lie on the matrix. At the end of this process you should have a dot on the matrix from each respondent.

- **Complete this risk benefit matrix** - map out where this application lies on the scale by placing a dot on the table provided. Once mapped out discuss why the group placed the dots where they are.
- **Sum up**- plot out the key issues for this area on a flip chart and stick up in the room.
 - **Key Question:** Under what conditions should research into this area be permitted?

Tea 13:55-14:10 (15min) head to plenary

SESSION 8 (Plenary): Presentations on Food/Crop applications
14:10-14:15 15min

Chair: Welcome everyone back and explain that we will be looking at the final application areas on food

Stimulus Material: Show Food/Crop video stimulus and allow time for feedback from the scientist/social scientist

Food/Crops: A video describing applications in plants/crops (5 min)

Chair: Introduce scientist and social scientist and develop the conversation around the application. It would be worth asking the scientist/social scientists what their take is on the video to start the discussion, alternate between them and ensure both have time to speak and give their opinions. They may do a joint discussion upfront instead of treating it as a presentation.

- Commentary from scientist and social scientist (10min)
 - Take questions from the group

SESSION 9 (Break out): Discussion on Food/Crop applications

14:25-15:20 55min

Discussion of presentations/stimulusHAND OUT PINK CARD A: *Current Crop Research: Crop modification*

- Ask participants to focus on the presentations and what they understood about the application of synthetic biology in crop and food applications
 - **Key Question:** Explore initial reactions to the presentations and use of synthetic biology in crop production (use research card after obtaining initial spontaneous views).
 - **Key Question:** What did they think about the potential research into crop production?

Probes:

- What do you like about the application/what are your concerns?
- Who do you see benefiting from this research? Who should benefit from it?
- Is this a good area for synthetic biology to be focusing on?

Discussion of alternative approachesHAND OUT PINK CARD B: *Other ways to increase crop yields and nutritional value*

- **Key Question:** how does synthetic biology and compare to other ways of addressing energy needs

Probes:

- What are the benefits/drawbacks of the alternatives?
- Is it worth the investment/risk
 - Probe low tech alternatives, crop selection for improved yield
 - Probe changes in investment/distribution to address food production issues
- If you had to back an alternative approach to addressing crop yields/food concerns, which would you select and why?

Regulation DiscussionHAND OUT PINK CARD C: *Crop/Food Applications: Regulation*

- **Key Question:** What do you think about the current regulation?
- **Key Question:** What is required to promote trust in regulation?
- **Key Question:** Should regulation decisions be made by weighing up risks and benefits?
- **Key Question:** Should regulation for synthetic biology differ from other technologies that could be used? Why?

Discussion of future scenarioHAND OUT PINK CARD D: *Possible Future Food scenario*

- Ask participants to read through the future scenario, stress that these are possibilities for synthetic biology, not current applications
 - **Key Question:** Initial reaction to possible future applications, hopes/concerns

Note to moderator: Wait for a spontaneous response to the top of mind issues before handing out CARD E. Use the flipchart to map out issues and stick up for future discussions

Discussion of environmental, social and ethical issues

HAND OUT PINK CARD E: *Crop/Food Applications: Environmental, Social and Ethical considerations*

- Ask participants to reflect back on all the applications and future scenarios discussed.
 - **Key Question:** Think about all of the discussions we have had, what do you think are the important issues in applying synthetic biology to crop production? What is the most important issue in your mind
 - **Key Question:** Are any of these issues specific to synthetic biology or would they also apply to other alternative approaches?

Probes:

- Who should control the rights to crop developments?
- Who do they think should benefit from this research? Does anyone lose?
- Who should fund it?
- What are the risks of these applications?
 - Modified crops could have unexpected interactions with the other plants e.g. transfer genes to other plants
 - Could have unexpected impacts on eco-systems e.g. harming species that are not targeted
- Loss of traditional farming and breeding methods/skills
- What are the risks of not investing in this area?
- Should food be engineered to have greater nutritional value in the future (moderator: emphasise that this has not been done yet)
- Should food be engineered to have other functions – such as health or ‘enhancement’ properties

Note to moderator: Put the risk benefit matrix in front of the participants and ask them to plot out where they think the food/crop applications in synthetic biology lie. Each application area will be represented by a different colour sticker (medical-red, environmental-green, energy-blue, food/crops-yellow), hand out the appropriate sticker to the participants and ask them to plot where they think the application should lie on the matrix. At the end of this process you should have a dot on the matrix from each respondent.

- **Complete this risk benefit matrix** - map out where this application lies on the scale by placing a dot on the table provided. Once mapped out discuss why the group placed the dots where they are.
- **Sum up**- plot out the key issues for this area on a flip chart and stick up in the room.
 - **Key Question:** Under what conditions should research into this area be permitted?

SESSION 10 (Break out): Summing up and looking forward

15:20-16:00 40min

- Discussing the future
 - **Key Question:** How do you feel about the possibilities for synthetic biology? What makes synthetic biology different from other areas of science and technology?
 - **Key Question:** If you had control over decisions in this area, what would synthetic biology look like?
 - **Key Question:** If you had control over decisions in this area, how would you regulate synthetic biology? How would this differ from regulation of other technologies?

Note to moderator: Plot out the final summing up on a flipchart

- **Summing up**
 - **Key Question:** What are your recommendations to the research councils?
 - **Key Question:** What areas should be covered by future dialogue?
 - What do you want to know more about
 - Who should be involved in the dialogues
 - Consent form, reminder to the participants to sign it if they want to (i.e. to ensure that if we want to involve public participants in the future BBSRC can hold their data)
 - 6DTV participation details: ask participants if they would be interested in participating in an online discussion of the findings from these workshops to further the debate and ensure that we have reflected their ideas. Take down their full name and e-mail details on the information form, hand back to BMRB representative.
- Moderator sum up the points to feed back to the group at the end of the session.

Note to moderator: Summaries key points from the group for feedback in final session

SESSION 11 (Plenary): Interactive Voting Session

16:00-16:15 15min

Chair: Thank participants; get brief feedback from moderators

Chair: introduce voting session, remember to ask participants to enter their pin before voting.

How much do you agree or disagree with the following statements about synthetic biology

Q1-5 Synthetic biology is a very exciting area of work

I am concerned about the unintended consequences of synthetic biology

Synthetic biology can be safely regulated

Synthetic biology may be able to address some of the world's major resource problems – such as producing more sustainable fuels

It is likely that synthetic biology applications will be driven by profit rather than social needs

- Agree strongly

- Agree
- Neither agree nor disagree
- Disagree
- Disagree strongly
- Don't know

We are now going to highlight a number of potential applications of synthetic biology. For each tell me if you agree or disagree with following statements

USING SYNTHETIC BIOLOGY TO...

a. Develop crops with different genetic traits to increase food production in the future

6. is morally acceptable
7. is a risk to the environment
8. is useful for society
9. should be encouraged
10. is not how we should be increasing food production

USING SYNTHETIC BIOLOGY TO...

b. Develop bio-fuels for transportation

11. is morally acceptable
12. is a risk to the environment
13. is useful for society
14. should be encouraged
15. is not how we should be addressing fuel needs

USING SYNTHETIC BIOLOGY TO...

c. Engineer bacteria to help clean up pollutants in the environment

16. is morally acceptable
17. is a risk to the environment
18. is useful for society
19. should be encouraged
20. is not how we should be addressing pollution problems

USING SYNTHETIC BIOLOGY TO...

d. Develop medical drugs...

21. is morally acceptable
22. is a risk to the environment
23. is useful for society
24. should be encouraged
25. is not how we should be producing drugs

For all:

- Agree strongly
- Agree
- Neither agree nor disagree
- Disagree
- Disagree strongly
- Don't know

Q 26. How concerned or unconcerned are you about the potential misuses of synthetic biology?

Very concerned

Quite concerned

A little concerned

Not at all concerned

Q27: Do you think synthetic biology has the potential to impact on you personally in the future?

(1) Yes

(2) No

(3) Don't know

SESSION 12 (Plenary): Wrap Up

16:15-16:30 15min

Chair: Thank participants, summarise the next steps and reporting process

Potentially ask the Research Council to say a few words on what is going to happen with the information that has been fed back to them, talk through the launch event

Ask the evaluator to briefly explain the evaluation process and ask them to fill in the forms

Make sure everyone gives in their voting pad and fills in the evaluation form

7. Workshop 3: Edinburgh Topic Guide

Aims of Workshop 3

The **overall aim** of workshop 3 is to look at potential application areas in synthetic biology. Specifically we will:

- Explore synthetic biology in relation to the following application areas
 - medical applications
 - energy applications
 - environmental applications
 - Crop/food applications
- It should be noted that only three applications will be explored in each area – in Edinburgh the focus is on medicine, food/crops and environmental issues

Topic Guide: Workshop 3

Arrival and Registration

09:30 – 10:00: 30 min

- Name badges and registration
- Group allocation
- Data cards / equipment distributed for polling
- Coffee / tea / refreshments in reception area

Note to moderators: Assist with lead in of participants at 09:50 for prompt start at 10.00am

SESSION 1 (Plenary, whole group together): Welcome and introductions

10:00-10:20: 20min

- CHAIR (BMRB) to welcome participants
 - Re-introduce TNS-BMRB – independent research company, research carried out on behalf of research councils
 - Introduce research councils, scientists and social scientists
 - Welcome from Research Councils – (If present) member of RC or OG to say a few words of welcome and the intention of this final workshop. Highlight the participant's role and purpose of this work.
 - Briefly reiterate deliberative nature of event; including ground rules, role of the moderator.
 - Also highlight that experts are there as a resource. We encourage participants to ask them questions. Experts are also there to hear participant's views and reflect on them for their own work.
 - Housekeeping
 - Fire exits/security

- Toilets
 - Smoking
 - Refreshments
 - Voting devices
 - Introduce agenda for the day
 - Outline aims for the research
- CHAIR reflection back from groups conducted in workshop 2
 - Key questions raised
 - Overview of issues raised
 - Overview of how opinions may have changed over workshop 2

SESSION 2 (Plenary, whole group together): Interactive Voting Session

10:20-10:35: 15min

Chair: introduce voting session and demonstrate how the voting pads should be used. Remind participants to enter their pin before voting (printed on their nametag). Note that the pin will be used to link the results we get back to different demographic groups in the research not individuals.

How much do you agree or disagree with the following statements about synthetic biology

Q1-5 Synthetic biology is a very exciting area of work

I am concerned about the unintended consequences of synthetic biology

Synthetic biology can be safely regulated

Synthetic biology may be able to address some of the world's major resource problems – such as producing more sustainable fuels

It is likely that synthetic biology applications will be driven by profit rather than social needs

- Agree strongly
- Agree
- Neither agree nor disagree
- Disagree
- Disagree strongly
- Don't know

We are now going to highlight a number of potential applications of synthetic biology. For each tell me if you agree or disagree with following statements

USING SYNTHETIC BIOLOGY TO...

a. Develop crops with different genetic traits to increase food production in the future

6. is morally acceptable
7. is a risk to the environment
8. is useful for society
9. should be encouraged
10. is not how we should be increasing food production

USING SYNTHETIC BIOLOGY TO...

c. Engineer bacteria to help clean up pollutants in the environment

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12. is a risk to the environment
13. is useful for society
14. should be encouraged
15. is not how we should be addressing pollution problems

USING SYNTHETIC BIOLOGY TO...

d. Develop medical drugs...

16. is morally acceptable
17. is a risk to the environment
18. is useful for society
19. should be encouraged
20. is not how we should be producing drugs

For all:

- Agree strongly
- Agree
- Neither agree nor disagree
- Disagree
- Disagree strongly
- Don't know

Q26. How concerned or unconcerned are you about the potential misuses of synthetic biology?

Very concerned

Quite concerned

A little concerned

Not at all concerned

Q27. Do you think synthetic biology has the potential to impact on you personally in the future?

- (1) Yes
- (2) No
- (3) Don't know

SESSION 3 (Plenary): Overview of Regulation

10:35-10:50: 15 min

CHAIR to note that a number of participants highlighted they would like to hear more about regulation. Before we discuss application areas in more depth – which will include a review of regulations in more depth, will see a brief video clip which outlines regulation with regards to two broad areas – namely contained use and deliberate release. This overview will be used to inform discussions of the different application areas in synthetic biology. (2min)

CHAIR to introduce video clip of regulator

- Presentation: Regulation of synthetic biology applications (10min)
 - Explain most synthetic biology applications will be regulated through existing provisions on GMOs
 - Comment on how current regulations work in terms of contained use and deliberate release
 - Comment on how regulation may apply to different application areas

SESSION 4 (Plenary): Presentation on Medical Applications

10:50-11:05: 15 min

Chair: Explain that three applications will be discussed in total, one before lunch and two after lunch. We are going to show a video and use discussions to demonstrate areas of research in synthetic biology and then ask our experts to comment on the content/take some questions.

Note that these are examples of application some of which are current and some that may form a focus in the future; there are a number of potential application areas which will be discussed in detail when we break out into the different rooms.

In this area we will be discussing:

Edinburgh: Medical, Food/Crop, environmental

Stimulus Material: Show the medical video stimulus and allow time for feedback from the scientist/social scientist

Medical: Show a clip demonstrating development of artemisinin (5 min).

Chair NB: Please ask the scientists to give a brief overview of how genetic engineering differs from synthetic biology before they start talking to the application.

Chair: Introduce scientist and social scientist and develop the conversation around the application. It would be worth asking the scientist/social scientists what their take is on the video to start the discussion, alternate between them and ensure both have time to speak and give their opinions. They may do a joint discussion upfront instead of treating it as a presentation.

- Commentary from scientist and social scientist (10min)
 - Take questions from the group
- CHAIR: allocate rooms to groups to certain rooms and moderators for the breakout session; explain that we may be coming in and out of the break out rooms for discussions throughout the day.

SESSION 5 (break out): Introduction and discussion of Medical Applications
11:05-12:00 55 min

Note to moderator. Please use the **main questions to drive discussion** and only refer to the additional probes if conversation runs dry.

- **Group introductions:** Participants to briefly reintroduce themselves to the group
 - Want to hear from everyone
 - No right/wrong answers; important to respect all views
 - Not expected to be experts; informal discussion
 - Scientist, social scientist and research council may come into the group occasionally
 - Permission to record discussion

Note to moderator: For each area we will print out a large overview card summarising key words/views from W2 to stimulate discussion across applications. Stick it up so it is visible throughout the discussions and explain it to the group. This is to enable groups to refer back to the previous issues raised.

Note to moderator:

Stimulus material: for each application area you will have 5 cards to hand out.

Discussion of presentations/stimulus

HAND OUT RED CARD A: *Current Medical Research: Artemisinin*

- Ask participants to focus on the presentations and what they understood about the application of synthetic biology for medicine
 - **Key Question:** Explore initial reactions to the presentations and use of synthetic biology for medical applications (use research card after obtaining initial spontaneous views).

Probes:

- What do you like about the application/what are your concerns?
- Who do you see benefiting from this research? Who should benefit from it?
- Who might suffer from it?
- Would you use artemisinin if you needed to?
- Is this a good area for synthetic biology to be focusing on?

Discussion of alternative approaches

HAND OUT RED CARD B: *Other ways to treat Malaria*

- **Key Question:** how does synthetic biology and artemisinin compare to the alternatives for malaria treatment

Probes:

- What are the benefits/drawbacks of the alternatives?
- Is it worth the investment/risk
 - o Probe the fact that malaria parasites can become drug resistant
 - o Probe the ability of synthetic biology to produce the drug cheaply and in large quantities
- If you had to invest in a treatment for malaria, which would you select and why?

Regulation Discussion

HAND OUT RED CARD C: *Medical Applications: Regulation*

- **Key Question:** What do you think about the current regulation?
- **Key Question:** What is required to promote trust in regulation?
- **Key Question:** Should regulation decisions be made by weighing up risks and measures to mitigate the risks?
- **Key Question:** Should regulation for synthetic biology differ from other technologies that could be used? Why?

Discussion of future scenario

HAND OUT RED CARD D: *Possible Future Scenarios*

- Ask participants to read through the future scenario, stress that these are possibilities for synthetic biology, not current applications
 - **Key Question:** Initial reaction to possible future applications, hopes/concerns
 - **Key Question:** what applications are you comfortable with? What are you less so? Why

Discussion of environmental, social and ethical issues

HAND OUT RED CARD E - *Medical Applications: Environmental, Social and Ethical considerations*

Note to moderator: Wait for a spontaneous response to the top of mind issues before handing it out. Use the flipchart to map out issues and stick up for future discussions

- Ask participants to reflect back on all the current applications and future scenarios discussed.

- **Key Question:** Think about all of the discussions we have had, what do you think are the important issues in applying synthetic biology to medicine? Which is the most important?
- **Key Question:** Are any of these issues specific to synthetic biology or would they also apply to other alternative approaches?

Probes:

- Thinking about artemisinin, synthetic biology could undercut traditional ways of making the drug in developing countries. Does this matter if we can make enough?
- Who should control the rights to medical developments?
- Who do they think should benefit from this research? Does anyone lose?
 - Probe people with specific genetic profiles
 - Probe the possibility of human enhancements
 - Probe personal responsibility, should people be encouraged to look after their own health
- Who should fund it?
- What are the risks of these applications?
 - Probe inserting biosensors/micro-organisms into the human body
 - Probe misuse and development of organisms that could be hostile to humans
- What are the risks of not investing in this area?

Note to moderator: Put the risk benefit matrix in front of the participants and ask them to plot out where they think the applications in synthetic biology lie. Each application area will be represented by a different colour sticker (medical-red, environmental-green, energy-blue, food/crops-yellow), hand out the appropriate sticker to the participants and ask them to plot where they think the application should lie on the matrix. At the end of this process you should have a dot on the matrix from each respondent.

- **Complete this risk benefit matrix** - map out where this application lies on the scale by placing a dot on the table provided. Once mapped out discuss why the group placed the dots where they are.
- **Sum up**- plot out the key issues for this area on a flip chart and stick up in the room.
 - **Key Question:** Under what conditions should research into this area be permitted?

Lunch 12:00-12:45 (45min)

**SESSION 6 (Plenary, whole group together): Presentation on Food/Crop Applications
12:45-13:00 15min**

Chair: Welcome everyone back and explain that we will be looking at two more application areas in the afternoon, one now and one after tea.

Edinburgh: Medical, Food/Crop, Environmental

Stimulus Material: Show Food/Crop video stimulus and allow time for feedback from the scientist/social scientist

Food/Crops: A video describing applications in plants/crops (5 min)

Chair: Introduce scientist and social scientist and develop the conversation around the application. It would be worth asking the scientist/social scientists what their take is on the video to start the discussion, alternate between them and ensure both have time to speak and give their opinions. They may do a joint discussion upfront instead of treating it as a presentation.

- Commentary from scientist and social scientist (10min)
 - Take questions from the group

SESSION 9 (Break out): Discussion on Food/Crop applications
14:25-15:20 55min

Discussion of presentations/stimulus

HAND OUT YELLOW CARD A: *Current Crop Research: Crop modification*

- Ask participants to focus on the presentations and what they understood about the application of synthetic biology in crop and food applications
 - **Key Question:** Explore initial reactions to the presentations and use of synthetic biology in crop production (use research card after obtaining initial spontaneous views).
 - **Key Question:** What did they think about the potential research into crop production?

Probes:

- What do you like about the application/what are your concerns?
- Who do you see benefiting from this research? Who should benefit from it?
- Is this a good area for synthetic biology to be focusing on?

Discussion of alternative approaches

HAND OUT YELLOW CARD B: *Other ways to increase crop yields and nutritional value*

- **Key Question:** how does synthetic biology compare to other ways of addressing energy needs

Probes:

- What are the benefits/drawbacks of the alternatives?
- Is it worth the investment/risk
 - Probe low tech alternatives, crop selection for improved yield
 - Probe changes in investment/distribution to address food production issues
- If you had to back an alternative approach to addressing crop yields/food concerns, which would you select and why?

Regulation Discussion

HAND OUT YELLOW CARD C: *Crop/Food Applications: Regulation*

- **Key Question:** What do you think about the current regulation?
- **Key Question:** What is required to promote trust in regulation?

- **Key Question:** Should regulation decisions be made by weighing up risks and benefits?
- **Key Question:** Should regulation for synthetic biology differ from other technologies that could be used? Why?

Discussion of future scenario

HAND OUT YELLOW CARD D: *Possible Future Food scenario*

- Ask participants to read through the future scenario, stress that these are possibilities for synthetic biology, not current applications
 - **Key Question:** Initial reaction to possible future applications, hopes/concerns

Discussion of environmental, social and ethical issues

HAND OUT YELLOW CARD E: *Crop/Food Applications: Environmental, Social and Ethical considerations*

Note to moderator: *Wait for a spontaneous response to the top of mind issues before handing it out. Use the flipchart to map out issues and stick up for future discussions*

- Ask participants to reflect back on all the applications and future scenarios discussed.
 - **Key Question:** Think about all of the discussions we have had, what do you think are the important issues in applying synthetic biology to crop production? What is the most important issue in your mind
 - **Key Question:** Are any of these issues specific to synthetic biology or would they also apply to other alternative approaches?

Probes:

- Who should control the rights to crop developments?
- Who do they think should benefit from this research? Does anyone lose?
- Who should fund it?
- What are the risks of these applications?
 - Modified crops could have unexpected interactions with the other plants e.g. transfer genes to other plants
 - Could have unexpected impacts on eco-systems e.g. harming species that are not targeted
- Loss of traditional farming and breeding methods/skills
- What are the risks of not investing in this area?
- Should food be engineered to have greater nutritional value in the future (moderator: emphasise that this has not been done yet)
- Should food be engineered to have other functions – such as health or ‘enhancement’ properties

Note to moderator: *Put the risk benefit matrix in front of the participants and ask them to plot out where they think the applications in synthetic biology lie. Each application area will be represented by a different colour sticker (medical-red, environmental-green, energy-blue, food/crops-yellow), hand out the appropriate sticker to the participants and*

ask them to plot where they think the application should lie on the matrix. At the end of this process you should have a dot on the matrix from each respondent.

- **Complete this risk benefit matrix** - map out where this application lies on the scale by placing a dot on the table provided. Once mapped out discuss why the group placed the dots where they are.
- **Sum up**- plot out the key issues for this area on a flip chart and stick up in the room.
 - **Key Question:** Under what conditions should research into this area be permitted?

Tea 13:55-14:10 (15min) head to plenary

SESSION 8 (Plenary): Presentations on Environmental Applications
14:10-14:15 15min

Chair: Welcome everyone back and explain that we will be looking at one more application areas

Newcastle: Medical, Energy, Environmental,

Stimulus Material: Show the environment video stimulus and allow time for feedback from the scientist/social scientist

Environment: A video describing bioremediation. (5 min)

Chair: Introduce scientist and social scientist and develop the conversation around the application. It would be worth asking the scientist/social scientists what their take is on the video to start the discussion, alternate between them and ensure both have time to speak and give their opinions. They may do a joint discussion upfront instead of treating it as a presentation.

- Commentary from scientist and social scientist (10min)
 - Take questions from the group
- CHAIR: allocate rooms to groups to certain rooms and moderators for the breakout session; explain that we may be coming in and out of the break out rooms for discussions throughout the day.

SESSION 9 (Break out): Discussion on Environmental Applications
14:25-15:20 55min

Discussion of presentations/stimulus

HAND OUT GREEN CARD A: *Current Environmental Research: Bioremediation*

- Ask participants to focus on the presentations and what they understood about the application of synthetic biology in the environment
 - **Key Question:** Explore initial reactions to the presentations and use of synthetic biology in the environment (use research card after obtaining initial spontaneous views).

- **Key Question:** What did they think about the current research being done on bioremediation

Probes:

- What do you like about the application/what are your concerns?
- Who do you see benefiting from this research? Who should benefit from it?
- Is this a good area for synthetic biology to be focusing on?
- Should we deliberately release synthetic biology into the environment, as would be necessary in this case?

Discussion of alternative approaches

(HAND OUT GREEN CARD B - *Other ways to clean up pollution*)

- **Key Question:** how does synthetic biology and compare to other ways of cleaning up pollution

Probes:

- What are the benefits/drawbacks of the alternatives?
- Is it worth the investment/risk
 - Probe the notion of releasing the organism into the environment
- If you had to back an approach to cleaning up pollution, which would you select and why?

Regulation Discussion

(HAND OUT GREEN CARD C - *Environmental Applications: Regulation*)

- **Key Question:** What do you think about the current regulation?
- **Key Question:** What is required to promote trust in regulation?
- **Key Question:** Should regulation decisions be made by weighing up risks and measures to mitigate the risks?
- **Key Question:** Should regulation for synthetic biology differ from other technologies that could be used? Why?

Discussion of future scenario

(HAND OUT GREEN CARD D - *Possible Future Environment scenario*)

- Ask participants to read through the future scenario, **stress that these are possibilities for synthetic biology, not current applications**
 - **Key Question:** Initial reaction to possible future applications, hopes/concerns
 - **Key Question:** what applications are you comfortable with? What are you less so? Why

Discussion of environmental, social and ethical issues

HAND OUT GREEN CARD E - *Environmental Applications: Environmental, Social and Ethical considerations*

Note to moderator: Wait for a spontaneous response to the top of mind issues before handing it out. Use the flipchart to map out issues and stick up for future discussions

- Ask participants to reflect back on all the current applications and future scenarios discussed.
 - **Key Question:** Think about all of the discussions we have had, what do you think are the important issues in applying synthetic biology to the environment? Which is the most important?
 - **Key Question:** Are any of these issues specific to synthetic biology or would they also apply to other alternative approaches?

Probes:

- Who do they think should benefit from this research? Does anyone lose?
- Who should fund it?
- What are the risks of these applications?
 - Probe new pollutant to environments
 - Organisms could mutate and change
 - Diminished responsibilities in terms of producing pollutants
- What are the risks of not investing in this area?
- The potential to use similar processes for cosmetic purposes

Note to moderator: Put the risk benefit matrix in front of the participants and ask them to plot out where they think the applications in synthetic biology lie. Each application area will be represented by a different colour sticker (medical-red, environmental-green, energy-blue, food/crops-yellow), hand out the appropriate sticker to the participants and ask them to plot where they think the application should lie on the matrix. At the end of this process you should have a dot on the matrix from each respondent.

- **Complete this risk benefit matrix** - map out where this application lies on the scale by placing a dot on the table provided. Once mapped out discuss why the group placed the dots where they are.
- **Sum up**- plot out the key issues for this area on a flip chart and stick up in the room.
 - **Key Question:** Under what conditions should research into this area be permitted?

SESSION 10 (Break out): Summing up and looking forward

15:20-16:00 40min

- Discussing the future
 - **Key Question:** How do you feel about the possibilities for synthetic biology? What makes synthetic biology different from other areas of science and technology?
 - **Key Question:** If you had control over decisions in this area, what would synthetic biology look like?
 - **Key Question:** If you had control over decisions in this area, how would you regulate synthetic biology? How would this differ from regulation of other technologies?

Note to moderator: Plot out the final summing up on a flipchart

- **Summing up**
 - **Key Question:** What are your recommendations to the research councils?
 - **Key Question:** What areas should be covered by future dialogue?

- What do you want to know more about
- Who should be involved in the dialogues
- Consent form, reminder to the participants to sign it if they want to (i.e. to ensure that if we want to involve public participants in the future BBSRC can hold their data)
- 6DTV participation details: ask participants if they would be interested in participating in an online discussion of the findings from these workshops to further the debate and ensure that we have reflected their ideas. Take down their full name and e-mail details on the information form, hand back to BMRB representative.
- Moderator sum up the points to feed back to the group at the end of the session.

Note to moderator: Summarise key points from the group for feedback in final session

SESSION 11 (Plenary): Interactive Voting Session

16:00-16:15 15min

Chair: Thank participants; get brief feedback from moderators

Chair: introduce voting session, remember to ask participants to enter their pin before voting.

How much do you agree or disagree with the following statements about synthetic biology

Q1-5 Synthetic biology is a very exciting area of work

I am concerned about the unintended consequences of synthetic biology

Synthetic biology can be safely regulated

Synthetic biology may be able to address some of the world's major resource problems – such as producing more sustainable fuels

It is likely that synthetic biology applications will be driven by profit rather than social needs

- Agree strongly
- Agree
- Neither agree nor disagree
- Disagree
- Disagree strongly
- Don't know

We are now going to highlight a number of potential applications of synthetic biology. For each tell me if you agree or disagree with following statements

USING SYNTHETIC BIOLOGY TO...

a. Develop crops with different genetic traits to increase food production in the future

6. is morally acceptable
7. is a risk to the environment
8. is useful for society
9. should be encouraged
10. is not how we should be increasing food production

USING SYNTHETIC BIOLOGY TO...

c. Engineer bacteria to help clean up pollutants in the environment

11. is morally acceptable
12. is a risk to the environment
13. is useful for society
14. should be encouraged
15. is not how we should be addressing pollution problems

USING SYNTHETIC BIOLOGY TO...

d. Develop medical drugs...

16. is morally acceptable
17. is a risk to the environment
18. is useful for society
19. should be encouraged
20. is not how we should be producing drugs

For all:

- Agree strongly
- Agree
- Neither agree nor disagree
- Disagree
- Disagree strongly
- Don't know

Q21. How concerned or unconcerned are you about the potential misuses of synthetic biology?

Very concerned

Quite concerned

A little concerned

Not at all concerned

Q22. Do you think synthetic biology has the potential to impact on you personally in the future?

- (1) Yes
- (2) No
- (3) Don't know

SESSION 12 (Plenary): Wrap Up
16:15-16:30 15min

Chair: Thank participants, summarise the next steps and reporting process

Potentially ask the Research Council to say a few words on what is going to happen with the information that has been fed back to them, talk through the launch event

Ask the evaluator to briefly explain the evaluation process and ask them to fill in the forms

Make sure everyone gives in their voting pad and fills in the evaluation form