speak up scotland!

a year of science debating

teacher's handbook

thanks

project funders

This project has been generously funded by a Science Engagement Grant from the Scottish Government, by the Robertson Trust and the MacRobert Trust. Without this funding this project could not have happened.

thanks

We are also extremely grateful to a number of other individuals and institutions, who have given their time and expertise to make this project a success, particularly:

Professor Martin Hendry, University of Glasgow
Professor Jonathan Side, Heriot Watt University
Emma Kemp and Dr Clare Blackburn , The Institute for Stem Cell Research
Dr Peter Reid, University of Edinburgh
Dr Mark Morrison, Institute of Nanotechnology
Steve Bakke and staff of the Science Dept, The Royal High School, Edinburgh
Evelyn Smith, The Royal High School, Edinburgh
STEM Ambassadors Programme
SSERC
Wellcome Library, NASA, Argonne National Laboratory
Rob Marrs and Greg Murray, ESU Scotland

and last but not least...

A huge thank you to you, the teachers, who are partcipating in this project and bringing science into the lives of young people every day.

Dr. Angeli Mehta
Suzanne Ensom, Stephen Jamieson, ESU Scotland

The Scottish Government

Cover photo: Hubble against Earth's horizon (photo NASA/Hubblesite)
This page photo: Wind turbine (photo Angeli Mehta)

introduction

welcome

Thank you for participating in the Speak up Scotland! Science Debating Project. There are many ways that the whole class can be involved in debating, building on the strengths of each individual pupil who will contribute to the activity in different ways, developing confidence and skills that will be useful throughout their lives.

We hope that this programme will be both enjoyable and beneficial for you and your pupils in building skills that can be used way beyond this project. This resource pack provides everything you need to get started on debating in your science classes. Additional resources are provided online at **www.speakupscotland.org.uk**.

Once you've chosen a debate topic, your pupils will be able to ask questions of a scientist working in the field. Depending on location, this can either be through a visit to the school or via the internet. You can debate in your class; in front of the school or year group; and later you may like to take part in our national competition in 2012. How far you go with debating is up to you and your pupils.

Happy debating!

contents

debating and cfe

The format of preparation, debate, and follow-up provides a flexible approach and context for the learner experiences and outcomes detailed in Curriculum for Excellence.

confident individuals
- Pupils develop skills in a protected environment
- Tasks are allocated so pupils build on their strengths
- Experience of expressing opinions in public

successful learners
- Develops research skills
- Encourages self-instruction
- Develops structure and logical thinking
- Develops literacy skills

effective contributors
- Encourages team work as everyone can contribute
- Develops transferable skills
- Ensures pupils are better equipped by being more knowledgeable

responsible citizens
- Engaging with topical issues and current affairs
- Ability to see both sides of the argument
- Pupils understand debate process and practice

getting started

what is debating?

Debating can take many forms, and this guide will show you different ways that debating can be used to get your pupils speaking about science. Not all debate formats have two sides, but all debating activities are goverened by rules which limit the amount of time people have to present their argument, and how and when others can respond.

The best way to start is to ask your class for ideas about what debating is. They will probably come up with “an argument”, “a discussion”, “an opportunity to put forward views”, “persuasion”. Then ask them to think of where debates happen: in politics, at work, at home even.

Ask pupils to name some famous people who are good at debating. Pupils will probably think of people like Barack Obama or Alex Salmond, but they might not know that Brad Pitt, Bruce Springsteen and Dara O’Briain were all debaters at school. Try to elicit why these people are good speakers, thinking about persuasion, credibility, confidence, style, humour and, of course, the content of their speech.

Lastly, ask pupils to think about the differences between debating and public speaking. In debating there has to be some clash, and speakers respond to arguments put forward by the other side. It’s no good turning up with a prepared speech and then ignoring what the other side says. This will be covered in more depth in the sections on Rebuttal and Points of Information.

Finally, debating is not just about the debate itself. There is plenty of work to be done during the preparation and follow up sessions, and even during the formal debate there are many ways that the whole class can get involved, building on individual strengths and developing skills step by step.

Ask your class and elicit ideas:
What is debating?
Where do we see it happening?
Name some famous debaters

if i ruled the world

A quick game to get pupils thinking and talking. The skills taught are helpful for good debating.

The first person in the circle announces their name and makes a statement about what they would do if they ruled the world. For example:

Person A - “My name’s Bob and if I ruled the world, I would give everyone cake.”
Person B – “His name’s Bob and if he ruled the world he would give everyone cake. My name is Amy and if I ruled the world I would eliminate poverty.”
Person C – “His name’s Bob and if he ruled the world he would give everyone cake. Her name is Amy and if she ruled the world she would eliminate poverty. My name’s Omar and if I ruled the world I would make everyone wear blue hats”.

This continues round the circle. You can re-start the game again half-way round the circle.

just a minute

Decide a topic that pupils can speak on without needing to prepare. This topic can either be set by the teacher or through discussion with the class.

When a topic has been chosen, ask for volunteers to speak. Explain that the minute begins as soon as the first speaker starts.

If the first speaker hesitates, repeats words or talks about something unrelated to the topic they can be challenged by one of the other pupils. To challenge, they should raise their hand and the speaker must stop, as will the stopwatch.

The pupil who has raised their hand will be asked to explain their objection. If the challenge is agreed they then will take over from the speaker (or can nominate another speaker) and the stopwatch will start again. The student speaking when one minute is reached is the winner!

formal debates

formal debates format

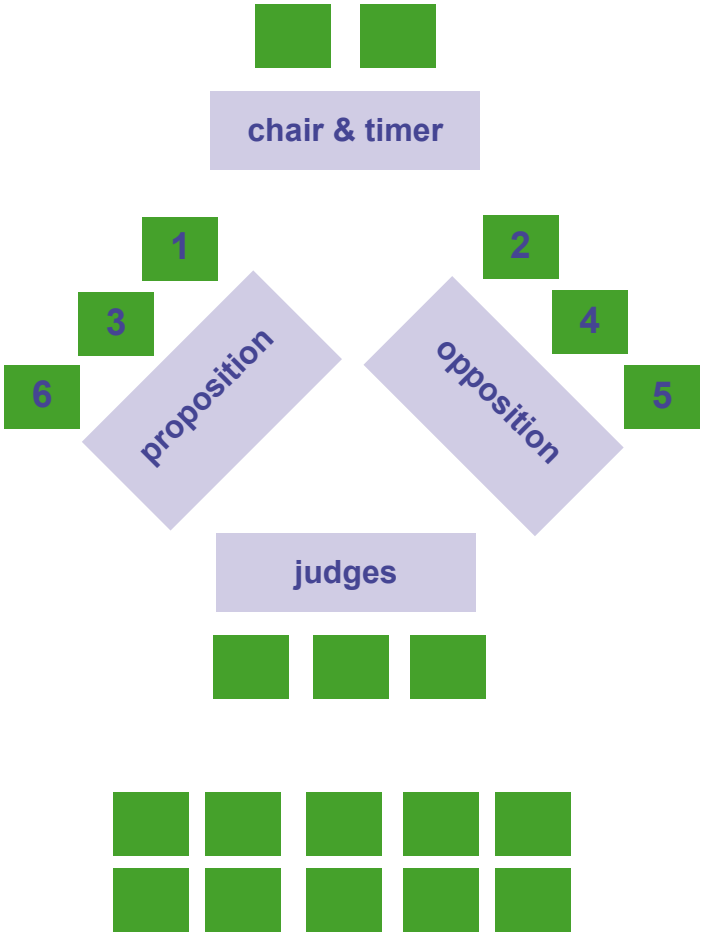
The most straightforward debate format is the Mace Format. There is one team on each side: the Proposition ('For Team') and the Opposition ('Against Team'). There are three speeches on each side: two main speeches and a summary speech. In competitive debates there are usually two speakers on each side and one of the main speakers does the summary speech. In the classroom it makes sense to have three speakers on each side. (You can adapt the number of speakers on each side to suit you class.)

The length of speeches can be adjusted according to the experience of the debaters or the time available. The main speeches are longer than the summary speeches so if the main speeches are 3 minutes, the summary speeches could be 2 minutes, or 5 minutes and 3 minutes.

The order of speeches is:
1. 1st Proposition Speaker
2. 1st Opposition Speaker
3. 2nd Proposition Speaker
4. 2nd Opposition Speaker
   -FLOOR DEBATE-
5. Opposition Summary Speaker
6. Proposition Summary Speaker

During the floor debate members of the audience can ask questions or make comments to any of the speakers. Have a floor debate for as long as you think appropriate - it is a great opportunity for other pupils to speak.

The summary speakers will need to write their speeches during the floor debate (see speaker roles section later). The Opposition Summary Speaker speaks first to allow the Proposition an equal chance to rebut arguments. This creates an equal level of engagement between the two sides, allowing for more ideas to be tested and critiqued. The greater level of clash that this fosters leads to a better understanding of both sides and a better debate.



roles in the debate

Each team and each person has a specific role in the debate. The roles of the teams and speakers, and ways to involve the whole class will be covered later.

Chair: Welcomes the audience, briefly introduces the motion and introduces the speakers.
Timekeeper: Times each speech and notes down the amount of time each speaker spoke for. The timekeeper also signals the beginning and end of protected time (see rebuttal and p.o.i.s section) and the end of the speakers' time.
Audience: Takes part in the floor debate.
Judges: Decides who has won the debate.

planning the debate

choosing a motion

Formal debates always start with a motion, usually expressed "This House would...." There are two types: policy motions, which propose a specific course of action; and analysis motions, which debate whether something is true or not. Policy motions are more straightforward for new debaters.

How you phrase a motion really matters as a poor motion will lead to a poor debate. When choosing a motion, think about:

- Is it clear what the debate is about?
- Do both sides have a variety of arguments?
- Does the proposition have the more controversial side, or the side that involves making a change?

Proposition teams should always be proposing a change to the status quo. Debates where the opposition are proposing reform and the proposition are proposing the status quo tend not to work as well.

brainstorming

Once you have decided which motion you are going to debate, the first step is to brainstorm about the topic. The best way to brainstorm is for one person (either you or one of the pupils) to take notes and everyone else to say things they know about the subject. The easiest way is to divide the page or white board into two halves and put down ideas for and against the motion.

It is important to think of arguments on both sides of the debate as it's good to have an idea about what the other side might say. It will also help pupils with POIs and rebuttal during the debate itself.

Brainstorming can be done as a class or in small groups, pooling the ideas later. At this stage the key is to get as many ideas as possible so it doesn't matter about the order or whether some arguments seem weak. Often the first arguments that a group thinks up will help stimulate further questions about what the debate is really about.

Brainstorming can help to involve pupils who may find debating difficult, as they can make a direct contribution without having to make an extended speech in public, which can help to build confidence. You could go round the class so everyone has the opportunity to contribute.

grouping arguments

Once a class or group has brainstormed the arguments that they are going to use, it is important to prioritise these arguments, group them together and divide them evenly between the main speakers. It is best to have a few key points rather than a disparate group of arguments. The best way to do this is to look for arguments that are similar and group them together under a heading according to their common theme.

Look at all the different arguments. Are any of them really different ways of saying the same thing? In which case, you can combine these. They may be different points, but related thematically. These points can be grouped together under the same heading, with sub-points within it. So for example, when considering a motion about banning school uniform pupils may think of a number of points which could be categorised under the headings "individuality" and "functionality" among others.

Researching arguments can be done at any time during preparation and can be an excellent way for students to become more successful learners.

allocating arguments

Don't give the 'stronger' speaker all the good arguments as it leaves the other speaker with very little to say. It is important to make sure that the arguments are equally distributed between the speakers. Don't hide all the good arguments in the second speech to trick the opposition: this isn't fair and speakers who do this will be penalised by judges for not allowing the other side a chance to respond.

example motion

defining the motion

Who is "this house"? The class, the UK, the world? How will you enforce this?

this house would give up non-essential flying to help curb dangerous climate change

What are "non-essential" flights? You will need to decide and explain. Anything but A&E? Diplomacy? etc.?

brainstorming

Write all ideas on the board. Points can be noted very briefly. It doesn't matter if some of the points are saying the same thing.

For
- People have to make sacrifices to help the environment
- Huge carbon emissions
- Can travel in other ways
- Energy intensive e.g. running airports
- Uses fossil fuels
- Meetings can be done over the internet
- Don't have to ship food etc. via planes
- Would help governments meet targets on climate change

Against
- Other sources e.g. industry produce far more carbon emissions
- Business needs some face to face contact
- People want to visit places
- Travellers can offset carbon emissions
- Individual rights of people
- Other forms of transport are too slow
- Air industry is economically important

At this stage all arguments are fine. Weak arguments will be weeded out later and may help to generate stronger ideas.

grouping arguments

Here, the points for the proposition can be grouped into two themes. Sometimes you will end up with more than two, in which case try to group similar/related themes so that you can allocate them to each speaker.

- Huge carbon emissions from flying
- Energy intensive e.g. running airports
- Uses fossil fuels
- Would help governments meet targets on climate change

Greenhouse gases

- Meetings can be done over the internet
- Don't have to ship food etc. via planes
- People have to make sacrifices to help the environment
- Can travel in other ways

Alternatives to flying

allocating arguments

Essentially, as well as defining the motion, 1st prop is explaining reasons why flying is causing the problem.

1st proposition
- Greenhouse gases arguments

2nd proposition
- Alternatives to flying arguments

2nd prop then explains that there are alternatives and why flying is not necessary i.e. how the solution will work.

prop and opp

the role of proposition

The first role of proposition is to set up the debate, explain the motion and make it clear to everyone what the debate is about. If this isn't done the debate can be very messy, making it confusing to listen to and difficult to persuade your audience to agree with you. The second role of the proposition is to put forward a policy or a mechanism to solve this problem. The proposition needs to tell us the benefits of their solution and how it is going to be better than the status quo. This is to persuade the judges not only that there is something that needs to be fixed but your idea is the best way of fixing it.

The proposition needs to do 3 things:

1. Define the motion
Are there terms in the motion that need explaining,? For example, what is meant by "This House"? Who are you talking about? The group, the country, the world?
2. Describe the Problem
What are you trying to fix? Why is it a problem? Who is it a problem for? Why should we fix it now?
3. Tell us how we fix the problem
How is it going to work? Who is going to do it?

Think: WHY? WHY THIS? WHY NOW?

the role of opposition

The main role of the opposition is to oppose the arguments put forward by the proposition. This can be done in a number of ways:

You can oppose the PROBLEM: the status quo is fine
You can oppose the SOLUTION: it won't work
You can oppose the OUTCOME: the situation will become worse

The opposition can put forward a counter-plan but this is unnecessary. The most important thing to remember is that the opposition must debate what the proposition has defined and proposed, not the ideas you came along with!

both sides

- Which arguments are the most important?
- Why does the action have to be taken now?
- How will the proposed solution change things?
- Will this affect anyone outside of the problem?
- Are there any analagous situations?

alley debates

Alley debates are a fun way to introduce debating to a class and to generate ideas. They emphasise persuasion, quick thinking, and rebuttal skills.

Divide the class into two groups and form two lines a few yards apart facing each other. Set a motion for the alley debate- this can be fun or serious. It should be an 'either/or' motion along the lines of 'Should I buy Fair Trade goods?' or 'Should Scotland become an independent country?'. Assign one side of the topic to one line and the other side of the topic to the other line.

The teacher (or one of the pupils) stands halfway between the lines. The first speaker in favour of the motion should give a reason why they should buy fair trade goods. If the point is convincing the teacher takes a step towards that side. If the teacher is not convinced, stay in the middle. Then ask the first speaker in the other line why you should not buy fair trade goods and repeat the process. The teacher should work their way down the lines until they reach the final speaker.

Alley debates can be used for almost any topic and can actually be used for quite complex motions.

Suggested topics for alley debates in science:
- **Nuclear power is the best way forward**
- **Man has an obligation to solve climate change**
- **Science is more important than the Arts**
- **Scientists should be able to work without constraint**

And for fun...
- **Biology is better than Chemistry (etc.)**

speaker roles

debating roles

In a formal debate each of the speakers has a specific role to play. This seems quite technical but should help all the speakers to plan their speeches. Speech structure will be covered later. Remember, the opposition HAS to oppose what the proposition has put forward!

1st proposition speaker

- Define the Motion (i.e. tell the judges and audience what the debate is about).
- Explain the arguments that they and their partner will put forward in the debate. This should be broken down into parts by explaining which arguments each speaker will say. (This is known as the Preview.)
- Develop your main arguments to persuade the audience and judges why the proposition should win the debate.

1st opposition speaker

- Rebut the most important arguments in the preceding speech.
- Explain the arguments that they and their partners are going to put forward in the debate. This should be broken down into parts by explaining which arguments each speaker will make.
- Develop your main arguments to persuade the audience and judges why the opposition should win the debate.

2nd proposition speaker

- Briefly recap what the first proposition speaker said in their speech, and outline what they are going to say in their own speech.
- Rebut the most important arguments in the preceding speech.
- Defend their partner's speech against attacks made on it from the first opposition speaker.
- Develop your main arguments to strengthen their case.

2nd opposition speaker

- Briefly recap what the First Opposition Speaker said in their speech, and outline what they are going to say in their own speech.
- Rebut the most important arguments of the previous speaker.
- Defend their partner's speech against any attacks made on it from the Second Proposition Speaker.
- Develop your main arguments to strengthen the Opposition case.

proposition summary speaker

- Defend the Proposition team's arguments from attacks on it from the other side.
- Address some points from the Floor Debate.
- Summate the entire debate for the Proposition team (normally by rebutting the Opposition by identifying the key issues in the debate and telling the audience/judges why the Proposition team won the debate).

opposition summary speaker

- Defend the Opposition team's arguments from attacks on it from the opposing side.
- Address some points from the Floor Debate.
- Summate the entire debate for the Opposition team (normally by rebutting the Proposition, by identifying the key issues in the debate and telling the audience why the Opposition team won the debate).

rebuttal and p.o.i.s

what is rebuttal?

Rebuttal is one of the main things which makes debating different from public speaking, as this is where the clash of ideas comes. The best debaters are very good at rebuttal. The most important thing is to LISTEN and REACT to what the other side says and explain point by point why you believe they are wrong. Apart from the 1st Proposition speaker, all main speakers should use rebuttal. For new debaters it is easiest to do this at the beginning of their speeches.

tips for good rebuttal

- Get to the core of the arguments: if you rebut the strongest arguments you are much more likely to win the debate.
- Try to think beforehand what the other side will say so you are better prepared.
- Write down what the speaker says so that you can rebut properly point by point.
- Do it at the beginning of your speech before you go on to your arguments.
- Don't be afraid of it!

what are p.o.i.s?

Points of information are short interruptions during a speech, where the opposing side can make a comment to the speaker. This can be a fact, a question, a statement or a challenge. Making a good POI shows that you are listening and responding to what the other side says. Usually at the beginning and end of a speech there is a period of 'protected time' where no POIs can be given, signalled by the timekeeper. This is normally 30 seconds at the start and end of a 3-minute speech, or a minute in longer speeches. POIs are not allowed during Summary speeches.

To make a POI, stand up and say "Point of information". Remember that the speaker does not have to take the point, and can respond "yes please" or "no thank you". It is good to take at least one POI during a speech, and you should try to offer at least one during each of your opponents' speeches.

tips for good p.o.i.s

- Write the question down so you are less likely to fluff it, or you can pass it to your partner.
- Your POI should be current - don't go back to something they said earlier in their speech.
- If you are the speaker, try to answer the POI when it is made: don't say "well, I have that later in my speech...."
- Most importantly, POIs should be SHORT, SHARP, AND TO THE POINT! (Ideally less than 15 seconds.)

i couldn't disagree more

A useful and quick game that can help practice rebuttal techniques and develop the ability to deal with points of information.

One pupil makes a statement (this statement could be serious, silly, topical, controversial or obvious). The next person has to reply to the statement by saying 'I couldn't disagree more' and then give a reason why. Here's an example:

Pupil A – ''I believe that politics is a waste of time''
Pupil B – ''I couldn't disagree more. Politics is incredibly important as politicians make decisions that affect every aspect of our lives'

Now it is Pupil B's turn to make a statement:
Pupil B – 'I believe that we should introduce road pricing in the UK'
Pupil C – 'I couldn't disagree more. In early 2007, over 1.8m people in the UK signed a petition saying that they didn't want it.

This game can be modified so statements have to be about a certain topic area for example 'The Environment'.

debating with 20+

involving the whole class

If you follow the process of preparation, debate, follow-up, every pupil should have a part to play in the process. Even during the debate there are many ways that the whole class can be involved actively.

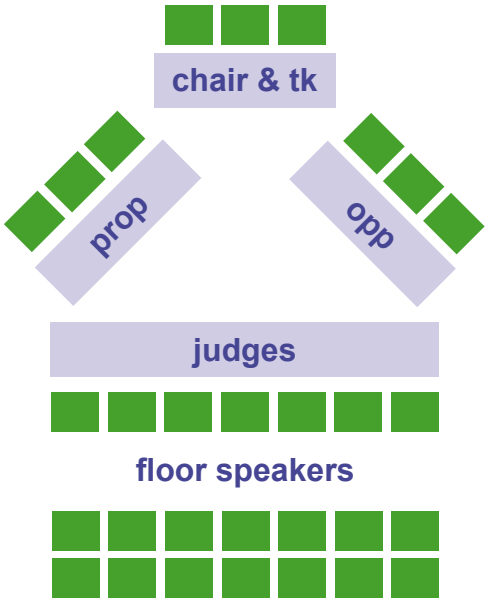
preparation

During the initial preparation, the brainstorming, grouping and allocating arguments can be done as a class or in groups. Once the teams have been agreed, pupils can be allocated the task of researching particular facts or aspects of their side's arguments. During the speech writing time, pupil coaches can be allocated to each of the speakers to help them plan, write, and even practise their speeches. This provides an opportunity for pupils who aren't so keen on speaking to use their knowledge.

during the debate

During the debate itself, you can allocate a position to every pupil. There can be three chairs, one to welcome the audience and direct questions during the floor speeches, and two to introduce the speakers on each side. You will also need at least one timekeeper. You can have as many judges as you wish, and you could task each judge with giving positive feedback, for example two things they liked about each speech, and something to work on. It is best to have an odd number of judges, or a chair judge to cast a deciding vote, in case the vote is tied.

The floor debate can last as long as you wish, it's up to you. You can task each member of the audience to ask a question of the speakers, make a comment, or a short speech. This can be a great way of building confidence and moving from asking a brief question, to making a short speech, to eventually becoming one of the main speakers (if desired!).



The diagram above shows how the debate could look with 20-30 pupils invloved.

debating with reporters

The most straightforward way of debating with reporters is to ask each pupil in the audience to make notes during the debate, and write up the debate in a certain style of newspaper report.

However, you can make this exercise a lot more sophisticated by introducing the reporting angle from the start. When you allocate the two teams, make a "third team" of reporters. During the planning stage the reporters will work together to think through both sides of the argument and identify what they think the most important points will be. They then plan questions to ask during the floor debate. They will need to listen carefully during the debate to note any additional questions. During the floor debate, each reporter will question the speakers.

After the debate, they can write up their reports, either alone or in groups, or even interview the speakers.

balloon debates

what are balloon debates?

Balloon debates have traditionally been used as a fun way to introduce debating to a class or debating society or as an end-of-term activity. However, with planning, you can use balloon debates in a much more sophisticated way following the same planning stages as with formal debates.

The premise of a balloon debate is that each person takes on a particular role and then we imagine that all these characters are together in a hot air balloon that is rapidly falling. One must be thrown overboard to save the others, but who will it be? Each participant must make a speech saying why they should be allowed to stay in the balloon. The rest of the class votes, and the loser is disqualified. This continues, until only one is left in the balloon. (The idea is quite similar to the Great Britons programme on television a few years ago.)

The most successful balloon debates require planning and research. Depending on the topic, the teacher can allocate the roles to different pupils (or pairs of pupils) or pupils can choose their own.

One of the main advantages of a balloon debate is that it can generate a large amount of information, with the pupils researching their own topic and then telling the rest of the class what they have learnt.

planning the debate

Once the roles have been allocated or chosen, pupils will need to research exactly why their role is so important and prepare their speech. The structure of the speech will be similar to that for formal debating, and in the later stages of the balloon debate, may also include some rebuttal.

the balloon debate

During the debate itself, each pupil will have 1-3 minutes (or however long you decide) to state their case as persuasively as possible. Pupils then vote on who will be thrown overboard or, alternatively, who will stay in the balloon (they cannot vote for themselves!) At this stage you could either eliminate pupils one by one or half of the class. If you choose to have longer speeches (e.g. 3 minutes) you could do the speeches over a number of lessons and eliminate a certain number per round, leading to a semi-final or final. Pupils left in the balloon prepare a second speech, developing their arguments and providing additional information. Two or three rounds is plenty. Pupils who have been eliminated continue to participate by assisting pupils left in the balloon with research and speech writing. They can also ask questions of the speakers during the second and third rounds, and vote. Alternatively you could allocate Chair and Journalist/Reporter roles.

follow-up

By voting to decide who stays in the balloon, the class, having considered all the arguments put forward in favour of the other roles, will have ranked the winner above all others in terms of merit. Ask the class why they made this decision. A discussion can take place about whether they voted someone off because of the arguments the speaker made or because of preconceived ideas.

Pupils could also write up factsheets or make wall displays on their roles to provide information to the other members of the class.

balloon debate topics

- Greatest scientist/scientific discovery/invention (these can be made more specific to cover a particular field, decade, Nobel prize winner...)
- Worst scientific invention/discovery
- Best way to spend £10 million to tackle ....
- Most important organ in the body
- Most important element
- Invention from Science Fiction you'd like to be real
- Most important decade/century in science
- Alternative energy sources

role play debates

role-play debates

Role-plays are a great way of exploring topics and issues where there are more than two sides or points of view. This is a good way to involve a large group in coming up with ideas and also emphasises persuasive skills. There are two sample role-play debates here, but many topics can be adapted to role-plays. As with formal debates, role-plays work best with preparation and follow-up, and during the "debate" lesson you can either run one role-play or have a number running simultaneously.

In each role-play the scenario is that a meeting has been called to discuss an issue that affects several different groups. The pupils will represent the members of each group and try to achieve the best outcome for their group.

First, explain the scenario and encourage pupils to think what the main issues and points of view might be. Divide the pupils into six groups, one for each role within the meeting.

planning the role-play

Once the pupils are divided into groups, they should work together to discuss what the group's point of view should be at the meeting and what information they might need to research. The groups should also think about what areas they are willing to concede in negotiation. At this stage the Chairperson and Journalist groups could be brainstorming questions to ask during the meeting.

Give each group their role card (either a print out of all of the groups' role cards or a cut out of the individual group's role card) to help stimulate ideas.

For the role-play itself, either each group should allocate a member of the group to make a speech at the meeting to describe the views of that group, or one person from each group should get together to make new groups for the meeting. This means running more than one role-play simultaneously but has the advantage that all pupils have the opportunity to speak, having prepared their roles together. If you choose to have one role-play only, then you could include a section for questions from the floor, as in a real planning meeting.

the meeting

At the meeting, the Chairperson should call the meeting to order and introduce the various groups and the representative from each group.

The Chairperson should then call upon the group that called the meeting to explain why they called the meeting and to outline their position (the speaker will have 3 minutes). After they have spoken, the Chairperson should then introduce the other group representatives in turn and they will each have 3 minutes to explain their group's position and give their suggestions for a fair outcome.

The Chairperson should then ask the rest of the audience (if there is one) if they have any questions and take questions from the floor. Alternatively, the Journalist(s) can ask all the questions.

After the questions, each representative should give a two minute summary of their position announcing their favoured outcome. At the end of the Summary Section, the Chairperson should make a list of points that all the representatives agree on and ensure there are some definite outcomes. However, in some circumstances, groups will not come to an overall agreement. The Chairperson can then hold a vote.

follow-up

As a follow up, the reporter can prepare a report about the role-play for the following class. If there are two or more reporters, ask them to report in different styles. You could also use the follow-up lesson for a more general discussion about the difficulties involved with issues such as these. The discussion would provide a good background for a discursive essay.

role play 1

finding medicine in the rainforest (bio-prospecting)

scenario

A major drugs company wants to start collecting samples of plants growing in part of the Manu rainforest in Peru. The rainforest is an area of great biodiversity- plants are used by local healers to treat many ailments and diseases. The company hopes to be able to discover plants which will help tackle some serious conditions- such as Multiple Sclerosis and Parkinson's disease which affect many across the world.

A meeting of representatives from interested groups has been called to discuss the proposals:
- Drugs company
- Patients' group
- Rainforest (Indigenous) peoples' group
- Conservation group
- Journalist
- Independent chairperson

some issues to consider

- The Rainforest is rich in plant and animal life- much of which is undiscovered. But the Rainforest is disappearing fast, as logging companies cut down the trees.
- Tribes in the Rainforest have vast knowledge of the plants and use them to treat a wide range of illnesses, but the search for Rainforest resources is destroying their land and livelihoods.
- Already chemicals found in some rainforest plants have been developed into drugs to treat cancers and diabetes.
- The Government of Peru wants to encourage the pharmaceutical company: it has been promised millions of pounds to pay for education of its poorest citizens and to provide better roads in return for allowing the company to explore its forests. The government also says it will stop rainforest being cut down.
- The Mashco Piro tribe which lives deep in the rainforest are very concerned that their way of life and health will be damaged by the search for promising plant species.

possible outcomes

- The drugs company gets to go ahead.
- The drugs company gets to go ahead but with restrictions on how it collects plants and new conditions for compensating the people who live on the land.
- An investigation is to be set up to work out how to protect the rainforest and its people before the company gets to start work.

rainforest medicine role cards

chairperson

• Calls the meeting to order and explains to those present why the meeting has been called.
• Explains the possible outcomes of the meeting
• Invites representatives from each of the groups to speak.
• Makes sure that each representative only speaks for 3 minutes.
• Introduces and controls the floor debate.
• Introduces the summary speeches.
• Announces the areas of agreement (if any) between the groups.
• Introduces a vote (if necessary).

drugs company

• Wants to press ahead with collecting samples.
• Rainforest plants offer hope to many millions who suffer from horrible illnesses, e.g. the pink-flowered Rosi Periwinkle found in Madagascar contains a chemical which has been successfully used to treat leukemia (a cancer of the blood or bone marrow) which affects over 200,000 people.
• Says it will respect the rights of all the rainforest people.
• Is being very generous with its offer of financial help to the Government of Peru, especially as it costs hundreds of millions of pounds to develop a drug successfully.

indigenous peoples' organisation

• Is very worried about the proposals.
• Believes that wildlife and land will be damaged by bio-prospecting.
• Fears that if the drugs company finds useful plants many more companies will come, and they will lose their land and way of life, as has happened in other rainforest areas.
• Have ancient knowledge of the plants and wild-life of the forest and this should be respected.
• The rainforest people have no immunity to western diseases carried by outsiders - many tribes have been wiped out by illnesses like the common cold.

patient group

• Says the rich biodiversity of the rainforest should be available to all the people of the world, and if it can help cure disease then it should be used for that purpose.
• But the group wants to make sure the rainforest is protected for everyone.
• Another drug company, Merck, did a deal with the government of Costa Rica which provided Costa-Ricans with scientific training, and money for conservation, an arrangement they say worked well.

rainforest conservation group

• Has mixed feelings about the drugs' company proposals.
• Potentially, finding useful plants could mean the rainforest will be protected from logging. Already many plants and animals are being destroyed by deforestation and it wants this to stop.
• But there are many examples where indigenous people lose out. The people of Madagascar did not get a penny from the discovery of the Rosi Periwinkle yet the company makes $160m a year from sales of the drug to treat leukemia.

journalist

• Keeps notes of everything said at the meeting.
• Asks questions during the questioning period.
• Prepares a report for the next class as part of homework. This can be in the style chosen by the student (tabloid, broadsheet etc) or in a style assigned by the teacher.

role play 2

badger culling

scenario

Farmers have been trying to persuade the Government to allow them to kill badgers on their land, because, they believe, the badgers are responsible for outbreaks of Tuberculosis amongst their cattle. TB is a nasty disease which damages the animals' lungs and eventually kills them. The numbers of cattle with TB is rising. The Government wants to allow culling of badgers on farmland, but a row has broken out with conservation groups who say it's wicked and immoral to cull badgers, especially as they are not the only cause of TB in cattle.

Some groups have been invited to a meeting with the Secretary of State for the Environment to discuss the proposals:

- Farmers
- Vet
- Conservation group
- Journalist
- Independent chairperson

some issues to consider

- Farmers are convinced their cows get TB from badgers. Cattle which become infected with TB have to be killed. This costs farmers millions of pounds. The government pays some compensation to the farmers so its expensive for the taxpayer too. But culling badgers also costs money.
- There is a vaccine to prevent TB spreading but the government says there are problems with it.
- Conservation groups do not believe that badgers are the only source of TB in cattle and say that killing badgers won't solve the problem.
- There have already been some trials in small areas to see if badger culls help reduce the number of cattle which get the disease. The results are mixed.
- Badgers are a protected species: it is illegal to kill or injure a badger.

possible outcomes

- Allow the culling of badgers to go ahead.
- Decide not to allow farmers to kill the badgers.
- Set up a trial in the county where culling is allowed in a limited area and monitor badger populations and numbers of infected cattle.

badger culling role cards

chairperson

- Calls the meeting to order and explains to those present why the meeting has been called.
- Explains the possible outcomes of the meeting
- Invites representatives from each of the groups to speak.
- Makes sure that each representative only speaks for 3 minutes.
- Introduces and controls the floor debate.
- Introduces the summary speeches.
- Announces the areas of agreement (if any) between the groups.
- Introduces a vote (if necessary).

journalist

- Keeps notes of everything said at the meeting.
- Asks questions during the questioning period.
- Prepares a report for the next class as part of homework. This can be in the style chosen by the student (tabloid, broadsheet etc) or in a style assigned by the teacher.

conservation group

- Opposes the cull.
- Asks what possible right does the government have to allow wildlife to be killed - especially when the badgers are already protected by legislation.
- At worst 30% of TB infections in cattle are caused by badgers, so farmers and the government should concentrate on dealing with the other causes first.
- Most cattle infections are from cow to cow, partly because of the trend towards intensive dairy farming where cattle are kept in large herds in crowded conditions.

secretary of state

- The decision to allow farmers to kill badgers is based on scientific evidence. The only thing still to be decided is if shooting badgers is the most humane way of culling them.
- A good vaccine for cattle is years away, and vaccinating badgers is very difficult as they are wild animals.
- More badgers get killed on our roads every year than the numbers we are proposing to allow farmers to kill.

farmers

- Adamant they should be allowed to cull badgers.
- TB in cattle is a huge problem. Last year about 25,000 cattle had to be slaughtered because of it. It's not just that farmers see their animals destroyed, but there are serious restrictions on the movement of cattle on and off their land so they can't get healthy cattle to market, so they lose even more money.
- Badgers carry TB, Cattle get TB from badgers so killing badgers on farmland should solve the problem.
- The badger population has become so large that they are now to be found foraging in the day because night time hunting doesn't get them enough food. So killing some badgers would be better for their overall survival.

veterinary group

- Trials involving badger culling have mixed results.
- In Northern Ireland TB infection rates have been halved by placing careful controls on the movement of cattle and by routine testing. No badgers have been killed.
- The British government has already had one trial (from 1998-2007 in England) with mixed results. In fact, in some areas the rate of TB infections actually rose and the cost of culling the animals was greater than the cost of compensating farmers for loss of cattle.
- Another series of trials is needed and more research needs to be done on cattle vaccines and dealing with the spread of TB between cattle.

structure

structuring your speech

In many ways, structuring a speech is like structuring an essay. Clear structure makes a speech easier to listen to and understand. We have looked at the roles of the speakers and speeches in formal debates, but some rules apply to ALL kinds of speeches, for different debate formats and in non-debating situations.

Introduction

- Include a preview of what the speaker is going to say (and in formal debates what their partner is going to say, or recap what their partner has said).
- This helps the audience know what to expect.

Rebuttal

- This is the easiest place to include rebuttal, if appropriate.

Substantive Material/Body of Speech

- After introducing the ideas, a speaker should highlight two or three main arguments.
- Use clear signposts in your speech. Unlike someone reading a book, an audience member in a debate cannot flick back up the page if they miss something a speaker is saying and signposts help the audience keep track of where the speech is going.

Conclusion

- Speakers should briefly tell the audience what they have said and why their side wins the debate.

Remember the Rule of Three: 'Say what you are going to say, Say it, and Say what you have said'!

A well-structured speech is something quite different from a scripted speech. Debaters should try to use notes as a guide rather than a script. With practice this becomes easier and it helps speakers become more convincing and confident.

r.e.a.l. arguments

It is not enough to simply make assertions or quote facts and hope the audience understands why these points are important. Arguments should be clear, fully developed, and relevant. A useful mnemonic for structuring arguments within a speech is R.E.A.L.: Reason, Example, Analysis, Link. It helps the audience to follow your point and it makes your arguments more effective and persuasive.

- Start with a Reason (why the speaker is proposing/opposing the motion or why the speaker is trying to persuade the audience of something)
- Follow this with an Example that underlines the point
- Provide Analysis which supports the point
- And Link it back to the motion (this helps keep arguments relevant to the debate)

It's harder than it looks, but it really does work!

r.e.a.l. example

This House would give up non-essential flying to help curb dangerous climate change

Reason (claim, statement)
Flying to go on holiday significantly damages the planet leading to the destruction of people's homes/environment.

Evidence/example (illustration, facts, evidence)
Flying contributes over 11% of the UK's total green house gas emissions. Greenhouse gases warm the planet causing the ice caps to melt. This will flood many low lying countries.

Analysis (impact or importance of the point)
In countries like Bangladesh millions of people live on low lying flood plains. The people of Bangladesh have built their homes and livelihoods in these regions and rely on their surroundings for food, water and work. If the regions were to flood they would have nowhere to live and would struggle to provide for themselves.

Link (why it's relevant to the motion)
If we cut out flying we could lower our contribution to climate change, helping to save people's lives.

r.e.a.l. guide

introduction, preview, rebuttal

reason

example/evidence

analysis

link

reason

example/evidence

analysis

link

reason

example/evidence

analysis

link

conclusion

judging debates

judging debates

Judging a debate is all about determining the persuasiveness of the speeches. Persuasiveness is subjective, but you can use a series of criteria to help examine a speech and more accurately compare speeches. These criteria will also help you provide feedback and recommendations on how to improve a speech. The criteria are meant to be applied holistically: all should be considered when judging a speech and no one aspect is significantly more important than another. When a decision is not clear because the teams are strong in different areas, after thorough examination the judge should step back and ask: who was I most persuaded by?

content

The content of an argument should effectively show that a point is true and is relevant to the debate. The r.e.a.l. guide should help pupils prepare.

- Do their points clearly lead to desirable (prop) or undesirable (opp) consequences?
- Do their points get to these consequences logically and consistently? Arguments are a lot more persuasive if they don't go off on a tangent and don't contradict themselves!
- Do their points have any logical gaps? Is there a gap in their analysis which leads you to wonder does X really lead to Y?
- Have they linked their point back to the motion?
- Have they used any examples or analogies to illustrate their case more effectively? Points are often stronger and more persuasive if speakers can use facts, statistics, case studies and news stories to substantiate their claim.

role fulfilment

Has the speaker done the job that is required in their position. This is contextual, based on the style of the debate that is being used, so you will need to adapt a bit for Balloon and Role-play Debates.

- Did the 1st prop speaker clearly define the debate? Was it clear after they sat down what the opposition should be opposing?
- Did the opposition oppose the motion as defined by the proposition? The opposition must engage with what the proposition has laid out.
- Did subsequent speakers on each side bring new points and new analysis to the debate, or did they just repeat their partners and what came before?
- Did the summation speakers summate the debate? Did they unfairly bring new points into the debate that the opposing side could not refute?

engagement

Have the speakers responded and listened to what the other team have said?

- Did they offer points of information?
- Did they take a POI and respond to it accordingly?
- Did they rebut what the previous speaker said?
- Did later speakers adapt their arguments to deal with what previous speakers said?

style and structure

Have the speakers and the team as a whole presented their arguments in a consistent and engaging manner? Did they keep your attention?

- Did the speech signpost important points and were the different points clearly distinguishable?
- Did the team split their material fairly amongst themselves and did the order of the speakers and their points lead to a more coherent argument.
- Did the speakers speak to time? Did they spend enough time on the more important points of their speech?
- Is the speaker speaking clearly and confidently? Is their body language effective, do they use hand gestures and eye contact?
- Did they use humour and rhetoric to help persuade the judges?

judging sheet

motion:

1st prop/opp

Name:

Notes on arguments made:

Rebuttal: (Not 1st prop)

Use of voice, language, body, etc.

POIS
offered
taken

2nd prop/opp

Name:

Notes on arguments made:

Rebuttal:

Use of voice, language, body, etc.

POIS
offered
taken

prop/opp summary

Name:

Notes on summary of debate (including summaries of your team's arguments and rebuttal of the other side arguments made:

Comments on floor debate

Use of voice, language, body, etc.

POIS
offered

first time speakers

getting started

For many pupils, speaking in a debate for the first time will be a nerve-wracking experience and even very experienced debaters get nervous before speaking in public.

Some confident pupils will immediately volunteer for speaking roles whilst others may be reluctant to speak in public. They may, however, become more involved in debating over time (speaking in floor debates and then taking part in the debate proper). You will know which of your pupils will be able to take on speaking roles initially and which will need more help to become more confident.

building confidence

You should let pupils know that it is perfectly natural to be nervous before speaking in a debate and that, in many ways, it is a positive thing – a few nerves can encourage dynamism and quick thinking.

Most young people are much better public speakers than they think are. However, many pupils will be very nervous about speaking in public, especially in front of their peers.

Working with pupil coaches and with their team mates helps encourage speakers – both in their preparation and showing them that all speakers get nervous before a debate. The pupil coaches and team mates can play an important role in encouraging and supporting speakers.

There are a number of strategies that can help young people overcome their nerves. These may be particularly useful for pupils debating for the first time or for pupils that find debating difficult.

preparation

Good preparation helps. The preparation stage will give the pupils plenty of time to research for the debate and prepare themselves. If a speaker has done a lot of research and worked with others to prepare their arguments and practise their speeches, they will be much less nervous.

the audience is on your side!

As the whole class is involved in the debate and has invested time in preparing, they want the speakers to succeed. Speakers should not see the audience as an intimidating factor but remember that they are on their side! Encourage the audience to applaud when they agree with a point being made – this will really boost the speakers.

positive mental attitude

Encourage a positive mental attitude by encouraging speakers to be confident. Team mates should support each other and pupil coaches should say encouraging words to their teams. If a pupil is especially worried before a debate, the teacher can go through their speech with them and offer reassuring advice.

provide constructive feedback

Judges (either pupils or adults) should provide positive and constructive feedback to speakers.

Judges should highlight the strong aspects of a speaker's performance and, rather than criticise elements, should suggest areas where the speaker can improve. Positive and constructive feedback is a useful way of building a speaker's confidence. Ask judges and pupils in the audience to say two things they liked about each speech and one thing to work on. Encourage peer support and learning from each other.

lesson plan

using debates in your classes

The most successful way to integrate debating into your teaching is to spread the activity over 2-3 lessons to ensure that pupils have plenty of time to think, research and plan. Pupils will benefit much more from this method and it will help to shift the main focus from the debate itself (which will be the highlight for many pupils) to the whole process of independent and collaborative learning: research, weighing up evidence, developing coherent and convincing arguments, and finally evaluating and using what they have discovered.

stage 1: planning

This stage is vital so the pupils really know what they will be debating. Better planning means a better debate. You may need several sessions .

In class:
Introduce the topic and some general discussion around the background information and questions on the factsheets. What do they already know?

Introduce the motion (or balloon or role-play topic). Brainstorm ideas as a class or in groups. What are the key points? What will the pupils need to find out?

Allocate roles to the pupils, asking for volunteers if appropriate. Emphasise that ALL pupils have a part to play, not just the speakers. Work through brainstorming, grouping and allocating arguments so that pupils have a focus for their research.

For a formal debate you may need to explain the format, roles and steps. You could have a mini-debate or an alley debate to help the class understand the format. You may choose to talk about structure here or leave it to the next lesson.

At home:
Pupils research their arguments or topics.

stage 2: debate

By this stage the pupils should have a good idea of their main arguments and have done the research to find evidence to support their case.

In class:
If you haven't done so already, go through speech structure with your pupils. This will help them to refine their arguments and structure their speeches. Pupils can work together in pairs or groups to plan their speeches. Encourage them to make notes and bullet points rather than writing the speeches out in full. This will help to avoid reading their speeches.

DEBATE!

stage 3: follow-up

A lot of the research, learning, and understanding will have taken place during the preparation and debate stages, but the follow-up stage is important to review and consolidate what has been discovered.

After the debate, start by discussing the main points with your pupils. Did the most important arguments come out during the debate? Were there any surprises? Have any of the pupils (either speakers or audience) changed their opinion about the motion? What have they learnt during the process?

There are various ways that the information gathered can be recorded. Here are some ideas:

- Posters for the classroom showing the two sides of the motion, with the main arguments and facts.
- Newspaper style reports on formal and role-play debates, or article for the school newspaper/ magazine/website
- Factsheets to be shared with other class members on roles in balloon debates
- Discursive essays on the motion, based on the debate

finding things out

introduction

Throughout this handbook we have emphasised how important it is for pupils to do their own research to take an active part in their learning. However, they make not be completely sure how to go about doing their research. Below are some suggestions for helping your pupils to get started.

the factsheets

The science factsheets which follow are designed as a jumping off point: to put the research in context, and to suggest the questions our current level of knowledge raises. You'll get a flavour of the huge potential benefits of science research.

We want to show you the difficult questions scientists are wrestling with and, above all, to demonstrate that science does not have all the answers. You could be the person who comes up with a solution.

Science is amazing. Discoveries are made every day which have consequences for our health, the environment and the economy. More and more, we as citizens will have to make decisions about what is acceptable; or safe. Where should our money be spent?

When you've decided on the topic and motion you are going to debate you can use the 'Fast facts' and 'questions to ask' to help brainstorm your arguments. That will provide you with some 'key' words and questions, which will help focus your research.

You will be able to talk directly to a scientist working in the field you have chosen- they will either come to the school or you can ask them questions via webchat on GLOW.

Try looking in the school or local library to see what resources are available.

using the internet

You may also want to look farther afield. We've suggested some websites where you might also find helpful articles or videos but you might want to do your own searches. When you put the key words into your favourite search engine you'll find an awful lot of stuff. Anyone can publish online, so how do you know what's reliable and accurate?

You'll get better at weeding out fact from fiction. Be sceptical. Don't take the word of one website - cross check with others.

Here are a few things to look out for which will help:

- Does the website you are looking at have an 'about us' section where you can find out about the aims of the website and who wrote its content?

- In general a site with the suffix .gov.uk (government); or .ac.uk (university) is likely to be more reliable than others, but you still can't assume everything is 100% accurate.

- Who is the author - are they an expert, or someone with an opinion?

- Is there any information about when the website was last updated, or the article written? The more recent the better, especially if you are researching science. Are there details of sources for the information the author has used?

- Is the material well written or are there grammar and spelling mistakes? If there are you should be wary that the author may not have taken any more care with their 'facts'.

When you are writing your speech or research notes put what you are reading into your own words- don't cut and paste. This will help you work out if it makes sense, and you'll probably write it as you like to speak. It also means you won't run the risk of being accused of plagiarism (taking someone else's work and passing it off as your own).

this house believes the government should fund research on planet earth rather than the cosmos

big bang

According to widely accepted theory, the Universe came into existence around 13.7 billion years ago in an event astronomers call the Big Bang. The cause of the Big Bang remains largely unknown, although among the ideas proposed is the intriguing possibility that our Universe is just one of a (possibly infinite) ensemble of universes known collectively as the Multiverse.

At the moment of the Big Bang all the matter and energy in our universe came into existence. The Universe at that moment was incredibly hot and dense. Then it began to expand, cooling rapidly as it did so. It is still expanding today, and the expansion seems to be getting faster. The first stars are thought to have formed several hundred million years after Big Bang. Planet Earth (and our solar system) didn't come into being for another 9 billion years or so after that.

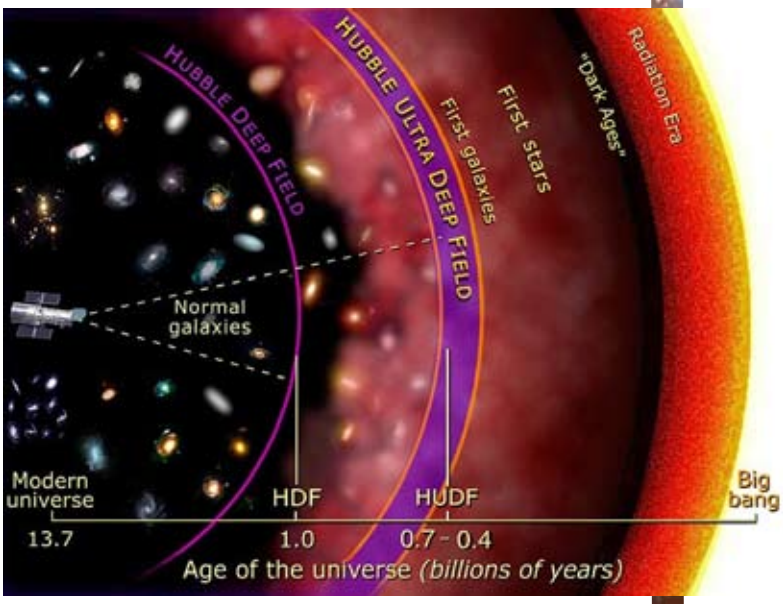
The story of our Universe is being told through both exploration of space, and complex and expensive experiments that probe the Universe on all scales - from the farthest reaches of the cosmos to the innermost secrets of sub-atomic particles.

looking back in time

Consider the Hubble space telescope, launched 21 years ago by the US space agency NASA. Hubble orbits above the earth's atmosphere so it gets a clearer, sharper view of the distant Universe than ground based telescopes. (The atmosphere distorts and blocks out some light). Hubble's recording equipment has captured some remarkable images of distant galaxies, offering us a window on the universe as it was in its early days.

In 2003 and 2004 the telescope was pointed at a seemingly empty patch of sky. Hubble's cameras took pictures over a period of about 11 days. The tiny trickle of light that was picked up had travelled billions of years to reach the telescope. When all the images were put together they revealed what the Universe looked like between 400 million and 800 million years after the Big Bang, when the light began its journey. The pictures reveal some 10,000 galaxies, racing away from us as the universe expands. This slice of time is called the 'Hubble Ultra Deep Field'. Scientists are still examining the images, and making discoveries about the stars and galaxies they reveal. Other facilities are now being planned and built to allow us to see further and farther back in time to the formation of those galaxies.

How Hubble sees back in time
(photo NASA)



Hubble ultra deep field
(photo S.Beckwith/NASA/GSA and HUDF team)

Giant nebula (photo NASA ESA and the Hubble Heritage)

the universe

this house believes the government should fund research on planet earth rather than the cosmos

smashing protons

No one knows what caused the Big Bang but scientists want to get closer to it. Theoretical Physics suggests that a lot happened within the first billionths of a second after the Big Bang. It's hard to imagine just how small a moment in time that is, but during it came the formation of all the sub-atomic particles - like quarks and protons and neutrons - that we know today. All these particles stuck together, paving the way for the production of the simplest elements of Hydrogen and Helium, within the first 100 seconds or so after the Big Bang .

What scientists want to do now is try to look back to the moments before the protons, for example, were formed. The idea is to smash them apart to look at their constituents - hopefully recreating how things were in those infinitesimally small fractions of a second immediately after the Big Bang.

Experiments have confirmed many of the ingredients of the theory of how these particles were formed and how they interact, but what has not been established is how those particles got their mass - essentially how "heavy" they are. (Without mass, the structure of the universe would be very different.)

In 1964 British physicist Peter Higgs suggested the presence of a force called the Higgs Field, which influences some particles to give them their mass. The field is packed with particles called Higgs Bosons, which deflect other sub-atomic particles as they move through it. In recent years, the search has been on for this last piece of the jigsaw - the Higgs Boson.

The hunt has been underway, deep underground, at the Large Hadron Collider. This is the world's largest particle accelerator, built to smash protons into one another at extremely high speeds. As the protons collide - the particles that make them up are released.

In July 2012, scientists made the exciting announcement that they had found a new particle which they think is indeed the Higgs Boson. Now there is a lot of work to be done to see if the Higgs particle behaves as physics theory predicts, and whether it helps unlock other mysteries, such as the nature of dark matter and dark energy.

origins of life

Just as scientists are looking deep into Space for the origins of our Universe, they are also investigating how life began. Could there have been life elsewhere in our own solar system? Since 2004 NASA's robotic rovers (Spirit and Opportunity), have been exploring Mars, investigating giant craters which seem once to have been soaked by water.

Throughout the history of the Solar System meteorites have crossed the gulf of space between Mars and Earth- did any ancient microbes get carried that way? It's not such an outlandish idea: back in 2006 Nasa's stardust programme showed that some life's essential building blocks could have been dropped off by comets passing through our solar system. Scientists found Glycine in the dust they collected: Glycine is one of the amino acids which makes up our DNA.

Astronauts carrying out Hubble repair
(photo NASA)

The desire to understand our universe has fuelled both huge progress in science and the technology needed to study it. Big advances in computing and optics, for example, have made possible the telescopes that allow us to see into the farthest reaches of our universe; advances in network engineering and software that allow us to peer back to the Big Bang itself, are all having a huge impact on our lives in diverse fields from medical diagnostics to weather mapping.

Grappling Hubble
(photo NASA 2009)

fast facts

- Light travels at 299,792,458 metres per second or approximately 186,000 miles per second, which means it takes about 8 minutes for the sun's light to reach us.

- A light year is the distance light can travel in one year - that's about 10 million, million kilometres. Because of the vast scale of the cosmos, the light year is the unit commonly used to describe the distances between stars and galaxies.

- A Galaxy is made up of stars, gases, dust and something called 'dark matter' which accounts for the mass of most galaxies - all held together by gravity. Scientists are trying to discover the nature and origin of dark matter.

- The Hubble telescope is named after Edwin Hubble, the astronomer who discovered that the Universe is expanding.

Hanging out with Hubble (photo NASA 2009)

- The Large Hadron Collider is a European project, built by 10,000 scientists in 100 countries. By smashing particles together at close to the speed of light, scientists hope to recreate the physical conditions which existed in the first trillionth of a second after the Big Bang.

find out more

Read Brian Cox's book : *Wonders of the Universe*

http://hubblesite.org/; http://www.nasa.gov/
Discover all aspects of space travel and research; look at the amazing pictures taken by Hubble - including the Ultra Deep Field; find out how Hubble works and hear from scientists using the telescope
http://www.streaming-madness.net/watch-online/documentary/hubble-ultra-deep-field-in-3d-hd720p/
Short video narrated by NASA scientist Tony Darnell, explains how the Ultra Deep field images were made
http://www.bigtelescopes.org.uk/
Technology and science behind other space telescope projects
http://www.lhc.ac.uk/
Details of the Large Hadron Collider and what scientists have discovered since it was switched on in 2008

questions to ask

- How do we know how old the universe is?
- How were galaxies and stars formed?
- Is life unique to our planet ?
- Is space research useful in our everyday lives?

the universe in fiction

George's Secret Key to the Universe	Lucy & Stephen Hawking
Taking Off	Jenny Moss

alternative motions: this house...

... believes the cost of space research outweighs the benefits
... would look for another planet humans can live on
... would invest in the search for extra-terrestrial life
... believes that at a time of austerity we cannot afford to do 'big science'

this house would give up non-essential flying to help curb dangerous climate change

rising temperatures

Climate change (or global warming) describes the recent increase in our planet's temperature which is caused by humans. Since the 1900s there has been a rise in the levels of 'greenhouse gases'. These gases - like carbon dioxide, methane, and nitrous oxide raise the earth's temperature by trapping energy from the sun and stopping it escaping back into space. Without any greenhouse gases the earth would be too cold for us, but in recent decades their levels have been rising at such an alarming rate that scientists predict dangerous changes to our environment.

Some of the increase in our planet's temperature can be explained by natural causes but the majority of scientists think that human activities - like burning fossil fuels (oil and coal), and chopping down forests - are mainly to blame. Methane has the strongest greenhouse effect but carbon dioxide stays in the atmosphere for ten times as long (100 years compared to 10 for methane). Governments around the world have committed to reduce carbon emissions, for example by encouraging new forms of energy for transport, industry and homes. However, progress is very slow. According to analysis of government figures (by Cambridge Econometrics) the UK has missed its 2010 target of cutting CO_2 emissions by 20% from 1990 levels.

Airplane contrails
(photo François Roche/creative commons)

As fossil fuels continue to be burnt, some countries are exploring Carbon Capture and Storage. At a coal-fired power plant, for example, carbon dioxide is separated from other waste gases, transported, and stored deep underground. At present, the process is expensive and uses up to a third more fuel.

tipping point

In 2010 global CO_2 emissions hit record levels and scientists are now warning that there's limited time left to act. They believe that climate change will reach a 'tipping point' - that is where a small increase in temperature triggers a serious change in the environment, which then sets off a bigger rise in global temperature. Once a tipping point is reached, any cuts in greenhouse gases will not be able to reverse it. For example: a huge area of western Siberia is the world's largest frozen peat-bog. It has started to melt for the first time since it was formed at the end of the last Ice Age. The fear is that, as it continues to melt, it will release billions of tonnes of methane into the atmosphere which will trigger further warming of the planet.

Earth - Antarctic sea ice
(photo NASA/Goddard Space Flight Centre)

Apart from reducing carbon emissions, are there any other options?

The world may have to find the means of adapting to a warmer climate, or come up with geo-engineering solutions as a final attempt to reverse or halt climate change. Geo-engineering - the "deliberate, large scale manipulation of the planetary environment" - is very controversial (see fast facts) as no-one knows how worldwide weather patterns could be affected.

Power station
(photo NASA/Goddard Space Flight Centre)

climate change

fast facts

- Climate change is already with us: global temperature has risen by around 0.75˚C during the last century. In the last 4 decades the earth has warmed at a faster rate. Scientists predict global temperatures could rise further, by between 1.1˚C and 6.4˚C by the end of this century.

- The organisation set up by governments to research and report on Climate Change - the IPCC (www.ipcc.ch) says that 77% of the world's energy needs could by met by renewables by mid century. If this could be achieved, it thinks the global temperature rise could be held to 2˚C.

- People in the Torres Strait Islands in Northern Australia expect to become the world's first climate change refugees as rising sea levels swamp their land.

- Geo-engineering - sometimes called climate engineering - is the idea of using technology to deliberately change the earth's climate. Some ideas include limiting the amount of sunlight reaching earth by erecting space sunshades; or by spraying reflective aerosols into the atmosphere. This option is under investigation by a team of British scientists.

find out more

The BBC's learning zone has a series of film clips you can watch **http://www.bbc.co.uk/learningzone/clips/**
http://news.bbc.co.uk/weather/hi/climate
for the latest news about climate change
http://www.metoffice.gov.uk/climate-change
http://ec.europa.eu/clima/sites/campaign/index_en.htm
Includes short film clips from teenagers across Europe on their ideas to curb climate change
http://video.nationalgeographic.com/video/player/
Use the menu to watch environment videos on the US site
http://www.transportdirect.info/Web2/JourneyPlanning/JourneyEmissionsCompare.aspx
Calculate carbon emissions by mode of transport
http://www.ted.com/talks/lee_hotz_inside_an_antarctic_time_machine.html
A video talk describing an Antarctic drilling project to find out about climate change

questions to ask

- What evidence is there that our climate is warming?
- How do scientists know global warming is due to human activity?
- Is climate change already having an impact on the planet?
- What can I do? What can governments do?
- What would have the biggest impact on reducing climate change?
- Will geo-engineering solve the problem? Who will decide what is safe?

climate change in fiction

The Carbon Diaries	Saci Lloyd
Exodus	Julie Bertagna
The Hunger Games (trilogy)	Suzanne Collins

alternative motions: this house...

...believes geo-engineering will be the only solution to climate change
...would become vegetarian to help curb climate change
...would put a limit on the world's population to help tackle climate change
...would pay developing countries to stop them using polluting industries

renewables

this house believes the government should focus energy research on renewables only

energy forever?

Renewable energy is so-called because it doesn't use up the earth's resources and can be used over and over again. What counts as renewable or 'clean' energy? Water, wind, geothermal (the earth's heat), wave, tidal, and solar energy can all be used to generate electricity.

Renewables are alternatives to fossil fuels such as oil, coal and gas which will one day run out. They don't create additional waste products (like carbon dioxide produced by burning fossil fuels; or radioactive waste from nuclear power plants).

There are two main reasons to be interested in renewables: climate change and energy security. The UK government has committed to reducing carbon dioxide emissions as part of its effort to limit climate change, but energy demand is continually rising. UK household energy use increased by 18% between 1970 and 2009. So both UK and Scottish governments have set targets for generating electricity from renewables. The Scottish government wants 80% of electricity to come from renewables by 2020.

The Intergovernmental panel on climate change (IPCC: www.ipcc.ch) suggests that as much as 77% of the world's energy needs could be met by renewables by the middle of the century if the right policies are put in place to encourage their development. Most of the 1.4 billion people who don't have electricity live in the developing world, where some of the best conditions exist for harnessing renewable energy.

Concern about having a secure energy supply is also focusing minds on renewables because fossil fuels will one day run out, and more of the world is competing for those dwindling resources.

If a country can't produce enough energy to meet its own needs it has to import energy from other countries. When demand is high, or resources are scarce, prices go up. One country could threaten to stop supplying energy to another, as happened between Russia and the Ukraine in 2006.

pros and cons

There are huge advantages to renewable energy but the technology is still relatively costly. The energy supply is sustainable but the costs are in building turbines or power stations and transporting the energy from where it is generated to where it is needed. The supply is intermittent: sunshine and wind are unpredictable: some days the wind doesn't blow or it's cloudy. Tides are absolutely predictable but the tides don't synchronise with peaks in electricity demand. So a mix of technologies will be needed.

There are other issues to be tackled: many renewable energy sources are distant from the main electricity grid, which means the grid will have to be extended. This means more pylons and additional cost to consumers.

Public opinion is another issue. Local campaign groups have fought plans to put up more electricity pylons or build wind farms, on the grounds that they adversely affect the landscape. Conservation groups have voiced concerns about the potential impact that wave, tidal and hydro projects could have on the environment and ecosystems.

Questions about intermittent supply and transport of renewable energy have led some people to argue for more nuclear power. Nuclear energy is not renewable, plants are expensive to run and there are huge problems in dealing with radioactive waste, as well as safety concerns. However, it is reliable and generating electricity from nuclear power doesn't add to carbon emissions.

Ultimately, choices will have to be made.

Solar panels (photo Greenearthenergy)

Wind turbines
(photo Angeli Mehta)

renewables

fast facts

- Of all European countries the UK gets the most suitable weather for generating renewable energy.

- Spending on renewables is growing rapidly across the world. Developed world countries invested about a third more in renewable energy in 2010 than they did in 2009.

- 101 offshore wind turbines were built around the UK coastline in the first half of 2011.

- Geothermal energy: the centre of the earth is just about as hot as the surface of the sun. That's a mind-boggling 5500˚C. But you don't have to dig that deep. Ground water in the top 15 metres can be used to heat hot water in winter and cool buildings in summer.

Geothermal bore hole house
(photo Lydurs/creative commons)

questions to ask

- How long before fossil fuels run out?
- What can replace them?
- How is renewable energy converted into electricity?
- What are the advantages and disadvantages of the various forms of renewable energy?
- Should public opinion influence investment in renewables?

find out more

http://www.bbc.co.uk/schools/gcsebitesize/geography/managing_resources/energyrev1.shtml
The BBC Bitesize site gives a complete run down of the pros and cons of different forms of energy
http://www.sciencemuseum.org.uk/exhibitions/energy/
The latest ideas on meeting our growing energy needs
The Renewable Energy Association has a useful section for students
http://www.r-e-a.net/REA/website/researchers

environment in fiction

City of Ember	Jeanne DuPrau
Hoot	Carl Hiaasen
Flush	Carl Hiaasen
Saving the Planet & Stuff	Gail Gauthier

alternative motions: this house...

...would build wind farms, wave or hydro projects regardless of what people think
...would choose nuclear as the best current option for energy supply

nanotechnology

this house believes that the potential benefits of nanotechnology outweigh the risks

the smallest scale

Think small. Think very, very small: so small you can't see it. So small it's hard to imagine.

In this field of science, things are measured in Nanometres (see fast facts). To see what's happening on the nanoscale you need incredibly powerful microscopes.

This is a huge area of study. It brings many branches of science together - from engineering to biology. It's about studying and making things on the nanoscale: sticking atoms and molecules together in new ways to make everything from computer chips to medicines. (Everything is made up of atoms including us).

At the nanoscale, materials have new properties. They're more reactive: colour, electrical conductivity and forces between particles are all different - so materials may be stronger or harder. Consider carbon: carbon nanotubes about 2 nanometres in size are 100 times stronger than steel. Or Zinc oxide, which is used in some sunscreens. Large particles of zinc oxide block harmful UV light, scatter visible light and appear white. But nanoparticles of zinc oxide don't scatter visible light because they are so small compared to the wavelength of visible light, that they appear clear. So no more smears of white when you don't rub sunscreen in properly.

nature did it first

Scientists can learn from what has evolved in nature. Engineers are exploring how the shells of marine animals withstand huge pressures, for example. This knowledge will help make lighter and stronger materials for cars and aircraft.

Nature was the inspiration for stain-resistant fabric. The leaves of plants like the Lotus or nasturtium are covered with waxy crystals only 1 nanometre in diameter. They form a coating which causes water droplets to run off the leaves, taking dirt with them. Scientists have used the idea to create nanoparticles that stick to clothing to make it repel dirt or soak up water.

At the moment scientists are adding nanoparticles to existing materials to create new products: ultimately the dream is to build materials up atom by atom, so there's no waste.

Advances in nanotechnology are making possible huge advances in biology. For example, scientists believe that the building blocks of life can all be made synthetically, so we can give new properties to bacteria so they could make things like rubber, and fuel, and even absorb greenhouse gases.

Nanotechnology will affect every area of our lives, from our food and houses to medicines and cars. Scientists imagine creating tiny preprogrammed nanoparticles - which could travel round the body, to repair damaged cells or deliver drugs to a diseased organ. Nanotechnology has been used to create the world's first artificial trachea (breathing tube) which was successfully transplanted into a patient with terminal tracheal cancer in July 2011.

Scientists at IBM have developed a nanoparticle 50,000 times smaller than a human hair which can destroy the cell walls of antibiotic-resistant bacteria. The nanoparticle works in the lab, but still has to be tested on animals. Could this spell the end for hospital superbugs, which kill hundreds of patients a year?

pros and cons

Potentially, nanotechnology offers huge benefits. But will there be unwanted side effects? As advances allow computers to get smaller and smaller, will nano-sensors we cannot see end up watching our every move?

No-one yet knows what the impact will be of tiny nanoparticles on human health, or the environment. Silver nanoparticles are already being used to make socks which destroy odour-causing bacteria; and in bandages which destroy harmful bacteria. But they also destroy useful kinds of bacteria. So what happens when they get into our water supply, or soil? Remember how small nanoparticles are - they will be able to cross cell walls in animals and in humans.

The food industry is trying to exploit nanotechnology to use in packaging to detect when foods are spoiled; and to deliver food that would change flavour, colour or nutrients as the consumer decides. Food scientists are working on less fattening fat; and even trying to build food with all the attributes we want, from the bottom up. Remember Willy Wonka's three course dinner chewing gum? Scientists now know how to achieve this, there's just the small problem of getting the taste right.

Nanotechnology - polymer art glass (photo Argonne National Laboratory)

nanotechnology

fast facts

- The nanoscale is defined as anything less than 100 nanometres. 1 nanometre = a billionth of a metre. To give you an idea of what that means: an atom is 0.1 nanometres; a piece of paper is about a million atoms thick - or 100,000 nanometres; a human hair is about 10,000 nanometres thick.

- On the nanoscale, materials have new properties: optical, magnetic, chemical and physical properties are different.

- Nature has been working at the nanoscale for a very long time, and has evolved hugely complex cellular structures.

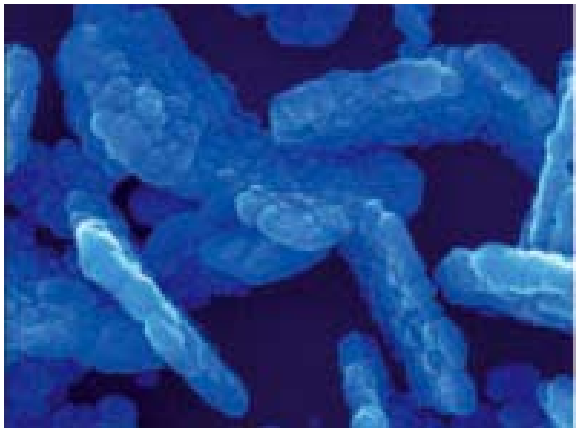
- Nanotechnology particles are already used in sunscreens; tennis racquets, self cleaning glass; anti-bacterial bandages; stain resistant clothing; solar panels; and computing (Intel has used nanotechnology to make computer chips since 2000).

- The idea to make things at the nanoscale came from the Nobel prize winning physicist Richard Feynman, way back in 1959, before any technology existed to make it a reality.

Students weigh chemicals for testing
(photo Argonne National Laboratory)

find out more

http://www.sciencemuseum.org.uk/antenna/nano/
Bite-sized and fascinating explanation of how nanotechnology is being used
http://www.at-bristol.org.uk/cz/teachers/Nano%20pairs.pdf
A pairs game to stimulate discussion on the pros and cons of nanotechnology
http://www.nanooze.org/
Cornell university site explores recent discoveries and what they might mean + Q &A sessions with young scientists
http://nobelprize.org/educational/physics/microscopes/1.html
Describes different types of microscopes and how they help scientists. You can try the techniques using simulators



Silver nanoplates (photo Argonne National Laboratory)

questions to ask

- How is nanotechnology being used?
- How could it be used?
- How will it affect us? Is it safe?
- Who decides if nanotechnology is safe?
- How do we control nanoparticles in our environment; or artificial organisms we create?
- Could we build 'better' humans?
- If nanotechnology extends healthy human life by say 10 or 20 years or more, what are the implications?

nanotechnology in fiction

Be More Chill	Ned Vizzini
The Diamond Age	Neal Stephenson

alternative motions: this house...

...would encourage nanotechnology research for human advancement
...would not use nanotechnology to create artificial life
...would use nanotechnology to monitor its citizens

stem cells

this house would ban research on embryonic stem cells

embryonic stem cells

All the cells in our bodies develop and grow from a fertilised egg. At just 4-5 days old the embryo, which is formed from the fertilised egg contains cells that can make any cell in our body. These cells divide over and over again. Then at some point they start to specialise. They have the amazing potential to become any type of cell. They become our skin, liver, bone or brain cells for example. When we are fully formed nearly all the cells in our body are specialised.

Scientists can grow this type of cell in the lab, and these cells are called embryonic STEM cells. They can multiply indefinitely, producing perfect copies of themselves every time, but can also make specialised cells when grown in different conditions.

Human embryo with inner cell mass
(photo Yorgos Nikas, Wellcome Images)

'adult' stem cells

Stem cells are also found in some adult tissues including bone marrow, muscle, skin and brain. Their job is to replace cells lost through wear and tear, or damaged by disease or injury. Stem cells in the bone marrow make new blood cells every day; skin cells make new skin cells every day. When scientists discovered these 'adult' stem cells they realised they had enormous healing potential. One of their earliest uses was to treat patients with blood diseases like leukemia.

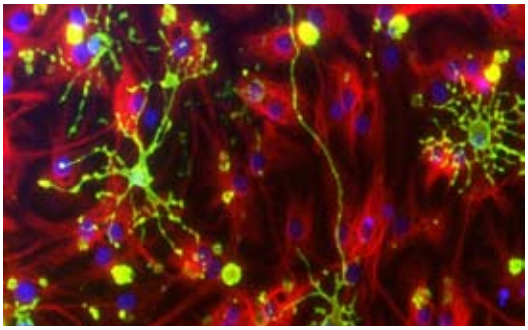
But these 'adult' stem cells can only grow into cells of the tissue in which they originate, so blood stem cells cannot specialise to become nerve cells. To study disease and to work on potential treatments scientists need to use embryonic stem cells. Cultured carefully in the lab they can produce millions of new stem cells which can then be directed to become specialised cells. They are being used to study disease and it is hoped they can one day be used to generate new tissue and organs to replace those damaged by disease or injury; to develop cures for conditions such as diabetes, multiple sclerosis, Parkinsons or Alzheimers; to test new drugs; and to treat genetic disorders.

Huge advances are being made, but scientists need to work out how to control what sort of specialised cells they can make from embryonic stem cells; how to transplant the specialised stem cells into patients to ensure they reach the tissue to be repaired; how to prevent them from multiplying to become tumours, or pass on disease; and how to ensure they are not rejected by the patient's immune system.

alternatives to embryonic stem cells?

Embryonic stem cells are made from embryos left over from fertility treatment (special stem cell banks have been set up). Using embryonic stem cells has been very controversial, because making the stem cells means destroying an embryo. Some people believe that all embryos - whether made in the lab or in the body - have the potential to become living beings and so should not be destroyed.

The question scientists began asking was whether 'adult' stem cells - or indeed any other type of cell - could be 'reprogrammed' or 'brainwashed' so they forget what type of cell they are, and can be directed to grow into something else? In 2006 a Japanese scientist managed to re-programme skin cells from a mouse. This has now also been done with human cells. Are these reprogrammed stem cells the same as embryonic stem cells? Scientists are trying to find out, so basic research still needs to be done on embryonic stem cells, while scientists continue to investigate reprogrammed stem cells.



Glial cells derived from neural stem cells
(photo Stephen Pollard, Wellcome Images)

Stem cell research (photo Wellcome Library)

stem cells

fast facts

- Embryonic stem cells, are what scientists call Pluripotent. They can specialise to become any cell in our body.

- Human embryonic stem cells come from embryos which are left over from fertility treatment; or made in the lab by the process of cloning.

- Cloning creates a genetically identical copy of an animal or plant. A sheep (called Dolly) was famously cloned at the Roslin Institute in Scotland. Cloning of humans is prohibited.

- Scientists are researching stem cells to study how tissues grow and become diseased; to develop new tissues and organs to replace damaged ones; and to discover how to cure diseases like Parkinson's, Alzheimer's, diabetes, and heart disease.

- Stem cells are already used to treat blood diseases; to make new skin for patients who have been badly burned. Many new therapies are being developed: eg stem cell trials for 150 MS patients across Europe were due to start late 2011.

- In July 2011 an artificial trachea (breathing tube) was implanted into a patient suffering from tracheal cancer. It was made in the lab and covered with stem cells taken from the patient's bone marrow. These cells grew into the types of cells found in a healthy trachea. This form of regenerative medicine holds huge potential for thousands of patients.

- Dutch scientists are trying to grow meat in the lab, from muscle stem cells. It's a slow and expensive process, so the first hamburger would cost £200,000.

questions to ask

- Does an embryo have human rights?
- Is stem cell therapy safe?
- Who decides if a therapy is safe and which patients get the treatment?
- If stem cell therapies were successful in humans and every disease or injury could be repaired- would you want to live for hundreds of years?
- Stem cell research is expensive: would it be better to spend the money in another way? for example, treating disease in poor countries .

find out more

http://www.eurostemcell.org/
Click on RESOURCES and FILMS for games, discussion and films tailored to different age groups
http://www.explorestemcells.co.uk
Has lots of articles on stem cell research including the potential of the work and possible areas of concern

cloning/gene therapy in fiction

Keep Her Safe	D.M Simons
Dr Franklin's Island	Ann Halam

alternative motions: this house...

...would not prohibit stem cell research on religious grounds
...would ban the use of stem cell technology for human enhancement
...believes scientific research and development is best pursued by private industry

esuscotland

The English-Speaking Union Scotland is an educational charity and membership organisation, dedicated to building skills and confidence in communication, through running debating and public speaking competitions and training; a creative writing competition and regular group; the teaching of English language classes; and travel scholarships for professional development.

Our successful and innovative Debates Outreach Programme has made debating skills accessible to many pupils who had never debated before, and our CPD workshops for teachers have provided a wide repertoire of approaches for cross-curricular teaching. This work was underpinned by our extensive online materials for the Learning and Teaching Scotland website, commissioned by the Scottish Government, launched in 2007.

Angeli Mehta has produced and directed science films for the BBC. Angeli first wrote about scientific issues for New Scientist and the (then) Science and Technology page of The Independent newspaper, while completing a science research PhD.

ESU Scotland
23 Atholl Crescent, Edinburgh EH3 8HQ
0131 229 1528
Scottish charity number 000653

www.speakupscotland.org.uk