Transgenic Plants: Economy, Environment and Ethics

UNIT 10

European Initiative for Biotechnology Education

Contributors to this Unit

Vic Damen (Unit Co-ordinator), Fred Brinkman, Dorte Hammelev, Margareta Johansson, Angela Kroß, Marleen Van Strydonck

The European Initiative for Biotechnology Education (EIBE) seeks to promote skills, enhance understanding and facilitate informed public debate through improved biotechnology education in schools and colleges throughout the European Union (EU).

EIBE Contacts

AUSTRIA

Rainhart Berner, Höhere Bundeslehr- und Versuchsanstalt für Chemische Industrie Wien, Abt. für Biochemie, Biotechnologie und Gentechnik, Rosensteingasse 79, A-1170 WIEN.

BELGIUM

Vic Damen / Marleen Van Strydonck, R&D Groep VEO, Afdeling Didactiek en Kritiek, Universiteit Antwerpen, Universiteitsplein 1, B-2610 WILRIJK.

DENMARK

Dorte Hammelev, Biotechnology Education Group, Foreningen af Danske Biologer, Sønderengen 20, DK-2860 SØBORG.
Lisbet Marcussen, Biotechnology Education Group, Foreningen af Danske Biologer, Lindevej 21, DK-5800 NYBORG.

EIRE

Catherine Adley / Cecily Leonard, University of Limerick, LIMERICK.

FRANCE

Gérard Coutouly, LEGTP Jean Rostand, 18 Boulevard de la Victoire, F-67084 STRASBOURG Cedex.
Laurence Simonneaux / Jean-Baptiste Puel, Ecole Nationale de Formation Agronomique, Toulouse-Auzeville, Boîte Postale 87,
F-31326 CASTANET TOLOSAN Cedex.

GERMANY

Horst Bayrhuber / Eckhard R. Lucius / Regina Rojek / Ute Harms / Angela Kroß, Institut für die Pädagogik der Naturwissenschaften an der Universität Kiel, Olshausenstraße 62, D-24098 KIEL.
Ognian Serafimov, UNESCO-INCS, c/o Jörg-Zürn-Gewerbeschule, Rauensteinstraße 17, D-88662 ÜBERLINGEN.
Eberhard Todt, Fachbereich Psychologie, Universität Gießen, Otto-Behaghel-Straße 10, D-35394 GIEßEN.

ITALY

Antonio Bargellesi-Severi /Alessandra Corda Mannino/ Stefania Uccelli , Centro di Biotecnologie Avanzate, Largo Rosanna Benzi 10 , I-16132 GENOVA.

LUXEMBOURG

John Watson, Ecole Européenne de Luxembourg, Département de Biologie, 23 Boulevard Konrad Adenauer, L-1115 LUXEMBOURG.

THE NETHERLANDS

David Bennett, Cambridge Biomedical Consultants, Schuytstraat 12, NL-2517 XE DEN HAAG.
Fred Brinkman, Hogeschool Holland, Academy for Communication, Postbus 261, NL-1110 AG DIEMEN.
Liesbeth van de Grint / Jan Frings, Hogeschool van Utrecht, Educatie Centrum voor Biotechnologie, FEO, Afdeling Exacte Vakken, Biologie, Postbus 14007, NL-3508 SB UTRECHT.

SPAIN

María Sáez Brezmes / Angela Gómez-Niño / Rosa M. Villamañán, Facultad de Educación, Universidad de Valladolid, Geologo Hernández Pacheco 1, ES-47014 VALLADOLID.

SWEDEN

Margareta Johansson, Föreningen Gensyn, PO Box 37, S-26881 SVALÖV.
Elisabeth Strömberg, Östrabo Gymnasiet, S-45181 UDDEVALLA.

THE UNITED KINGDOM

Wilbert Garvin, Northern Ireland Centre for School Biosciences, NIESU, School of Education, The Queen's University of Belfast, BELFAST, BT7 1NN.
John Grainger / John Schollar / Caroline Shearer, National Centre for Biotechnology Education, The University of Reading, PO Box 228, Whiteknights, READING, RG6 6AJ.
Jill Turner, Department of Science and Technology Studies, University College London, Gower Street, LONDON, WC1 6BT.
Paul Wymer, Society for General Microbiology, Marlborough House, Basingstoke Road, READING RG7 1AE.

EIBE Co-ordinator

Horst Bayrhuber, Institut für die Pädagogik der Naturwissenschaften an der Universität Kiel, Olshausenstraße 62, D-24098 KIEL, Germany. Telephone: + 49 (0) 431 880 3166 (EIBE Secretary: Regina Rojek). Facsimile: + 49 (0) 431 880 3132.

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MATERIALS

Contents

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World Wide Web

Few areas are developing as rapidly as biotechnology. So that they can be revised and kept up-to-date then distributed at minimum cost, the EIBE Units are published electronically.

These pages (and the other EIBE Units) are available throughout Europe and the rest of the world on the World Wide Web. They can be found at:

http://www.eibe.reading.ac.uk:8001/

All of the EIBE Units on the World Wide Web are Portable Document Format (PDF) files. This means that the high-quality illustrations, colour, typefaces and layout of these documents will be maintained, whatever computer you have (Macintosh - including Power PC, Windows, DOS or Unix platforms).

PDF files are also smaller than the files from which they were created, so that it will take less time to download documents. However, to view the EIBE Units you will need a suitable copy of the Adobe Acrobat ® Reader programme.

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With this software, you can view or print the EIBE Units. In addition, you will be able to 'navigate' around and search the documents with ease.

EIBE contributors

- Brinkman, Fred
  Vrije Universiteit Amsterdam,
  The Netherlands

- Damen, Vic (Unit Co-ordinator)
  Universitaire Instelling Antwerpen,
  Belgium

- Hammelev, Dorte
  FaDB Frederiksberg, Denmark

- Johansson, Margareta
  Föreningen Gensyn, Svalöv, Sweden

- Kroß, Angela
  IPN-Kiel, Germany

- Van Strydonck, Marleen
  Universitaire Instelling Antwerpen,
  Belgium

Design, illustration and typesetting:
Caroline Shearer, NCBE, The University of Reading, RG6 6AJ

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About EIBE Units

These materials have been devised by practising teachers and educationalists from several European countries, brought together with financial support and encouragement from DGXII of the European Commission, under the auspices of EIBE, the European Initiative for Biotechnology Education.

The EIBE materials have been extensively tested in workshops involving teachers from across Europe.

The views expressed in this Unit and the activities suggested herein are those of the authors and not of the European Commission.

INTRODUCTION

Introduction

This unit is a decision making exercise involving problem solving techniques. It confronts students, of age 15 years up, with a realistic but imaginary situation of whether or not a firm in the local community should expand its activities and start the production of transgenic plants. The proposed transgenic plants could have an impact both on the environment and on the economy of some Third World countries.

Economic, moral and social questions are the core elements of the ethical reasoning needed in this exercise. It should also increase students' knowledge about transgenic plants. Both a role play exercise or a structured debate would be good methodologies to tackle the controversial issues posed and the attitude development involved in this exercise. Materials for such a role play are included.

Objectives

Process objectives

By participating in the role play:

- students are confronted with the complexities of decision making on issues with societal impact, by considering economic, ethical, environmental, personal and even irrational issues;
- students get a better understanding about the meaning and the methodology of risk perception;
- students have the opportunity to gain communication skills by explaining and defending/promoting the point of view taken by them in their roles;
- students have the opportunity to gain insight into human interactions within a group dynamic setting.

Product objectives

Students will be able to:

- explain the basic techniques for developing transgenic plants;
- explain the problems associated with the development and exploitation of transgenic plants;
- differentiate between descriptive and normative statements used in a discussion, and use this in the process of decision making;
- differentiate between the use of a naturalistic and a personalistic way of reasoning during an argument and respect both ways.

Guidelines for the teacher

This unit is written to promote the problem solving skills of young people. Role play is suggested as a good methodology for both imparting the expected knowledge and developing problem solving skills. When considering societal issues it is particularly effective in developing decision making, value clarification and problem solving skills.

For those who are completely inexperienced with role play, Morry van Ments's book is an excellent source of information: *The effective use of role play. A handbook for teachers and trainers.* Kogan Page Ltd. London 1983 - ISBN 0 85038 700 0.

Aims of the unit

The unit sets the scene for a meeting of a town council to decide whether or not 'Honeysuckle', a local firm, will be allowed to expand its activities to include field-testing and production of transgenic plants. Initially luminous Christmas trees and coffee plants for temperate to cold climates are planned. Students participate in the role play at a public hearing and afterwards in a council meeting. Roles of mayor, aldermen, council members, interested inhabitants, experts, members of pressure groups, journalists, etc... are distributed amongst the students. The role play is concluded with a debriefing (getting rid of tensions and possible frustrations) and a discussion and analysis of the treatment of the issues.

Prior knowledge and attitudes

It is not necessary for the students to have an extensive knowledge of transgenic plants or of gene technology in general. A basic knowledge of genetics is required. Aspects of gene technology are taught during this unit (more specific information can be found in *EIBE Unit 9*).

The concepts of plant, gene and the expression of genetic traits are central scientific themes in this unit, it is therefore worthwhile evaluating the students' understanding of these concepts in a pre/post test situation (*EIBE Unit 9*). The test should not take more than 10 minutes. It is important not to help at this stage as the meaning of the test is to get an idea of preconceptions (and misconceptions). Students should be encouraged to answer the questions even if they are not sure. Results of this pre-test can be helpful during the classroom introduction of gene technology when misconceptions can be corrected.

It is also important to have an idea about the attitudes of the students towards the development and use of transgenic plants, discussion of items in the questionnaire (*EIBE Unit 9*) can form an excellent introduction to the role play.

Timing

The following teaching scheme for this unit has been tested in the classroom situation and found satisfactory. Of course, many other classroom and project approaches are still possible. Experiences, reactions and suggestions are welcomed by the unit co-ordinator.

Timing in general

Week 0: Pre-knowledge analyses. (10 min.)
Week 1: Introduction of gene technology, discussion about attitudes, introduction of the role play. (2 x 50 min.)
Week 2: Role play 1: Public hearing. (50 min.)
Week 3: Role play 2: Town council meeting + debriefing (including discussion about decision making and the problem solving process). (1 hr 40 min.)

Timing in detail

Week 0: pre-test analysis

The questionnaire (see *EIBE Unit 9*) could be used to assess conceptions and misconceptions of the terms plant, gene and the expression of genetic traits . Students should of course be notified about the purpose of the pre-test.

Week 1: Introduction of gene technology and role play (2 x 50 min)

A possible starter for this lesson could be a short outline of a real case such as the human genome project, or the use of genetically modified yeast cells in brewing. This would include a basic explanation of the fundamental concepts and processes of gene technology. Possible misconceptions revealed by the pre-test would be taken into account during this lesson.

The questionnaire (*EIBE Unit 9*) about attitudes and beliefs of students towards some societal applications of biotechnology could also be a starter for discussion about the possible benefits and disadvantages of biotechnology. After answering the questionnaire individually, the results of the group can be compared and discussed. It is then possible to evaluate the current knowledge and attitudes/beliefs of the students towards biotechnological applications in general. It is probable that normative and descriptive statements will be put forward during the discussion, together with naturalistic and personalistic ways of thinking. This is an excellent moment to spend some time analysing these ways of thinking (*Annex 9*). It will also give the students experience of the difficulty of clear decisions pro or contra particular biotechnological applications.

After the introductory lesson distribute and discuss *Annex 1: Stating the problem*. Is it possible to agree with the request from Honeysuckle or not, or is there insufficient information? A brainstorming session about the problem and possible solutions is in order. What would be the result of an immediate inquiry? Students should

consider the questions: "If you were a member of a town council, how would you vote? Yes, no or undecided? And why?" It is obviously important for the teacher to remain impartial. The written results of this session should be kept and redistributed after the role play, at the end of the debriefing, when the students will vote again. This could then be a point of reflection.

After this short discussion you can suggest that a way to consider this problem could be by taking the roles of the town council members and other interested parties. How can the problem be tackled? How would this be done in real life? A suggestion is made to hold a council meeting, but preceded by a public hearing where all the different ideas and viewpoints can be put forward and discussed.

Introduce the idea of role play. Explain how a role play works and why it is a valuable methodology, ... Make it clear to the students that a role play is not a play and that they don't have to change their personality because of the assigned role. The idea is to adapt themselves to the function of their role and to defend that function! It is important that students are convinced about the value of role play and don't see it as a game. In general this is not difficult.

Using the list on page 9, assign the roles in relation to the characters of your students. With large groups, e.g. in a school project, some roles could be allocated to small groups of 2 or 3 students who would then have to choose a spokesperson to take part in the discussion / presentation during the public hearing. Some roles are core roles (COR), others complementary (COM), their status is indicated on the list on page 9, but not on the role descriptions for the students.

Each student should be given a copy of their role description together with:
Annex 0: List of characters;
Annex 1: Setting the scene;
Annex 2: Christmas trees that glow in the dark (promotional brochure made by TGP);
Annex 3: Map of the town;
Annex 5: News article: Bright business! Fireworks in town! (good summary of the pros and cons);
Annex 8: News article: Partytime!!! (gossip news).
Some roles should receive additional information (e.g. the scientific expert gets more information about gene technology). The documents needed for each role are listed with the role descriptions.

How will the aldermen and 'interested citizens' obtain their information? The decision is very important for Smalltown, so participants will have to look for information in all available internal and external sources. The Mayor and Aldermen organise a public hearing because they want to be well informed before they take the decision and they want the population of Smalltown to be aware of the issues. This public hearing will take place next week (or later). Everyone (individuals, environmental groups, consumer groups, etc.) will get ample time to look for information and to develop an intervention strategy. Time to speak at the hearing is limited, so if it seems appropriate, information pamphlets may be prepared to put a particular case forward. Outside experts (e.g. scientists, environmentalists) could also be invited to take part. Take into account that this will take good co-ordination and more time!

Students who are chosen to be observers may be disappointed (or overjoyed, thinking that they don't have to do any work!). Stress that observers are important because they can give feedback on the role play such as the (mis)use of scientific knowledge, the different kinds of ethical reasoning or the use of different discussion techniques. In short, they can give feedback about the decision making process. As teacher you can also act as an observer and give some additional feedback during the debriefing, focusing on the original objectives of the role play.

Homework: reading the assignment and making the best possible preparations for the public hearing.

Week 3: Role play 1

Public hearing (50 min.)
The session is led by the Mayor. Bob Jensen, Judy Blakely, Tom Barker and Phil O'Brien are invited to give specialist advice. After a brief introduction from the Mayor each person has 5 minutes of presentation time. The public then has about 25 minutes time to ask questions or to make statements (maximum 4 minutes for one question and response). Experts and other individuals and groups may also distribute information sheets, brochures, pamphlets, etc. that they have prepared.

For the role play (public hearing and council meeting) the classroom has to be arranged to simulate a hearing or a council meeting as much as possible. The teacher should only interfere with the role play if it gets out of hand!

If a video-camera is available, the public hearing and the council meeting could be covered by a TV-crew (e.g. two students). Eventually two 'journalists' could each make newspaper article, one objective one and the other more 'coloured'.

If for some reason role play is not seen as the most suitable method, the materials of the unit can also be used in a more formal debate or discussion

Week 3: Role play 2

Town council meeting (50 min.)
The council meeting is held in public session but only the town council members have the right to speak. All the other students are observing the meeting from the public benches. Journalists will be reporting the meeting for their papers or magazines. The classroom should look as much as possible like the interior of a town-hall with name cards in front of the different members of the town council. The Mayor should lead the debate, each member of the town council (majority and opposition) gets a maximum of 3 minutes to explain their standpoint. The Mayor makes a summary of the different points of view and proposes a motion. Corrections can be made to the motion. After a short discussion the Mayor organises a vote. A decision is taken.

Debriefing (50 min.)
It is essential that after this initial exercise, students get the opportunity to relieve their feelings. They will need to communicate their personal emotions and frustrations about their roles to the rest of the group. The debriefing should be led by the teacher.

The second part of the debriefing deals with the decision making process. In this part it is important to allow maximum input from the observers. Their job is to assess how the decision making process went, and how it was influenced.
Suggestions:

- Interview by a (TV)-reporter of the Mayor and the Aldermen about their arguments and final decision.
- Did the role play deliver what was expected of it? What went wrong? What feelings were experienced in the various roles? What influenced the final decision?

In the third part of the debriefing discuss what has been learnt about transgenic plants and their economic, environmental and ethical significance? This understanding could be taken as a starting point for further discussions during moral education, economics, biology, etc.

At the end of the debriefing the students should 'vote' again, not in their role, but for themselves as 'responsible persons'. They should also discuss why they voted as they did. These results can be compared with the results of the vote the previous week. The differences can be discussed but may also serve as material that can be incorporated into a lesson about decision making, debate and ethical reasoning.

To finish the topic, the understanding of the concepts plant, gene and expression of genetic traits could be tested again using the questionnare *(EIBE Unit9)*.

The debriefing should take place immediately after the role play!

Roles

COR : core roles, COM : complementary roles

Role description		Student name
Mr. John Boot Mayor first commission as Mayor, lawyer	*COR*	.....
Mr. Bernard Eldershot Alderman (Finances and Economics) bookkeeper (wholesale trade organisation and local shop-keepers), divorced, responsible for attracting the distribution company	*COR*	.....
Mrs. Elisabeth Coburn Alderman (Culture and Education) language teacher, headteacher's wife, landscape painter	*COR*	.....
Mr. Bob Halsey Alderman (Agriculture and Infrastructure) married, Fred Halsey's uncle, pig farmer (family farm)	*COR*	.....
Mr. John Hopper Alderman (Environment) single, biology teacher, bee-keeper, naturalist	*COR*	.....
Ms. Carol Davies Town councillor (majority) founder environmental protection group (with Hannah Bouquet)	*COR*	.....
Mr. Dirk Sundet Town councillor (opposition) sole representative of a small political party	*COM*	.....
Mr. Erik Slimmings Town councillor (opposition) member of a strict religious group	*COR*	.....
Mr. Gus Logan Town councillor (opposition) former Mayor of Smalltown	*COM*	.....
Mr. Bob Jensen TGP director of economics in TGP, son of a local farmer	*COR*	.....
Mr. Al Reinhart TGP TGP head engineer	*COR*	.....
Ms. Judy Blakely Nat. Soc. for Environmental Protection environmental expert	*COM*	.....
Mr. Tom Barker University of Sevengreat head of the Department of Biochemistry	*COM*	.....
Mr. Ed Jones Journalist reporter for *The T-news* for 30 years	*COM*	.....
Mr. Marc Pearce - journalist freelance journalist of the gossip magazine *Hot news*	*COM*	.....
Ms. Joan Halston TV reporter freelance reporter for a local TV station	*COM*	.....
Mrs. Hannah Bouquet general public extreme environmental activist; farmer's wife, founder of an environmental protection group (with Carol Davies)	*COR*	.....
Ms. Ingrid Ball general public member of the environmental pressure group The Green Planet	*COM*	.....
Mr. Phil O'Brien general public member of the National Consumers Association	*COM*	.....
Dr. Phil O'Soffer general public Department of Ethics, National Institute of Philosophy and Ethics	*COR*	.....
Observers	*COR*	.....

ROLES

Mayor

Mr. John Boot

This is your first commission as Mayor. In your professional life you are a lawyer, but because of your political assignment your partner at the law centre has taken over. The elections will be next year. Attracting an interesting firm, with a high employment rate and a high tax-contribution to the community would be good for your image. The previous mayor Gus Logan, now an opposition member of the town council, tries every trick in the book to prevent you succeeding.

You have talked to Mr. Bob Jensen from TGP. You have discussed the benefits and costs of the transgenic factory for the town and also the possible benefits for your law firm.

However, you are an idealist and you intend to make a decision in the best interest of the town - but what would be in your best interests?

As the Mayor you are the chairman of the town council, so during the meetings (the council meeting and the public hearing) you have to keep the discussion close to the agenda and the timetable. You also have to lead the discussion, when it seems to go out of control you must intervene.

At the public hearing the following experts are invited: Bob Jensen, Judy Blakely, Tom Barker and Phil O'Brien. After a short introduction from you, each person has 5 minutes of presentation time. The public then has about 25 minutes to ask questions or to make statements (allow a maximum of 4 minutes for one question and response). Experts and other individuals and groups may also distribute information sheets, brochures, pamphlets, etc. that they have prepared. After that it is your job to make a summary of the arguments provided, both pros and cons.

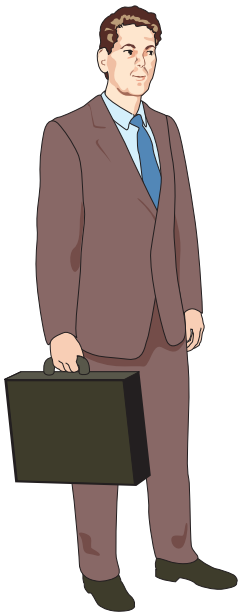
The council meeting is held in public session, this means that no one else but the town council members have the right to speak. You lead the debate. Every member of the town council (majority and opposition) gets maximum 3 minutes to explain his or her standpoint. You will make a summary of the different points of view, propose a motion to the council, allow a short further discussion and organise the vote.

Annex 0, 1, 2, 3, 5, 8

Alderman 1

Finances, economic affairs

Mr. Bernard Eldershot



Divorced. You are a bookkeeper for several local shopkeepers and for the wholesale trade organisation. In the previous council you were also Alderman for finances and economic affairs. Together with Gus Logan, the previous Mayor and your best friend, you attracted a distribution firm to the town which now causes a lot of problems in the town centre. Mrs. Davies and Mrs. Bouquet, together with other inhabitants of the town, have formed an environmental protest group. They have delivered a petition and presented many proposals to the town council for a ringway around the town.

On one hand there is the thought that this road would become possible with the taxes from the new Honeysuckle development. You are keen to get into Carol Davies' good books as you really fancy her and you have some reason to think that she is attracted to you.

On the other hand the management of the wholesale trade organisation has pointed out that they are not in favour of a new multinational firm coming to the area, as this would be in direct competition with them. Furthermore they are also doing research on transgenic plants. They have asked you to use your influence as Alderman.

Bob Jensen, in conversation, has suggested the possibility of you becoming one of the accountants of the new Honeysuckle factory.

Prepare your strategy.

Annex 0, 1, 2, 3, 4, 5, 8

Alderman 2

Education, cultural affairs

Mrs. Elisabeth Coburn

You are an English teacher and married to the head of the local secondary school. In your free time you like to paint country landscapes, flowers etc. You think that all this genetic manipulation is unnatural and would change and impoverish nature. You like the rural character of your town and are afraid that an invasion of city people would ruin this. In your opinion, nobody has the right to genetically manipulate plants or animals! For you, the heavy traffic passing the classroom every day is one of the evils of modern society. The idea of finding luminous fir trees in the beautiful forests near town horrifies you. Can you find other arguments for the conservation of a natural life without genetic manipulation?

Your husband, on the other hand, is very keen on expanding the town as this would mean more young families and more schoolchildren. The school needs this as the number on the school role has fallen and without the new plant the school will have to lose some teachers. How can you bring your husband's wishes and your own ideas in line?

Annex 0, 1, 2, 3, 4, 5, 8

Alderman 3

Agriculture, infrastructure

Mr. Bob Halsey

You are the son of a (retired) local farmer. When you took over the farm the problems with milk surpluses led you to concentrate on intensive pig rearing. The wholesale trade organisation, a branch of the multinational FU, lent you the necessary money together with a grain contract for 20 years. The contract expires in two years.

There is huge manure production from your pig farm, causing constant conflict both with your colleague John Hopper, Alderman for the environment, and with the environmental protection group led by Ms. Davies and Mrs. Bouquet.

Your brother came over to plead for his son, Fred Halsey. Fred owns a large area of arable land that could be sold to TGP for a good price but this would mean that the deposition land for your pig manure would be substantially reduced. You have your doubts about the work of TGP, messing around with God's creation must inevitably lead to catastrophe. On the other hand, a vote in favour of the Honeysuckle development would mean that John Hopper had another environmental scapegoat.

Develop a strategy to make sure that there is an alternative for the manure surplus. Perhaps Fred Halsey, TGP or someone else have something to offer. If not, be firm in rejecting TGP's proposal.

Annex 0, 1, 2, 3, 4, 5, 8

Alderman 4

Environment

Mr. John Hopper

Biology teacher at the local secondary school. Not married. Your life is devoted to nature, and especially to bee-keeping. You know about the concepts of gene technology, but you don't like all those lab biologists who don't know a thing about 'real' nature. You wonder if you will be allowed to bring your bee-hives close to the transgenic plant factory. What if pollen of manipulated plants is transferred to the wild-types?

You have been Alderman for the environment for the past 11 years. The Environmental Impact Report on the proposal gives you many reasons to oppose to the building of the factory.

In the past you have had contacts with the multinational that owns TGP. They have experimental fermenters where manure is converted to biogas. You suggested to them then that several farmers, such as Bob Halsey, could use this technique. They weren't interested because there was no market for the biogas and most of all because Bob Halsey was engaged with FU, their competitors. Perhaps the biogas could now be used by the TGP firm and Bob Halsey could be persuaded to stop depositing manure on Fred Halsey's land. For you, the building of the TGP-factory has some advantages, but also a lot of disadvantages. You are afraid that when the manipulated plants get out into the natural environment, this could lead to disruption of the ecological balance. You know something about risk assessment studies for bacteria, but not for plants. You haven't yet decided which way to vote, you will wait for the discussions in the council meeting.

Clarify the issues for yourself , is it an opportunity or a risk for the environment.

Annex 0, 1, 2, 3, 4, 5, 6, 8 + EIBE Unit 9

Town Councillors

Political majority:

Ms. Carol Davies

You formed an environmental protection group, together with Mrs. Hannah Bouquet, a farmer's wife and manager of an organic farm. The group is trying to move the heavy traffic, especially from the distribution firm, out of the town centre. You have forwarded a petition with more than 500 signatures to the Mayor and the Aldermen of Smalltown. There has never been enough money to build a ringway around town. You know that your friend, Hannah Bouquet, is against the building of the TGP development, but, as Mr. Bernard Eldershot told you privately a few days ago, this factory could bring enough money for that road and many other things. You like him, believe him and will try to convince Mrs. Bouquet that the TGP development is OK.

Annex 0, 1, 2, 3, 5, 8

Political opposition:

Mr. Dirk Sundet

You are the sole representative of a small political party. You have no specific opinion on whether or not this factory should be build. As you see it this could mean jobs, perhaps for your eldest son who is in his last year at university studying to become an engineer. You had no time to study the different reports issued over to members of the town council, so you will wait and see what comes out of the discussion. You will put up a constructive opposition.

Annex 0, 1, 2, 3, 5, 8

Mr. Erik Slimmings

You are member of a strict religious group. You believe that no one should ever try to alter the hereditary structure of a living organism, it would be going against the will of God. By manipulating genes man would be 'playing God' and showing great disrespect. You strongly oppose Alderman Bernard Eldershot because of his capitalistic tendencies.

Think about it! What points could you bring up in the discussion to argue that gene technology is against the will of God?

Annex 0, 1, 2, 3, 5, 8

Mr. Gus Logan

Previous mayor of Smalltown

Mr. Bernard Eldershot was your Alderman 1 at the previous council. Although a member of the opposite party, he is one of your best friends. Together you attracted the distribution firm to Smalltown that now causes a lot of noise and traffic problems. You still think that you should have become Mayor again instead of John Boot. You suspect him of pandering to the party officials.

Make sure that you know the dossier inside out and develop a strategy to make John Boot look foolish.

Annex 0, 1, 2, 3, 5, 8

Representing TGP

Mr. Al Reinhart

Head engineer

Information about the release of GMO's can be found in *Annex 6*, the environmental report in *Annex 4*. You must quickly find new (or old) evidence to convince the town council about the safety of the production plant.

Annex 0, 1, 2, 3, 4, 5, 6, 8 + EIBE Unit 9

Mr. Bob Jensen

Managing director - economy

You are the son of a farmer from one of the largest farms in the county. You studied economics at the University of Sevengreat and you are now one of the managing directors of the national branch of a multinational organisation TGP (TransGenic Plants). Your firm wants to find an excellent location for the production of their new transgenic plants as quick as possible. The development of the plants has cost the firm almost one billion ECU. Failure is out of the question. It is either success or total loss. But you also want your home town to profit from the huge possibilities you predict for these transgenic plants. The board of directors gave you strict instructions to do whatever it takes to get a suitable place with enough workers and in the shortest possible time!

Make a proposal to put to the council meeting outlining all the benefits for the community (financial, employment, benefits for the local trades people) to persuade them to support the request to change the designation of the required land from an agricultural to an industrial purpose. Try to anticipate opposing arguments.

Prepare expert information for use in the council meeting (5 minutes presentation time).

Annex 0, 1, 2, 3, 5, 8

Experts

Ms. Judy Blakely

Member of the National Society for Environmental Protection

Gather as much information as you can about the release of GMO's in the environment using *Annex 0, 1, 2, 3, 4, 6* and any other source you can find *(EIBE Unit 9)*.

Prepare expert information for use in the council meeting (5 minutes presentation time).

Annex: 0, 1, 2, 3, 4, 5, 6, 8 + EIBE Unit 9

Dr. Tom Barker

Senior researcher from the Department of Biochemistry, University of Sevengreat

Gather as much information as you can about the release of GMO's in the environment using *Annex 0, 1, 2, 3, 4, 6* and any other source you can find *(EIBE Unit 9)*.

Prepare expert information for use in the council meeting (5 minutes presentation time).

Annex: 0, 1, 2, 3, 4, 5, 6, 8 + EIBE Unit 9

Journalists

Mr. Ed Jones

Reporter for the local newspaper *Smalltown News*

You are in your late fifties and have been a reporter for the Smalltown news for more than 30 years. You are known as a person of high standards and can be very influential in the local community. You have a personal aversion to Bob Halsey, alderman for agriculture and infrastructure. You know that the proposed site for the factory belongs to Fred Halsey, Bob's nephew. You wrote the article Bright business! Fireworks in town! *(Annex 5)*. Write an article for your newspaper about the town council meeting. Use the notes you will take during the meeting and at the debriefing.

Annex 0, 1, 2, 3, 5, 7, 8

Ms. Joan Halston

Freelance reporter for the local TV-station, *ZTV*

You know how important the possibility for new jobs are for a local community. In your youth you saw your father lose his job and you can still feel the agony and distress that came over your family. You will try to interview the Mayor and the Aldermen after they have reached a decision. You will focus on the opportunities to create new jobs. You know little or nothing about biotechnology.

Prepare yourself for the interviews.

Annex 0, 1, 2, 3, 5, 7, 8

Mr. Marc Pearce

Freelance reporter for a gossip magazine from Smalltown *Hot News*

You think that Bob Jensen is favouring Smalltown and especially Honeysuckle because his friendship with Mrs Burton, the owners wife, dates back to their student days. You are also keen on the idea of producing luminous fir trees and will try to contact Bob Jensen to arrange publicity for these transgenic plants.

Write an article for your newspaper about the town council meeting. Use the notes you will take during the meeting and at the debriefing.

Annex 0, 1, 2, 3, 5, 7, 8

Interested individuals

Mrs. Hannah Bouquet

You are a farmers wife and an extreme environmentalist. You run an organic farm, and are completely against any form of intervention in the natural process of the transfer of genes. The fact that plants will be developed that need no pesticides and are resistant to bugs and other organisms worries you because this could mean competition for your new organic project in which you invested heavily. Of course you are smart enough not to show it at the council meeting.

Together with Carol Davies you started an environmental protection group. The group is trying to get the heavy traffic, especially from the distribution firm, out of the town centre. You have forwarded a petition with more than 500 signatures to the Mayor and the Aldermen of Smalltown. There has never been enough money to build a ringway around town.

Prepare some annoying questions for the council meeting.

Annex 0, 1, 2, 3, 5, 8

Mr. Phil O'Brien

Representative of the National Consumers Association

You see no benefit in the luminous fir tree and certainly not in the coffee plant which would ruin part of the economy of some developing Central African and Central and South American countries. You arranged a petition in Smalltown which has 425 signatories. You will hand over the petition during the council meeting.

Prepare remarks about the TGP's proposal, especially about the possible effects on third world countries. Use the newspaper articles. Prepare expert information for use in the council meeting (5 minutes presentation time).

Annex 0, 1, 2, 3, 5, 7, 8

Dr. Phil O'Soffer

Director of the National Institute of Philosophy and Ethics

You want to take part on the session about the Honeysuckle development. You love to break into the discussion to show everybody the flaws in their arguments. You are not real interested in the final decision, only in the different ways people argue.

In this role play, a controversial discussion will take place which aims at illustrating the advantages and disadvantages to the town of the proposed Honeysuckle development. In the course of the discussion the well-being of the city will not always be the priority. Many different people, for a variety of reasons, will attempt to steer the discussion in a direction which is only advantageous for themselves and hence to influence the decision of the Mayor and the Aldermen. One of the main tasks for you as an ethics expert is to find out the arguments in the discussion with a "naturalistic wrong conclusion". That is any mistaken argument, occurring in the discussion, that is based on the fact that people think that what already happens in nature can be carried out by mankind without any need for the ethics to be taken into consideration. You know this to be a false concept, the actions of humans always need ethical justification, so no arguments in the discussion should be founded on statements which contain a naturalistic wrong concept!

Annex 0, 1, 2, 3, 5, 8, 9

Ms. Ingrid Ball

Member of an environmental protection pressure group The Green Planet

You are very concerned about the possible effect of this new technology, both on the environment and on the economy of developing countries. You find support from Phil O'Brien, representative of the National Consumers Association. Look for supporting arguments in *Annex 5, 6* and any other source you think is helpful.

Annex 0, 1, 2, 3, 5, 6, 7, 8

Observers

Information for the observers

In this role play, a controversial discussion will take place which aims at illustrating the advantages and disadvantages to the town of the proposed expansion of the "Honeysuckle" firm. In the course of the discussion the well-being of the city will not always be the priority. Many different people, for a variety of reasons, will attempt to steer the discussion in a direction which is only advantageous for themselves and hence to influence the decision of the Mayor and the Aldermen.

As an observer you should analyse the discussion. In order to do this it is helpful to know that their are two different kinds of statement:

- Descriptive statements describe or depict a fact, e.g.
  The colour of a blossom of a petunia can be changed through genetic engineering.

- Normative statements evaluate a fact or an action; they state if something is to be regarded as right or wrong, e.g.
  (1) It is wrong to change the colour of petunia blossom, because it is man playing God.
  (2) People may change the colour of the blossom of petunias by genetic engineering, because a new cultivated plant is created which can bring many people pleasure and can generate profits in its production.

Tasks for the observers:

- Collect statements made by the participants during discussion. Draw up a table with pros and cons for the TGP development.

- Outline the most important arguments and prepare a summary for the debriefing.

- Decide which arguments are the most important for the councillors to consider.

- Decide which arguments are descriptive, which are normative.

Annex: 0, 1, 2, 3, 5, 8, 9

ANNEX 0

The Roles

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

Mayor
Mr. John Boot

This is his first commission as Mayor. In his professional life, he is a lawyer but because of his political assignment, his partner at the law centre has taken over. The elections will be next year.

Alderman 1 (Finances, Economics)
Mr. Bernard Eldershot

Divorced. He is a bookkeeper for several local shopkeepers and for the wholesale trade. In the previous council he was also Alderman for finances and economic affairs. Together with Gus Logan, the previous Mayor and his best friend, he attracted the distribution firm to the town that now causes a lot of problems in the town centre. Mrs. Davies and Mrs. Bouquet have formed an environmental protest group together with other inhabitants of the town to campaign against the traffic and noise. They have put forward a petition and formulated many proposals for the town council to build a ringway around the town. This road would become possible with the taxes from the new Honeysuckle development.

Alderman 2 (Education, Culture) Mrs. Elisabeth Coburn

She is an English teacher and married to the head of the local secondary school. In her free time she likes to paint a variety of country landscapes, flowers, etc.

Alderman 3 (Agriculture, Infrastructure)
Mr. Bob Halsey

He is the son of one of the small local farmers. When his father retired, he took over the farm, but because of milk surpluses he now concentrate on intensive pig rearing. The wholesale trade, branch of the multinational FU, has lent him the necessary money, together with a grain contract for 20 years. The contract expires in two years. The huge manure production from his pig-farm means that he is in constant conflict with his colleague John Hopper, Alderman for the environment, and with the environmental protection group of Ms. Davies and Mrs. Bouquet.

Alderman 4 (Environment)
Mr. John Hopper

A Biology teacher at the local secondary school. Not married. His life is devoted to nature, and especially to bee-keeping. He knows about the concepts of gene technology, but he doesn't like all those lab biologists who don't know a thing about 'real' nature. He has been Alderman for the environment for the past 11 years.

Town councillor (political majority)
Ms. Carol Davies

Together with Mrs. Hannah Bouquet, wife of a farmer and manager of an organic farm, she formed an environmental protection group. The group is trying to get the heavy traffic, especially from the distribution firm, out of the town centre. She has forwarded a petition with more than 500 signatures to the Mayor and the Aldermen of Smalltown. There has never been enough money to build a ringway around town.

Town councillor (political opposition)
Mr. Dirk Sundet

The sole representative of a small political party.

Town councillor (political opposition)
Mr. Erik Slimmings

He is member of a strict religious group.

Town councillor (previous mayor of Smalltown)
Mr. Gus Logan

Mr. Bernard Eldershot was his Alderman 1 at the previous council. Although Mr. Eldershot is a member of the opposition, he is one of his best friends. Together they attracted to Smalltown the distribution firm that now causes a lot of noise and traffic hindrance.

Mr. Al Reinhart
Head engineer at TGP.

Mr. Bob Jensen
Managing director (economics) at TGP. A farmer's son from one of the largest farms in the county. He studied economics at the university of Sevengreat and he is now one of the managing directors of the national branch of the multinational organisation TGP (TransGenic Plants). His firm wants to find an excellent location for the production of their new transgenic plants as quickly as possible. The development of the plants has cost the firm almost one billion ECU.

Ms. Judy Blakely
Member of the National Society for Environmental Protection - expert.

Dr. Tom Barker
Senior researcher from the Department of Biochemistry, University of Sevengreat - expert.

Mr. Marc Pearce
Freelance journalist for a gossip magazine from Smalltown, *Hot News*.

Ms. Joan Halston
Freelance reporter for the local TV station, *ZTV*.

Mrs. Hannah Bouquet
She is a farmers wife and an extreme environmentalist. She owns an organic farm and is completely opposed to any form of intervention in the natural process of the transfer of genes. Together with Carol Davies she started an environmental protection group. The group is trying to get the heavy traffic, especially from the distribution firm, out of the town centre. They have forwarded a petition with more than 500 signatures to the Mayor and the Aldermen of Smalltown. There has never been enough money to build a ringway around town.

Dr. Phil O'Soffer
Director of the National Institute of Philosophy and Ethics.

Mr. Phil O'Brien
Representative of the National Consumers Association. Convinced of the disadvantages of the scheme for the economy of the Third World countries, he arranged a petition in Smalltown signed by 425 people.

Mr. Ed Jones
Journalist for the local newspaper *'Smalltown News'*. He is in his late fifties and has been a reporter for the Smalltown News for more than 30 years. He is known as a person of high standards and can be very influential in the local community.

Ms. Ingrid Ball
Member of an environmental protection pressure group The Green Planet.

Observers
They observe and analyse the process of decision making.

Gossip about...

Mayor John Boot...
Next year is election time. 'Catching' an interesting firm, with a high employment rate and a high tax contribution to the community would raise his standing.

Mrs. Elisabeth Coburn...
Her husband is very keen on expanding town, because this would mean more young families and more schoolchildren. He badly needs this as the school role is falling and if permission for the expansion is not granted the school will have to lose some teachers.

Mr. Bernard Eldershot...
There is a rumour that he is in love with Carol Davies and will do anything to please her. He is also doing his best to find the money for the ringway. The Honeysuckle development could be the solution to his emotional problems.

ANNEX 1

Setting the Scene

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

Smalltown is a small rural town with a surface area of 60.5 km^2 and a population of 20,535 inhabitants. In the forties the majority of the active people of Smalltown were employed either in agriculture or in the steel factory some 50 kilometres away in Y. As a result of mechanisation in agriculture, the surpluses of milk and meat and the decline of the heavy metal industry, unemployment has gradually risen to almost 25% of the active population. In the same period, population growth stopped and even, occasionally, dropped. The population of Smalltown now shows rather an elderly demographic distribution.

The previous mayor and the council have tried to attract SMIs (small and medium sized industries); they were only successful for a storage and distribution firm and a wholesale seed trader. The latter is a branch of the multinational Farmers Union (FU) that loans money to farmers wanting to change their traditional farming into intensive rearing of pigs and poultry. The transport firm has brought in some employment but also a lot of problems (noise pollution, traffic accidents, ...). Another local firm *Honeysuckle* that specialises in growing ornamental plants is almost at the point of bankruptcy.

Honeysuckle has been a part of Smalltown for over forty years. At its height, 12 workers and 2 clerks were employed, nowadays Fred Burton, the owner, has to cope with 3 workers. He is considering whether to sell the place or to expand, but for that he needs investors.

Next year the elections for a new council will take place, the present council is very eager to attract new industries which would benefit the local tradesmen, provide more jobs, have a minimal environmental impact and perhaps bring in new inhabitants with their families.

Bob Jensen, a farmer's son from one of the biggest farms in the county studied economics at the university of Sevengreat and is now one of the managing directors of the national branch of a multinational organisation TGP (TransGenic Plants) involved with seeds, plants, fertilisers, agricultural equipment and bio-industry. His firm wants to install a production unit where transgenic plants, developed and tested on a small scale in their research centres, can be field tested and, after appropriate permission has been granted, taken into production. For that they need a large area of farming land, people who know something about farming/horticulture, housing for the scientific and administrative staff and suitable buildings.

Bob talked to the Mayor and some of the Aldermen privately. A month later, a formal application dossier was sent to the town council, requesting permission to expand *Honeysuckle* with field testing and a production unit for transgenic plants. Initially they are aiming at the production of luminous fir trees, excellent for Christmas and for bordering streets, and a transgenic coffee plant that grows effectively in our climate, even in the northern parts of Europe.

TGP has taken over *Honeysuckle*, but as this family business is so entrenched in the local community, TGP has decided to keep the name and to let Fred Burton be one of the managing directors, responsible for PR.

In view of the high intended investment cost and the favourable impact for the local community in terms of taxes, TGP has asked that the council should contribute. They have requested that they pay for the initial preparation of the building area for laboratories and office buildings, and for the construction of the roads and public utility infrastructure. An estimate of the sum involved is 300,000 ECU. For this development, TGP would buy Fred Halsey's adjacent farm land but first the designation of this farming land (in the National Land Structure Development Plan) would need to be changed to permit industrial use.

It is now up to the council meeting to decide whether or not this development will be permitted, and if yes, to stipulate the conditions.

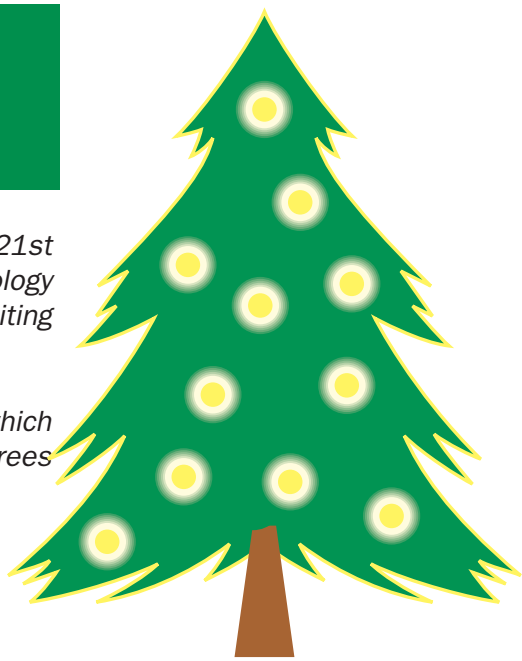
Honeysuckle

A glowing future

Honeysuckle is a modern seed company of the 21st century. New innovations within plant biotechnology have enabled us to develop novel plants with exciting new uses.

We expect great interest in our glowing trees which have potential as road markers, as Christmas trees and to increase safety in public places.

You will love our inventions!



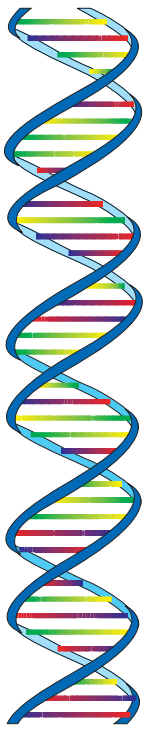
An illuminating example

Researchers at Honeysuckle have succeeded in transferring the gene responsible for the glow in the glow-worm, *Lampyris nocticula* into a fir tree, *Picea abies*. The gene codes for an enzyme that enables the organism to produce light. The energy required for the whole process is produced naturally! The energy gained from photosynthesis is directly converted to light in the trees. An economical and ecologically acceptable way to produce light .

A natural transformation process

The translocation of the "glowing" gene has been carried out using a well established system. Scientists at Honeysuckle have succeeded in introducing the gene directly into the new cell nucleus using a particle gun, a technique successfully used in other commercial crops. This particular gene has already been transferred to tobacco plants as a marker gene (attached to another gene of interest) to give a visible indication of successful gene transfer.

The Christmas trees will look like ordinary Christmas trees during the day. It is only in the dark, at night time, that our trees will glow. The Honeysuckle Christmas trees have inherited the glowing gene from both parents and a special new technique has been used to ensure that the transformed genes are only expressed in the tip of the branches. The trees are made pollen sterile to prevent the gene from spreading into the natural growing population of fir trees in the area.



The potential of glowing Christmas trees

The potential of the new tree is enormous. Honeysuckle has already been approached by several overseas companies.

The trees are of great interest as Christmas trees for families with small children. For safety reasons it is often a problem to use candles on Christmas trees. Electric lights require a wire which makes it difficult to dance around the tree without the danger of tripping over the wire. Use a safer glowing tree!

The tree has to be alive to be able to glow. The trees are delivered in pots and after use they can be kept in the garden between seasons for several years. The lovely tradition of having a Christmas tree in every home every year requires a lot of land to be occupied to produce fresh trees each year. The recyclable glowing tree is an ecologically sound solution to this problem.

Glowing trees can be planted along the roadside, hence cutting down the necessity for streetlights. Again an ecological solution which means savings for tax payers. They will also make driving safer and more comfortable.

Another potential use is to plant these trees in public parks, squares and close to public buildings or banks in order to counteract the increasing violence and burglary in the streets at night time. They will also make it easier to patrol the areas at night time.

The far northern part of Europe has very short days during winter time. For some people the lack of day light causes nervous problems that cause them to move further south. Glowing trees will be extend the hours of light and therefore give people a better quality of life in these areas. The world population is growing and it may be important that people enjoy staying in these areas.

With all these potentials, the export possibilities for the glowing tree are good and Honeysuckle expects to increase employment in the local community.

Are there any risks?

The possible risks associated with growing transgenic plants have been seriously considered by scientists and the European Commission. Strategies have been developed to overcome any problems. The aim of the risk assessment is to ensure that no unforeseen side effect emerges when the gene modified plants are introduced into nature. Three different situations are evaluated:

Possible transfer of gene material to other organisms
The environmental consequences
The health consequences

It is very important for Honeysuckle not to take any risks when growing this new crop. Before the project was launched a risk assessment was carried out along the lines of the directives from the European Union.

Our community authorities requested that several more risk assessments should be carried out. We monitored several bird populations that normally live on fir trees. They have been fed with seeds from the glowing trees. Squirrel behaviour when collecting and eating cones has also been followed. We have monitored the dispersal of self pollinated glowing fir-trees. No fir-tree found outside the test area was glowing. Taken together these tests have shown negligible risks to health or the environment.

Honeysuckle has always had good relations with the community and a personal connection to many families in this area. We are respected for our high business and working morals. Our new crop is a result of combining the expertise of some of the best specialists in the world with our old fashioned, high quality working procedures. We are therefore proud that Honeysuckle can present this novel organism to the world.

Future crops

We already have another crop under development. A cold resistant coffee plant, that enables it to be grown in areas with frost. A gene has been transferred from a flounder normally living in the sea around Greenland. Scientists have already developed cold resistant Alder trees using the same gene with very good results.

This product is part of our third world aid programme, aiming to help coffee growers by giving them a better basis for their production. At present, in the traditional production areas, coffee production goes down dramatically in cold periods. Our programme, which is supported by FAO (Food and Agriculture Organisation), will ensure that new coffee plant breeding will be carried out at Honeysuckle in co-operation with scientists from third world countries. We plan to start a small coffee production area in the north of Sweden to test selected specimens for the quality of the coffee produced.

Future products!!

Pet food that decreases the amount of droppings. Dogs often leave very annoying droppings in the wrong places. This food will be able to reduce this problem dramatically!

A special maize that can reduce the cholesterol level in the human blood. Cholesterol is the big killer in our society. This product could reduce the problem without having to alter eating habits.

Where to get more information?

We will be delighted to help you. Do not hesitate to contact us for more information and to see details of our planned development.
Please call us on: 007 557 665.

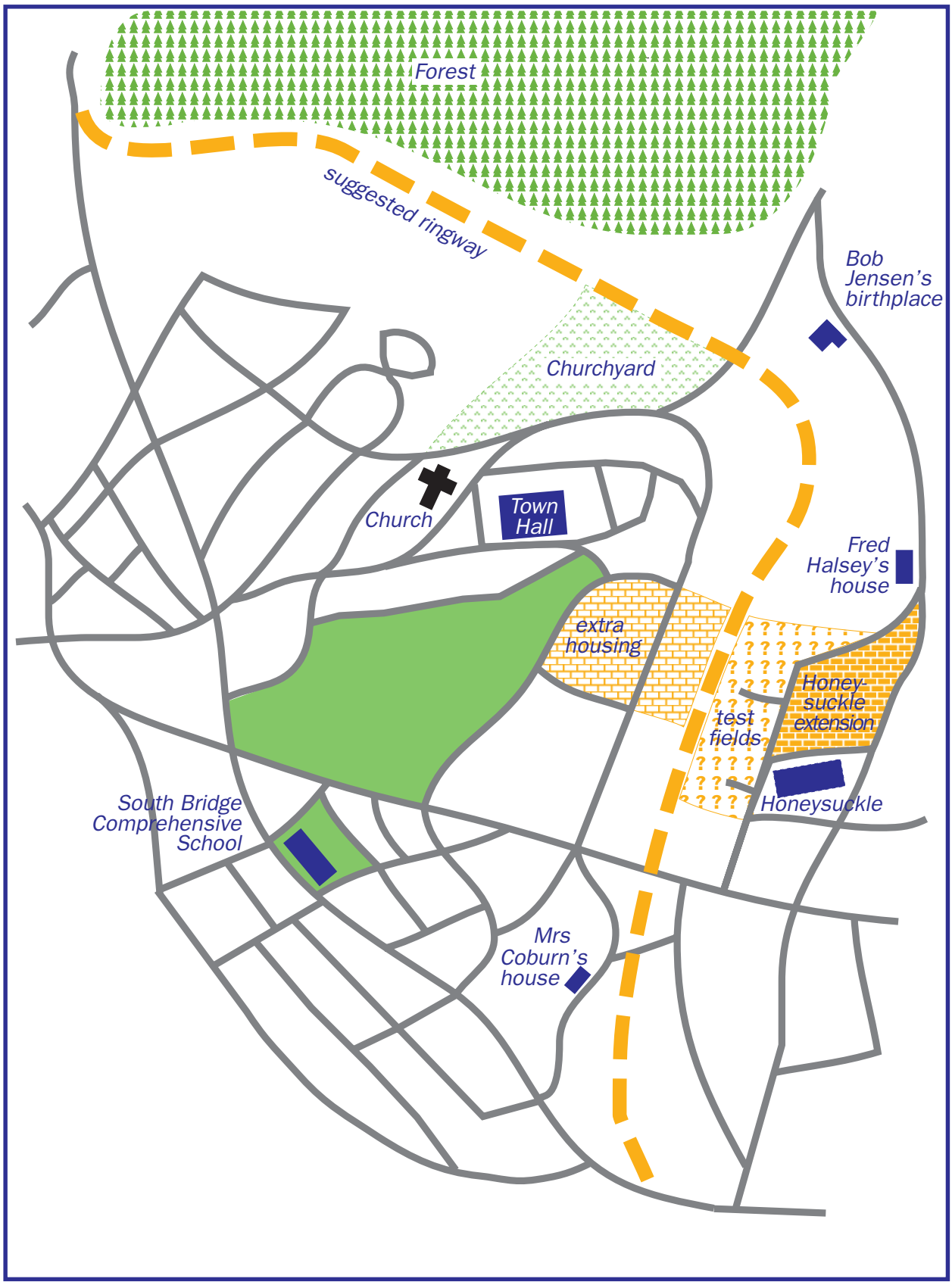
Yours sincerely

Fred Burton

Fred Burton
Managing director

ANNEX 3

Map of Smalltown



ANNEX 4

Advice to the Smalltown Council concerning the location of test fields for Honeysuckle.

Report from the Environmental Consultant

In answer to your letter at the 21st of July, I have carefully studied the data submitted by Honeysuckle and here are my comments for your consideration.

It is well recognised that a single gene modification, such as Honeysuckle's glowing gene, shows a high chance of disappearing in subsequent generations. In my view stable crop production using this technique is not ensured.

A large unknown factor is the influence of these genetically modified plants on the environment.

The introduction of monocultures in the field always goes hand in hand with extensive use of insecticides and herbicides to protect the valuable culture. This is likely to be the case with the production fields of Honeysuckle, no data on the use of these chemicals has been presented by the Honeysuckle submission.

The required change in designation of the land will cause further reduction in areas that are designated natural environment, which are already disappearing too quickly.

There is a risk of the genetically modified plants spreading into the environment and dominating the natural plant populations. The experiments carried out by Honeysuckle are too short term to exclude this possibility.

The location of these fields with glowing trees could be the beginning of a spread of glowing trees across Europe, changing the continent into an area where the difference between night and day is lost. Consequences on natural living cycles and the whole ecological balance could be disastrous. The experiments reported on the ecological impact have been carried out on far too small a scale. More experiments are needed that include night animals such as owls and mice, key plants and soil fungi and bacteria.

The risk of natural DNA transfer to other plants (that might start glowing) has not been studied sufficiently by Honeysuckle scientists. More studies are needed to discount this possibility.

Honeysuckle has not explored the health risks of their project to humans, animals or other plants.

I therefore advise the council to refuse Honeysuckle's request to use this area to grow genetically modified crops.

J. Vandenberghe

Prof. Jacques Vandenberghe
University of Sevengreat
Department of Environmental Protection

ANNEX 5

Bright Business! Fireworks in Town!

Can Smalltown regain its lost importance? The Council has our future in its hands.

from our local reporter - Ed Jones

Will Smalltown remain asleep for ever or is the sleeping beauty about to be woken?

Rumour has it that something exciting is going on in the forests and the gene technology labs but little had leaked out to the public.

At last Honeysuckle has announced:
A GLOWING FUTURE.

FIREWORKS, yes that is really what you can call it.

A brand new invention that can be of great importance for all of us living in Smalltown but also for all who are concerned about the environment. So let me enlighten you all.

Can you imagine going out to the fields on a dark hazy November afternoon and seeing all the fields aglow with Christmas trees?

Can you imagine our now dull and empty parks sparkle with beautiful light on winter nights? The light emanating from nature itself, made by the trees and giving a cosy glow.

The fields will be filled with light and the fragrance will be preferable to pigs or poultry. The manure problem that has caused so many strong feelings in the neighbourhood may be solved by the same company. This could be the end of terror in dark alleys; children can safely make their own way to outdoor activities at all times.

Yesterday, at the press conference, the managers of TGP showed us the first naturally glowing tree ever seen in the world. We were enthralled. A Christmas tree, glistering in a beautiful way without any bulbs or candles, just an enchanting light coming from the small twigs.

All of this made possible using a new and exciting technique 'gene technology'. Scientists took a gene from a glow-worm and transferred it to our common Xmas tree - and it works!

TGP, the new owners of Honeysuckle, have spent millions on research to bring this idea to the production stage in such a short time. They have established that Smalltown can offer an excellent climate, good soil conditions and the necessary water supplies. They are already familiar with the region and know that we can provide both skilled workers and experienced agricultural workers.

Some of those involved in this business are well known in Smalltown. They are well aware of the benefits to all of us if the town can make the required adjustments in infrastructure to accommodate TGP. Fields will be needed for testing as well as fields for commercial production. They also need land for new research and administration buildings.

A new product of this significance is important for the region as well as the nation. Of course Honeysuckle has consulted the government and all necessary experts concerning both legal and environmental aspects.

This town, with its beautiful surroundings, can keep its successful rural economy by these means, protected from the impact of the changes in agricultural practices that are taking place nationwide.

Experts, consulted by Honeysuckle, assured the press conference that the procedures used are well established and tested and have been used for years in laboratory conditions. If the town council supports this project and votes in its favour, Honeysuckle may have more new and exciting crops to sell that will boost both employment and the economy of Smalltown.

Beware, this is an invention of world-wide importance which could easily be established elsewhere.

ANNEX 6

The development of risk analysis for the deliberate release of genetically modified organisms: an outline of the international discussion.

N.Bergmans

Here we present an overview of the general principles of risk analysis, and of the way these principles are applied to genetically modified crop plants. The following is the personal interpretation of the author of the state of the art of the international discussion, it does not represent an official view of any of the participants in the international discussion.

Safety in biotechnology

Biotechnology is that part of technology that involves the use and exploitation of living organisms to meet the requirements of mankind. It differs from other parts of technology in the respect that it involves living organisms, posing particular practical and ethical considerations.

Safety in biotechnology is ensured by the application of risk analysis and a subsequent appropriate risk management at the different stages of development of a biotechnological product. In this paper, we will focus on the safety of GMO's (**G**enetically **M**odified **O**rganisms) as one aspect of safety in biotechnology. We will consider some of the concepts that have been developed for the safe development and use of GMO's.

Stepwise development

Like any scientific progress, the development of a GMO proceeds in a stepwise fashion through a number of stages. The concept of stepwise development has been a key concept in the discussion of safety in biotechnology. As each step is taken in this process, the relevant information of the previous stage is analysed before the step into the next stage is taken. Safety considerations are always inherently part of this process, and at each step some form of risk analysis is done, in order to decide whether the next stage can be entered and, if so, to design the risk management appropriate at the next stage.

The production of a new genetically modified plant cultivar, e.g. a potato with a bacterial gene that codes for the production of an insecticidal protein (toxin), that will cause some degree of insect resistance in the potato plant, may serve as an example of stepwise development.

The process starts with a planning stage, putting together all available knowledge on: the plant; the insects that are particular pests to the plant; the available insecticidal proteins and their specificities; the strategies to isolate the gene expressing the toxic protein; the methods available to obtain expression of the toxin in the plant at useful levels.

Subsequently there are several steps. The gene is isolated from its source organism, in this case a variant of *Bacillus thuringiensis*. It is characterised (usually its entire sequence will be determined). It is joined to genes that will govern its expression in its future host, the potato plant. The package of genetic information is then transferred to the bacterium *Agrobacterium tumefaciens*, this bacterium has the natural ability to insert genetic information into plant cells. The modified *Agrobacterium tumefaciens* is used to infect potato cells, some of which will take up the foreign DNA and integrate it into their chromosomal DNA. In this way a genetically modified potato cell is made. From each of these cells new plants can be cultured.

The next stages involve study of the performance of the genetically modified plants. Expression of the desired characteristic (production of the insecticidal toxin) is confined to particular parts of the plant, without appreciable side effects on the general growth and development of the plant. The best plants from the cells cultured are selected in growth chamber

and glass-house experiments, promising plant lines eventually being tested in field experiments.

Risk analysis in biotechnology

Risk analysis in the development of a GMO is based on the characteristics of the organism used, the introduced traits, the environment into which it is introduced, and the interaction between all these.

In general, the hazards associated with the release of a new GMO into the environment are considered to be:

- the behaviour of the GMO, its potential to behave as a weed or pest or to damage other organisms in the environment:
- the ability of the GMO to spread its new characteristics to other organisms by sexual crosses (or para-sexual processes in micro-organisms).

In the example given above, pest resistance in general is not a novel trait in potatoes, although the actual molecular mechanism of the resistance caused by expression of a bacterial toxin is novel.

Using what we know already

The hazard identification and risk assessment of a potato with a cloned *Bacillus thuringiensis* endotoxin gene may be used as an example.

Influence of the toxin on natural dispersion

Potatoes are very common in the Netherlands as a crop plant. They show no tendency at all towards natural dispersion, and potatoes have never been found to spread outside managed agricultural settings.

Insect resistance is a well-known trait in potatoes. Potatoes are relatively pest resistant because of toxic substances (glyco-alkaloids) that occur naturally throughout the genus *Solanum*. Wild *Solanum* species related to the potato (*Solanum tuberosum)* have been used as a source to cross pest resistance into the potato. This has never noticeably increased the natural spread of potatoes. There appears to be no tendency for insect resistance to increase the tendency of potato plant to spread outside the cultivated area, irrespective of the molecular mechanism of the insect resistance.

Damage to non-target organisms

The possibility that insect resistance could also damage innocuous insects, possible even endangered insect species, is an obvious hazard.

The molecular mechanism of insect resistance as found in *Bacillus thuringiensis* can be used here to help assess the associated risk. Endotoxins of *Bacillus thuringiensis* have been studied extensively. It is known that the toxins are produced by the bacterium in an inactive form, as intracellular crystals.

When insects that are sensitive to the toxin eat some of the bacteria it is known that:

- the toxin is activated by proteolytic cleavage in the gut of insects;
- the active toxin then binds to specific receptor molecules on the cell surface of epithelial cells of the insect gut.

There are many different strains of *Bacillus thuringiensis*, which form toxins that use different specific receptor molecules on the cell surface. Familiarity with the molecular mechanism therefore leads to the reasonable certainty that damaging effects of the toxin will be restricted to the group of insects for which susceptibility to the toxin has been shown.

Development of resistance to the toxin in the target organism

For this issue the expression of the trait in the organism has to be considered.

In the genetically modified plants that are equipped with a *Bacillus thuringiensis* endotoxin, the trait is usually expressed continuously and at relatively high level in the entire plant. This results in constant exposure of the target insect population to the toxin. Experiments in which the bacterium itself is sprayed on plants have shown that such a constant high exposure may lead to development of resistance in the insect population. This is a scientific

fact. Whether it is also seen as a hazard is in principle a political question. Bacterial endotoxins are seen as relatively environmentally friendly pesticides of great value, which it would be a pity to lose through the unnecessary fast development of resistance.

If this is taken to be a hazard, then the associated risk can be assessed by considering how resistance develops when bacterial endotoxins are used and by knowledge of the level of expression of the toxin in the GMO. If it turns out that expression of the toxin in the GMO is high enough to cause resistance development, it may be deemed necessary to implement risk-management practices when the GMO's are released into the environment. It may even be preferable not to release the GMO at all, but to construct better GMO's, e.g. those in which the trait is not expressed continuously, or with two different toxins that both have specificity for different receptors in the same target insect.

The case-by-case approach

Currently each release situation is judged on its own merits, in a case-by-case approach. Even so, in the international debate a certain degree of categorisation becomes apparent. Crop plants, being typically dependent on man for growth and survival, are deemed relatively safe host organisms for genetic modification. Traits that influence typical agronomic properties of crop plants will in general change the properties of the crop in a predictable way. It is a simple matter to check whether the prediction holds for the actual GMO.

In some cases, these considerations have already led to categorical statements. For instance, a bacterial gene, causing resistance to the antibiotic kanamycin, is used as a marker during the development of transgenic plants and is generally thought to be safe. The concentration of this antibiotic encountered by the GMO in the environment is not high enough to cause any selective advantage for the resistant plant, the trait will not contribute to the spread of any GMO. The trait is not likely to have any toxic effects; in fact bacteria expressing this trait are frequent, familiar guests in our gut micro-flora.

Conclusion

The development of risk-evaluation for the deliberate release of genetically modified organisms is rapidly evolving towards a rational system of hazard identification and risk assessment. The driving force behind this process is the fact that large scale release of GMO's into the environment is imminent. As this can only be permitted if and when risk evaluation has shown that there is only a negligible associated risk, there is an acute need for clear evaluation of these risks. The international discussion, that has been treated briefly above, is moving towards such a clear evaluation. Familiarity with the novel trait at the appropriate level is a key concept in this risk evaluation.

Elements for thought

On the problem of safety:

Sheldon Krimsky in (1) Ch. 2*: Risk assessment of Genetically Engineered Micro-organisms: from Genetic Reducationism to Ecological Modelling* (p. 33 - 45).

"There is no way to demonstrate that an organism is safe. All one can expect to do from a methodological standpoint is to demonstrate either that (a) an organism is hazardous or (b) when tested against various scenarios, the results falsify the conjectures that a hazard exists. The powerful legacy of Popperian philosophy (Popper 1965) has important implications for risk assessment in biotechnology, especially when we are a long way from canonical protocol" (p. 42).

A moral claim:

Brian Goodwin (1) Ch. 5: *Species as Natural Kinds that Express Distinctive Natures: the case for a moratorium on deliberate release.* (p. 73-78).

" The rapid dynamic of human history is threatening to tear apart the indispensable ties which bind us to the history of nature, which runs more slowly. For this reason, moratoria (pauses for thought) are indispensable, so that we can examine the unforseeable consequences of science, technology and progress. For such moratoria to be regulated there is a need for democratically legitimated process of institution and control with the participation of the critical public. There must be an end to the underevaluation of nature in theoretical and practical calculations which regard it as a resource that is available more or less freely. The rights of nature must be shaped in such a way that nature is taken seriously as a 'third partner' in business alongside labour and capital." (p. 78).

On uncertainty:

Soemini Kasanmoetalib (1) *Deliberate release of genetically modified organisms: applying the precautionary principle.* (p. 137-146).

"The regulatory system of deliberate release is said to fit well with the precautionary principle. The gist of this principle is said in facing uncertainties we are morally obliged to take a precautionary stance in decision-making. This presupposes that scientists involved should be experts about uncertainty and ignorance. Unfortunately scientists often disagree about uncertainty and ignorance." (p. 137).

Later from the same chapter:

"Current risk assessments are mainly structured around controlled experiments which cannot be extrapolated to the real world. Outside the controlled environment of trials, unknown parameters, non-linearities and threshold effects combine to make events unpredictable. The reductionist approach of genetic engineers, appropriate at all, only holds in closed systems. An adequate non-reductionist environmental science should allow for much uncertainty." (p. 144).

ANNEX 7

Newspaper cuttings

BIKE ACCIDENT

Last night a young boy, Jimmy H , aged 8 was hurt in a traffic accident just outside school.

The young boy was on his way home with friends after his tennis lesson, when he was run over by a teenage girl cyclist on her way home from the stables. The girl also had some injuries and is shocked from the accident. She claims that she never saw young Jimmy. Jimmy's mother says she has been complaining for years about the lack of streetlights and the heavy traffic in the centre of the town.

"This time we were lucky, but do we really need a serious accident before something is done to protect our youngsters? How long do we have to live with the dark streets and all those cars and bikes where children have to go?"

Drastic changes on Japanese stockmarket

Yesterday witnessed a quite unexpected rise on the Japanese stockmarket. It became known that Japanese researchers have succeeded in making transgenic rice which will increase the productivity by 10 %. A very contented head of the company says that after years of hard work they have finally been successful; this will soon offer solutions to the food problems for a great part of South East Asia. Even the stockmarket in Europe was affected by the news.

Canadian bird watchers puzzled

One of Canada's most beloved and popular birds, the so called "redneck", has changed its feeding habits over the last years. The redneck was known to feed only on buds and leaves of the birch-tree, but a lot of independent ornithologists have reported that they actually have seen the bird eating fir-spruces.

Local bird-watchers will now carefully follow the very common European relative looking for behavioural changes.

CANCER FROM PLANTS??

Is there a connection between a cancer found in mice and a plasmid from a plant?

The Californian cancer institute reports that there is a possible link between a special plasmid, commonly used to introduce genes into plants, and a very specific sort of cancer affecting the ears of mice.

THOSE WERE THE DAYS.....

A reunion was held on Saturday evening at the University. More than 50 ex students who graduated 10 years ago had a dinner dance. You can see Mrs. Fred Burton from Smalltown dancing with Bob Halsey. They apparently still have much in common, long after finishing their studies.

BRAZIL ECONOMY SAVED!

The government of Brazil can finally feel a bit safer. After very thorough negotiations they have managed to sell their coffee production for the next five years. A multinational company, who wants to remain anonymous, has invested in Brazil's future. Everyone is speculating on the reasons, but up till now little is known.

It means that the Brazil government can now fight inflation and invest in health and education, long wanted by the opposition. Poor farmers will no longer have to worry about one cold night destroying the entire crop and therefore their livelihood.

ART EXHIBITION

Winner from Smalltown

At the yearly art exhibition in the Museum of Smalltown, which opened last Sunday, a special award was given to our well known Mrs. Elisabeth Coburn. The jury states that *"her sensitive affection with the beautiful rural countryside brings back memories from long forgotten days of a nature in perfect harmony."*

Mrs E. Coburn is very happy with the publicity and plans to continue painting, she says she gets her inspiration from the wonderful, undisturbed natural areas close to her home.

New tragedy in Africa, what can we do?

Through the years we have regarded Africa as an overpopulated continent. For some areas this is still so, but in many countries the situation has totally changed. Some villages are almost uninhabited due to the spread of the HIV-virus and the high death rate from AIDS, leaving the very old and the very young to take care of themselves.

A volunteer, working as a missionary in one of the worst affected areas writes of her concern. *"There is nobody left to work at the coffee farms to earn the money to buy food and other essentials. Reformation is needed. The land must be given back to those actually living in the villages. A new cash crop requiring minimum investment is needed. Healthy and nutritious food crops that are very easy to grow, even for those with little or no experience of farming, are urgently required. Surely the least the rest of the world can do for Africa.*

Multinational companies should return the land to the inhabitants and provide help in the form of modern biotechnology to develop suitable crops. Also stop the luxury consumption of coffee, a habits that is increasing the problems of the third world. Every Christian person should seriously consider this huge and still growing problem. If nothing is done, the lack of balance between poor and rich will effect not only the ecology of this planet but also the chance for peace on earth."

Newspaper cutting

Partytime !!!

Glitter and glamour was prominent at the golden jubilee of the law centre Boot, Boot and Simpson. About 50 years ago John Boot Sr. set up a legal practice in Smalltown. His practice flourished and very quickly he did business with many local farmer and small traders of our community. His son, J.J. - John junior - our mayor, continued the good work of his father and brought the law centre to dizzy heights. John Simpson has temporarily taken over.

Of course both Johns were accompanied by their lovely and charming wives. The complete town council, even members of the opposition, were present.

Bernard Eldershot was busy plying Carol Davies with drinks and snacks, Carol really seemed to enjoy this and relished all the attention. Her smiles encouraged Bernard who was getting quite carried away!

Carol's best friend, Hannah Bouquet, was also present. The three of them spent a lot of time in deep discussion... about??? Was it about the accountancy of the environmental protection group, the ringway around town, or what is going on here?

Who else did we see there ?!? Al Reinhart and Bob Jensen of ... TGP !! We do know that lately Al Reinhart spent some time at the law centre, but presumably this is not to draw up a will. To be correct, both gentlemen are outsiders, although Bob Jensen was born and raised in Smalltown. So he knows the law centre, and would like to work with them but on what project? Watch out - to be continued.

Elisabeth Coburn and John Hopper gave Bob Halsey a dressing down. One must admit that pig manure does not smell as nice as a field of poppies, but I really felt sorry for Bob, poor man.

Appearances may be deceptive, from a well-informed source we learned they were not quarrelling but exchanging views, rather intensely, about genetic manipulation. Is this possible? When they went for the buffet, they seemed to be good friends.

Naturally, Gus Logan could not miss such an event although he and John Boot are not the best friends. He was mayor at the previous council and he is now in the opposition. He hates the idea that John Boot might succeed in improving employment especially after all his sucking up to party officials.

But by the end we only saw happy faces. Everybody relaxed and enjoying themselves. The Boots can look back on a ***very*** successful party!!

ANNEX 9

Gene technology and ethics

Discussions about gene technology involve many ethical questions. The morality of a technique or an action needs to be considered. Answering such a question is often difficult because there is no absolute solution. It depends on individual values. That's why it is helpful to have a structure for analysing statements and reasoning in discussions. A lot may be learnt about communication, critical reasoning, decision making and reasoned judgements.

The following notes should be applied to the points raised by different participants in the role play. Observers should make a list of the arguments and conclusions which can then be discussed at the debriefing.

Background information

Important facts should be taken into consideration in the ethical analysis of the arguments in a discussion.

Make a separation between descriptive and normative statements!
Descriptive statements describe or depict a fact, e.g.

The colour of a blossom of a petunia can be changed through genetic engineering.

Normative statements evaluate a fact or an action; they state if something is to be regarded as right or wrong, e.g.

a) It is wrong to change the colour of petunia blossom, because it is man playing God.

b) People may change the colour of the blossom of petunias by genetic engineering, because a new cultivated plant is created which can bring many people pleasure and can generate profits in its production.

These examples show that there are different ways of justifying arguments.

If you compare many different ways of putting arguments you notice that, in the end, they refer to certain fundamental values. They are based either on the wellbeing of nature (naturalistic argumentation), or on the dignity of mankind (personalistic argumentation).

There are differences between arguments, which follow a naturalistic or a personalistic way of reasoning!
For example, sentence a) corresponds with a personalistic argument. The argument refers to the value of the petunia in itself. Man has no right to interfere with nature.

Argument b) corresponds to a naturalistic argument. The consequences of changing the colour of the petunia flower could have positive effects for man, so interference is allowed.

The argument that interference should not be allowed because the risks involved in the release of petunias which have been genetically changed are difficult to estimate both for humanity and for nature, would also be naturalistic.

Both kinds of argument will probably occur side by side in the discussion. A situation will occur in which individuals have to decide for one form of argument or another and act accordingly. It should not be the aim of the discussion to convince someone to choose a particular form of argument. This would contradict the self-determination of the individual.

For a profitable discussion it is necessary to recognise the arguments in the discussion with a "naturalistic wrong conclusion". That is any argument, occurring in the discussion, that is based on the fact that people think that what already happens in nature can be carried out by mankind without any need for the ethics to be taken into consideration. This is a false concept. Arguments cannot be founded on statements which contain a naturalistic wrong concepts!

Argument types

	Naturalistic argument	*Personalistic argument*
Aim	to do justice to the well-being of mankind, respect. nature	to do justice to human dignity
Conception of man	there is no principal difference between the nature of people and the nature of other creatures and things in nature	reason, freedom and responsibility are regarded as unique and absolutely valuable human characteristics
Correct action	serve human interests, satisfy needs and fulfil wishes	in harmony with the dignity of man, i.e. with his responsible self-determination.

For example:
Some cells of ivy leaves can loose the ability to form chlorophyll due to a naturally occurring mutation. White-green (variegated) ivy leaves then develop. Such leaves can also be produced with the help of genetic engineering.

From the natural occurrence of variegated leaves among different types of plants, the conclusion should not be drawn that people should also be allowed to cause such changes in plants. The actions of humans always need an ethical justification.