  

**BIOSAFETY CURRICULUM AUDIT REPORT**

**Prepared and submitted**

**By:**

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**To:**

**The Swaziland Environment Authority (SEA)**

**Preamble**

As part of the process of mainstreaming Biotechnology and biosafety concepts into the school curriculum, it was necessary that an audit of the existing curriculum is done to ascertain the state of such concepts in the present curriculum. The curriculum audit process is important in identifying the gaps in as far as the integration process is concerned and there by indicating whether or not the integration is necessary. As part of the preparatory activities for the curriculum audit the SEA-NCC Biotechnology and Biosafety Task team developed some curriculum audit guidelines and came out with a tool which subject specialists used as a framework to ascertain the state of biotechnology and biosafety issues in the existing curriculum. Based on this tool, subject specialists made some comments and recommendations after scrutinizing each subject component. These comments are found at the end of each audited subject area.

**The Curriculum Audit Process**

The curriculum audit process took place on the 18th November, 2013 at the SEA Boardroom where subject specialists were engaged to look into the present school curriculum and ascertain the extent to which biotechnology and biosafety issues have been integrated in the school curriculum. During this day the subject specialists were first of all introduced to the whole project, its rationale and its aims as well as the curriculum audit tool and how to use it. The following subject area specialists participated in the curriculum audit process:

|  |
| --- |
| **SUBJECT AREAS & SPECIALISTS** |
| **LANGUAGE ARTS** |
| SISWATI | DUDU SIMELANE |
| ENGLISH (PRIMARY) | CYNTHIA HLOPHE |
| NEW LANGUAGE FOR LIFE | KHANYISILE SCHROEDER |
| **SCIENCE/MATHS** |
| SCIENCE (PRIMARY) | NTOMBENHLE DLAMINI |
| MATHS | MUSA HLOPHE |
| SCIENCE (SECONDARY) | THEMBELIHLE DLAMINI |
| **SOCIAL SCIENCES** |
| RELIGIOUS EDUCATION | PATIENCE MAVUSO |
| SOCIAL STUDIES | GCINA MABUZA |
| DEVELOPMENT STUDIES | ATTICIA DLADLA |
| **PRACTICAL ARTS & TECHNOLOGY** |
| PHYSICAL EDUCATION | EWARD NDLANGAMANDLA |
| PRACTICAL ARTS & TECHNOLOGY | KHANYISLE THWALA |
| OCNSUMER SCIENCE (PRIMARY & Form 1-3) | MAKHOSAZANA NYONI |
| **PRE-VOC & AGRICULTURE** |
| BUSINESS STUDIES | ROBERT KHUMALO |
| TECHNICAL STUDIES | TOLLY HLOPHE |
| HOME ECONOMICS | ABIGAIL MKHONZA |
| AGRICULTURE | EVART DLAMINI |
| **SCIENCE (Form 4-5)** |
| PHYSICS, BIOLOGY & CHEMISTRY | TURU KHUMALO |
| **AGRICULTURE (Form 1-5)** |
| AGRICULTURE | ELSON KHOZA |
| **GEOGRAPHY (Form 1-5)** |
| GEOGRAPHY | MAGDALENE THWALA |

After the subject specialists were given an orientation to how the curriculum audit tool, the curriculum audit process began where the subject specialists looked into their respective areas of specialisation.



*Subject Specialists conducting the curriculum Audit*

**Conclusion**

In the majority of subjects offered in the school curriculum it has been observed through the curriculum audit process that certain subjects land themselves more easily on to biotechnology and biosafety issues while others still have limited information related to these concepts. In subjects like Sciences, Social Studies and Agriculture at all levels of the education system topics related to biotechnology and biosafety are dealt with. However what is worth noting is that the inclusion of such topics in these syllabuses has not been guided by any framework hence the discussion of such concepts is mainly generic in nature. With the rest of the subjects offered in the school curriculum, the audit revealed that there is not much in terms of biotechnology and biosafety that has been incorporated into the present syllabus.

The audit process therefore revealed the gaps that exist in so far as these concepts are addressed in the curriculum. It is evident that there is need to outline the biotechnology and biosafety issues as this can help guide the integration process at all levels of the education system. In conducting the curriculum audit process the subject specialists used the designed audit tool and the following criteria were used to assess the availability of these key issues in the present school curriculum.

**key**

√ - there is a direct link between the biotechnology and biosafety topic and the syllabus

c/l - the topic can be easily linked to the highlighted topic of the syllabus

x - the topic is not linked to any topic, activity, text or illustration or artwork in the syllabus or social studies materials. In other words;

* there is no objective that directly links with the topics
* there is no activity that is done to address the topic in part or in full
* there is not text that addresses the topic in part on in full
* there are no illustrations that can be linked to the topic

**SOCIAL STUDIES (Grade3-7)**

| **Grade level**  |  | Grade 3 | Grade 4 | Grade 5 | Grade 6 | Grade 7 | **Extent of Coverage in the subject** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject**  | **Social studies** |
| **Aspects of biotechnology**  |  |  |  |  |  |  |  |
| Definition of biotechnology  |  | X | X | c/l | x | X | Grade 5, unit 5, lesson 1, What is technology, page 85, (*can be an added lesson e.g. lesson 4*) |
| Types of biotechnology |  | X | X | c/l | x | X |
| Traditional biotechnology |  | X | X | c/l | x | X |
| Modern biotechnology |  | X | X | c/l | x | X |
| Applications of modern biotechnology  |  | X | X | c/l | x | X |
| What are GMOs |  | X | X | x | x | X |  |
| What is DNA?* Replication
* Transcription
* Translation
* Genetic code
 |  | X | X | x | x | X |  |
| What is RNA? |  | X | X | x | x | X |  |
| How are GMOs developed* Stem cell culture
* Cloning
* Genetic engineering
 |  | X | x | x | x | X |  |
| Genetic Engineering* How is it accomplished
* What are the products
 |  | X | x | x | x | X |  |
| Benefits of GMOs  |  | X | x | x | x | X |  |
| Concerns/risks linked to GMOs |  | X | x | x | x | X |  |
| **Aspects of Biosafety**  |  |  |  |  |  |  |  |
| Definition of Biosafety |  | X | x | x | x | X |  |
| Why biosafety? |  | X | cl | x | c/l | X | * Grade 4, unit 7, lesson 2, causes and effects of pollution
* Grade 6, Unit 7, lessons 1-4, pages 108-126
 |
| * Risk assessment, risk analysis and risk management
* Socio-economic considerations
 |  | X | c/l | x | x | X | * **Grade 4**, unit 7, lesson 3, reducing pollution
 |
| **Legal instruments** |  | X | x | x | x | X |  |
| International * Convention on Biological Diversity (CBD)
* Cartegena Protocol on Biosafety (CPB)
* Nagoya-Kuala Lumpur Supplementary Protocol (NKLSP)
 |  | X | x |  | x | √ | **Grade 7***, unit 6, lesson* *1, Environmental laws, Activity 4 International Environmental Laws e.g. Convention on International Trade In Endangered Species page 148**(These conventions can be discussed in this activity of the lesson)*  |
| Scope of CBD  |  | X | x | x | x | X |  |
| Scope of CPB |  | X | x | x | x | X |  |
| Scope NKLSP |  | X | x | x | x | X |  |
| National * Biosafety/biotechnology policy
* Biosafety Act, 2012
 |  | X | cl | X | x | √ | **Grade 4**, unit6, lesson 2 on rules in the country (PB page117), objective 2 *list some national rules that govern the country***Grade 7***, unit 6, lesson* *1, Environmental laws in Swaziland- Biodiversity Conservation and management Bill 2008, Page 149-150 PB,*  |
| Biosafety Act, 2012 * Scope (what it regulates)
* Institutional arrangements
* Notification requirements
* Application process & decision making
* Labeling, documentation & identification
* Public participation
* Offences and penalties
* Liability and redress
 |  | x | x | X | x | X |  |
| COMMENT:Social Studies appears to be one the carrier subjects of biotechnology and biosafety issues in the school curriculum. Some aspects of biotechnology, biosafety and legal instruments feature in the Social Studies syllabus and instructional materials. There is also room to integrate the other aspects of biotechnology, biosafety and legal instruments that are in-line with the requirements and nature of social studies subject matter. |

**PRACTICAL ARTS & TECHNOLOGY (GRADE 3-7)**

| **Grade level**  |  | Grade 3 | Grade 4 | Grade 5 | Grade 6 | Grade 7 | **Extent of Coverage in the subject** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject**  | **Practical Arts & Technology (Grade 3-7)** |
| **Aspects of biotechnology**  |  |  |  |  |  |  |  |
| Definition of biotechnology  |  | X | X | X | X | X | Biotechnology issues can be linked to organizer 3: the environment; project 2 and 3 |
| Types of biotechnology |  | X | X | X | X | X |
| Traditional biotechnology |  |  |  | √ | X | X |
| Modern biotechnology |  | √ | c/l | c/l | c/l | c/l |
| Applications of modern biotechnology  |  |  |  |  |  |  |
| What are GMOs |  | c/l | c/l | c/l | c/l | c/l | This topic can be linked to the project done by pupils in Organizer 2; lesson 1 & 2  |
| What is DNA?* Replication
* Transcription
* Translation
* Genetic code
 |  | X | X | X | X | X |  |
| What is RNA? |  | X | X | X | X | X |  |
| How are GMOs developed* Stem cell culture
* Cloning
* Genetic engineering
 |  | X | X | X | X | X |  |
| Genetic Engineering* How is it accomplished
* What are the products
 |  | X | X | X | X | X |  |
| Benefits of GMOs  |  | √ | √ | c/l | c/l | c/l | Basic information is necessary for creative awareness.  |
| Concerns/risks linked to GMOs |  | c/l | c/l | c/l | c/l | c/l | Topic can be linked to Grade 3 project 2 & grade 4 project 1 |
| **Aspects of Biosafety**  |  |  |  |  |  |  |  |
| Definition of Biosafety |  | c/l | c/l | c/l | c/l | c/l |  |
| Why biosafety? |  | √ | √ | c/l | c/l | c/l | This can be linked to some topics in Organizer 3 and 4 in all the material |
| * Risk assessment, risk analysis and risk management
* Socio-economic considerations
 |  | c/l | c/l | c/l | √ | √ | Topic is linked to what learners learn in the material but more information can still be put and spiralled throughout the material |
| **Legal instruments** |  |  |  |  |  |  |  |
| International * Convention on Biological Diversity (CBD)
* Cartegena Protocol on Biosafety (CPB)
* Nagoya-Kuala Lumpur Supplementary Protocol (NKLSP)
 |  | X | X | X | X | X | A discussion on the environment can link well with these conventions, particularly in Organizer 3 |
| Scope of CBD  |  | X | X | X | X | X |  |
| Scope of CPB |  | X | X | X | X | X |  |
| Scope NKLSP |  | X | X | X | X | X |  |
| National * Biosafety/biotechnology policy
* Biosafety Act, 2012
 |  |  |  |  | c/l | c/l | The topic can be linked and integrated in Organizer 3 that deals with the Environment |
| Biosafety Act, 2012 * Scope (what it regulates)
* Institutional arrangements
* Notification requirements
* Application process & decision making
* Labeling, documentation & identification
* Public participation
* Offences and penalties
* Liability and redress
 |  | X | X | c/l | c/l | c/l | This aspect can be linked to lessons in Organizer 2 & 3. However basic information related to biosafety can be included in this section. |
| COMMENT:Aspects of biotechnology and biosafety can be linked to Organizer 3 which deals with “The Environment’ as well as Organizer 4 which deals with ‘Safety’ in the different lessons both in Grade 6 & 7. In grade 3-5 a lot of integration can be done as aspects of biotechnology and biosafety link very well to topics such as ‘Personal Health & Safety ‘and also Organizer 3 which also deals with the environment. It is therefore evident the there is enough room and opportunity to address issues relating to biotechnology and biosafety in the Practical Arts syllabus. |

**ENGLISH LANUAGE GRADE 1 - 7**

| **Grade level**  |  Grade 1 | Grade 2 | Grade 3 | Grade 4 | Grade 5 | Grade 6 | **Extent of Coverage in the subject** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject**  | **English Language (Grade 1-7)** |
| **Aspects of biotechnology**  |  |  |  |  |  |  |  |
| Definition of biotechnology  | X | X | X | X | X | X | This aspect of biotechnology can be linked and discussed in all grade levels particularly when discussing syllabus topics such as food, water, safety etc, which always feature in Language Arts |
| Types of biotechnology | X | X | X | X | X | X |
| Traditional biotechnology | X | X | X | X | X | X |
| Modern biotechnology | X | X | X | X | X | X |
| Applications of modern biotechnology  | X | X | X | X | X | X |
| What are GMOs | X | X | X | X | X | X | This topic can be addressed under the syllabus topic on food, water, and safety. |
| What is DNA?* Replication
* Transcription
* Translation
* Genetic code
 | X | X | X | X | X | X | This aspect of biotechnology can be linked and discussed in all grade levels particularly when discussing syllabus topics such as food, water, safety etc, which always feature in Language Arts |
| What is RNA? | X | X | X | X | X | X | This needs to be clarified and unpacked for better understanding |
| How are GMOs developed* Stem cell culture
* Cloning
* Genetic engineering
 | X | X | X | X | X | X | This section can be linked and readily integrated in syllabus topics dealing with environment, water, food & safety. These could also be integrated in children’s reading passages  |
| Genetic Engineering* How is it accomplished
* What are the products
 | X | X | X | X | X | X | Can be linked to topics such as water, food & safety |
| Benefits of GMOs  | X | X | X | X | X | X | Can be linked to topics such as water, food & safety |
| Concerns/risks linked to GMOs | X | X | X | X | X | X | Can be linked to topics such as water, food & safety |
| **Aspects of Biosafety**  |  |  |  |  |  |  |  |
| Definition of Biosafety | X | X | X | X | X | X | Can be linked to discussions on topics such as water, food & safety |
| Why biosafety? | X | X | X | X | X | X |  |
| * Risk assessment, risk analysis and risk management
* Socio-economic considerations
 | X | X | X | X | X | X | This aspect of biotechnology can be linked and discussed in all grade levels particularly when discussing syllabus topics such as food, water, safety etc, which always feature in Language Arts |
| **Legal instruments** |  |  |  |  |  |  |  |
| International * Convention on Biological Diversity (CBD)
* Cartegena Protocol on Biosafety (CPB)
* Nagoya-Kuala Lumpur Supplementary Protocol (NKLSP)
 | X | X | X | X | X | X | This aspect of biosafety can be linked and discussed in all grade levels particularly when discussing syllabus topics such as food, water, safety etc, which always feature in Language Arts |
| Scope of CBD  | X | X | X | X | X | X |  |
| Scope of CPB | X | X | X | X | X | X | Can be linked to discussions on topics such as water, food & safety |
| Scope NKLSP | X | X | X | X | X | X |  |
| National * Biosafety/biotechnology policy
* Biosafety Act, 2012
 | X | X | X | X | X | X | Can be linked to discussions on topics such as water, food & safety |
| Biosafety Act, 2012 * Scope (what it regulates)
* Institutional arrangements
* Notification requirements
* Application process & decision making
* Labeling, documentation & identification
* Public participation
* Offences and penalties
* Liability and redress
 | X | X | X | X | X | X | This aspect of biosafety can be linked and discussed in all grade levels particularly when discussing syllabus topics such as food, water, safety etc, which always feature in Language Arts |
| **COMMENT:**In the English Language curriculum content is sourced from many topical issues. When the curriculum gets revised; biotechnology issues can be treated as follows:Grade I: Could be linked with issues of Safety, Food, and Healthy eating habits.Grade 2: Could be linked with Unit 5, 6, 7 and 14Grade 3: Could be linked with Units 2, 3, 7, 15 and 17Grade 4: Could be linked with Units 5, 8, 11, 15, 16, 20, and 27Grade 5: Could be linked with Units 3, 4, 5, 7 and 12 Grade 6: Could be linked with Units 3, 5, 8, and 15Grade 7: Could be linked with Units 7, 8, 14 and 15Languages are quite flexible because of the reading and listening passages that can be manipulated to include environmental issues. Now that we are aware, we could add this information quite easily. It should be noted however, that these issues will only reflect in the learning materials since they cannot be reflected in the syllabus. This is how such issues and other topical issues are dealt with in the subject and they are used as themes or vehicles to teach language. |

**CONSUMER SCIENCE (Grade 6-7)**

| **Grade level**  |  |  |  |  | Grade 6 | Grade 7 | **Extent of Coverage in the subject** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject**  | **Consumer Science (Grade 6-7)** |
| **Aspects of biotechnology**  |  |  |  |  |  |  |  |
| Definition of biotechnology  |  |  |  |  | X | X | Aspects of biotechnology can be linked to topics dealing with bread making; brewing emahewu; raising agent; spices .g., the cream of tartar for thin sour porridge |
| Types of biotechnology |  |  |  |  | X | X |
| Traditional biotechnology |  |  |  |  | √ | √ |
| Modern biotechnology |  |  |  |  | √ | √ |
| Applications of modern biotechnology  |  |  |  |  |  |  |
| What are GMOs |  |  |  |  |  |  |  |
| What is DNA?* Replication
* Transcription
* Translation
* Genetic code
 |  |  |  |  | X | X | This topic can be linked to Nutrition and food preparation |
| What is RNA? |  |  |  |  | X | X |  |
| How are GMOs developed* Stem cell culture
* Cloning
* Genetic engineering
 |  |  |  |  | c/l | c/l | This can be linked to the discussion on common foods used at home (Under nutrition & Food Preparation) |
| Genetic Engineering* How is it accomplished
* What are the products
 |  |  |  |  | √ | √ | This topic is related to topics on under Nutrition and Food preparation |
| Benefits of GMOs  |  |  |  |  | √ | √ | Basic information for awareness |
| Concerns/risks linked to GMOs |  |  |  |  | √ | √ | Topic can be dealt with in the nutrition part and health |
| **Aspects of Biosafety**  |  |  |  |  |  |  |  |
| Definition of Biosafety |  |  |  |  |  |  | This concept can be included under environmental health and food hygiene |
| Why biosafety? |  |  |  |  | c/l | c/l | This topic can be linked to topics on health & food hygiene  |
| * Risk assessment, risk analysis and risk management
* Socio-economic considerations
 |  |  |  |  | c/l | √ | This aspect can be linked to syllabus topics like; Nutrition; food hygiene; Family resources & environmental health |
| **Legal instruments** |  |  |  |  |  |  |  |
| International * Convention on Biological Diversity (CBD)
* Cartegena Protocol on Biosafety (CPB)
* Nagoya-Kuala Lumpur Supplementary Protocol (NKLSP)
 |  |  |  |  |  |  | This aspect can be linked to syllabus topics like; Nutrition; food hygiene; Family resources & environmental health |
| Scope of CBD  |  |  |  |  |  |  | This aspect of Biosafety can be discussed in relation to food security |
| Scope of CPB |  |  |  |  |  |  | This aspect of Biosafety can be discussed in relation to food security |
| Scope NKLSP |  |  |  |  |  |  |  |
| National * Biosafety/biotechnology policy
* Biosafety Act, 2012
 |  |  |  |  |  |  | This aspect of Biosafety can be dealt with under food security |
| Biosafety Act, 2012 * Scope (what it regulates)
* Institutional arrangements
* Notification requirements
* Application process & decision making
* Labeling, documentation & identification
* Public participation
* Offences and penalties
* Liability and redress
 |  |  |  |  | c/l | c/l | This aspect of Biosafety can be dealt with under food security |
| COMMENT:Although topics on biotechnology and biosafety are not directly discussed in the material, it is possible to infuse such into the materials. This would especially be so in topics like Nutrition and Food preparation; Environmental Safety; Clothing and Textile under manufacture of man-made fabrics  |

**RELIGIOUS EDUCATION (Grade 1-7)**

| **Grade level**  |  Grade 1 | Grade 2 | Grade 3 | Grade 4 | Grade 5 | Grade 6 | Grade 7 | **Extent of Coverage in the subject** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject**  |  | **Religious Education** |
| **Aspects of biotechnology**  | X | X | X | X | X | X | X |  |
| Definition of biotechnology  | X | X | X | X | X | X | X | This topic can be linked to the Themes: Importance of Life & Religion, the family and the Community  |
| Types of biotechnology | X | X | X | X | X | X | X |
| Traditional biotechnology | X | X | X | X | X | X | X |
| Modern biotechnology | X | X | X | X | X | X | X |
| Applications of modern biotechnology  | X | X | X | X | X | X | X |
| What are GMOs | X | X | X | X | X | X | X |  |
| What is DNA?* Replication
* Transcription
* Translation
* Genetic code
 | X | X | X | X | X | X | X | This topic can also be linked to family and community |
| What is RNA? | X | X | X | X | X | X | X |  |
| How are GMOs developed* Stem cell culture
* Cloning
* Genetic engineering
 | X | X | X | X | X | X | X | This aspect of biotechnology can be linked and discussed under God’s creation and a stem on human intervention maybe added |
| Genetic Engineering* How is it accomplished
* What are the products
 | X | X | X | X | X | X | X | This topic can also be linked to family and community |
| Benefits of GMOs  | X | X | X | X | X | X | X |  |
| Concerns/risks linked to GMOs | X | X | X | X | X | X | X |  |
| **Aspects of Biosafety**  |  |  |  |  |  |  |  |  |
| Definition of Biosafety | X | X | X | X | X | X | X | Although not much is there at present but such a concept can be linked to the topic on importance of life  |
| Why biosafety? | X | X | X | X | X | X | X | This aspect of biosafety can be linked to themes on family and community |
| * Risk assessment, risk analysis and risk management
* Socio-economic considerations
 | X | X | X | X | X | X | X |  |
| **Legal instruments** |  |  |  |  |  |  |  |  |
| International * Convention on Biological Diversity (CBD)
* Cartegena Protocol on Biosafety (CPB)
* Nagoya-Kuala Lumpur Supplementary Protocol (NKLSP)
 | X | X | X | X | X | X | X | This can be linked to discussions on pastoral care in Grade 7, which has an objective which deals with organisations that help disadvantaged groups in Swaziland |
| Scope of CBD  | X | X | X | X | X | X | X |  |
| Scope of CPB | X | X | X | X | X | X | X |  |
| Scope NKLSP | X | X | X | X | X | X | X |  |
| National * Biosafety/biotechnology policy
* Biosafety Act, 2012
 | X | X | X | X | X | X | X |  |
| Biosafety Act, 2012 * Scope (what it regulates)
* Institutional arrangements
* Notification requirements
* Application process & decision making
* Labeling, documentation & identification
* Public participation
* Offences and penalties
* Liability and redress
 | X | X | X | X | X | X | X | This topic can be linked with the teaching of God in the four religions, by comparing God’s and manmade Acts/Laws on nature |
| COMMENT:Biosafety and biotechnology issues are relatively new issues and as such the existing syllabus for Religious Education has no links to such issues. Currently none of the aspects highlighted in the audit tool appear in the materials. However there is sufficient room for incorporating these issues particularly under the Theme on Importance of life. It can also be suggested that there is need to redefine Religious education to Religious Studies which will apply tools of scientific investigation, accumulation, differentiation and systematisation of information more effectively and diligently than what is currently being offered by Religious Education. This could in turn open more space for new concepts.  |

**MATHEMATICS GRADE 1-7**

|  |
| --- |
| **Subject**  |  | **Mathematics** |
| **Aspects of biotechnology**  | X | X | X | X | X | X | X |  |
| Definition of biotechnology  | X | X | X | X | X | X | X | This aspect of biotechnology does not have links with any of the Mathematical strands |
| Types of biotechnology | X | X | X | X | X | X | X |
| Traditional biotechnology | X | X | X | X | X | X | X |
| Modern biotechnology | X | X | X | X | X | X | X |
| Applications of modern biotechnology  | X | X | X | X | X | X | X |
| What are GMOs | X | X | X | X | X | X | X |  |
| What is DNA?* Replication
* Transcription
* Translation
* Genetic code
 | c/l | c/l | c/l | c/l | c/l | c/l | c/l | This section can be linked to Mathematical Investigation and problem solving |
| What is RNA? | c/l | c/l | c/l | c/l | c/l | c/l | c/l |  |
| How are GMOs developed* Stem cell culture
* Cloning
* Genetic engineering
 | X | X | X | X | X | X | X | This topic seems to be highly technical and as such cannot be linked to any Maths concept |
| Genetic Engineering* How is it accomplished
* What are the products
 | X | X | X | X | X | X | X |  |
| Benefits of GMOs  | X | X | X | X | X | X | X |  |
| Concerns/risks linked to GMOs | c/l | c/l | c/l | c/l | c/l | c/l | c/l | This topic can be linked to problem solving |
| **Aspects of Biosafety**  |  |  |  |  |  |  |  |  |
| Definition of Biosafety | X | X | X | X | X | X | X |  |
| Why biosafety? | X | X | X | X | X | X | X |  |
| * Risk assessment, risk analysis and risk management
* Socio-economic considerations
 | c/l | c/l | c/l | c/l | c/l | c/l | c/l | This topic can be linked to statistical problem solving (deciding on options) |
| **Legal instruments** |  |  |  |  |  |  |  |  |
| International * Convention on Biological Diversity (CBD)
* Cartegena Protocol on Biosafety (CPB)
* Nagoya-Kuala Lumpur Supplementary Protocol (NKLSP)
 | X | X | X | X | X | X | X | This topic seems too technical for and is not linked to any topic in the Mathematics syllabus |
| Scope of CBD  | X | X | X | X | X | X | X |  |
| Scope of CPB | X | X | X | X | X | X | X |  |
| Scope NKLSP | X | X | X | X | X | X | X |  |
| National * Biosafety/biotechnology policy
* Biosafety Act, 2012
 | X | X | X | X | X | X | X | This aspects also seems too technical for Maths concepts |
| Biosafety Act, 2012 * Scope (what it regulates)
* Institutional arrangements
* Notification requirements
* Application process & decision making
* Labeling, documentation & identification
* Public participation
* Offences and penalties
* Liability and redress
 | Xc/l | Xc/l | Xc/l | Xc/l | Xc/l | Xc/l | Xc/l | The topic on application process can be linked to problem solving in the Mathematics syllabus |
| **COMMENT:**Aspects of biotechnology and Biosafety have not been incorporated in the current Mathematics syllabus and instructional materials. However there is room to include these and integrate them particularly in the Mathematical Investigation and problem solving aspect of the materials.  |

**SCIENCE GRADE 1-7**

| **Subject**  |  | **Science** |
| --- | --- | --- |
| **Aspects of biotechnology**  |  |  |  |  |  |  |  |  |
| Definition of biotechnology  | X | X | x | x | x | x | c/l | Only the following aspects are addressed in grade 6 which theoretically introduce aspects of biotechnology. These are Technology advancements in agricultureAdvantages and disadvantages of technological advancements.Description of technology facilities used in medical services |
| Types of biotechnology | X | X | x | x | x | x | c/l |
| Traditional biotechnology | X | X | x | x | x | c/l | c/l |
| Modern biotechnology | X | X | x | x | x | ✓ | ✓ |
| Applications of modern biotechnology  | X | X | x | x | x |  ✓ |  ✓ |
| What are GMOs | X | X | x | x | x | x | x | *There is a possibility to introduce this in a simplistic way in grade 5 under the theme technology* |
| What is DNA?* Replication
* Transcription
* Translation
* Genetic code
 | X | X | x | x | ✓ | c/l | c/l | Only cells as building blocks of living things in Grade 5.*However basic concepts on what DNA is ,where it is found in the cell and what it is capable of doing can be introduced in the last two upper grades to lay foundation for in-depth information at Secondary school* |
| What is RNA? | X | X | x | x | x | x | c/l | Only the Cells structural differences are addressed in Grade 5 upon which RNA can be linked in the upper levels  |
| How are GMOs developed* Stem cell culture
* Cloning
* Genetic engineering
 | xxx | Xxxx | xxxx | xxxx | xxxx | xxx | ✓✓✓✓ | Only these aspects are covered as simplified introduction to the concepts of GMOs These include the following:  -debate issues relating to technological advancements applied to living things including organ transplants, cloning, reproduction, cosmetic applications.  |
| Genetic Engineering* How is it accomplished
* What are the products
 | X | X | x | x | xxx | xxx | xxx | *Since the electronic structure of the cell is not taught in the primary school level, it would be hard to teach concepts of genetic engineering in the primary level. hence better placed in high school after the foundation has been laid by teaching the detailed cell structure*  |
| Benefits of GMOs  | X | X | x | x | x | x | c/l | *Can be linked to the discussions of disadvantages of* technological advancements applied to living things including organ transplants, cloning, reproduction, cosmetic applications. |
| Concerns/risks linked to GMOs | X | X | x | x | x | x | c/l | *Can be linked to the discussions of disadvantages of* technological advancements applied to living things including organ transplants, cloning, reproduction, cosmetic applications |
| **Aspects of Biosafety**  |  | X | x | x | x | x | x | Even though absent in the syllabus these are possible aspects to discuss as means of dealing with the disadvantages of technological advancement on living things |
| Definition of Biosafety | X | X | x | x | x | x | x | *It is possible to introduce in a simple manner* |
| Why biosafety? | X | X | x | x | x | x | x | *It is possible to introduce in a simple manner* |
| * Risk assessment, risk analysis and risk management
* Socio-economic considerations
 | xx | Xx  | xx | xx | xx | xx | c/lc/l | *Can possibly be taught in very simple terms to link to secondary science details*Only the social aspect/ ethics are discussed within disadvantages of technological advancements applied to living things including organ transplants, cloning, reproduction, cosmetic applications in grade 7 |
| **Legal instruments** |  |  |  |  |  |  |  | *This content area is better placed in the social sciences and possibly languages so that the same child who learned about the scientific concepts involved would understand the legal aspects as well* |
| International * Convention on Biological Diversity (CBD)
* Cartegena Protocol on Biosafety (CPB)
* Nagoya-Kuala Lumpur Supplementary Protocol (NKLSP)
 | xxxx | xxxx | xxxx | xxxx | xxxx | xxxx | xxxx | *This content area is better placed in the social sciences and possibly languages so that the same child who learned about the scientific concepts involved would understand the legal aspects as well* |
| Scope of CBD  | X | X | x | x | x | x | x | see comment above |
| Scope of CPB | X | X | x | x | x | x | x | see comment above |
| Scope NKLSP | X | X | x | x | x | x | x | see comment above |
| National * Biosafety/biotechnology policy
* Biosafety Act, 2012
 | xx | xx | xx | xx | xx | xx | xx | see comment above |
| Biosafety Act, 2012 * Scope (what it regulates)
* Institutional arrangements
* Notification requirements
* Application process & decision making
* Labeling, documentation & identification
* Public participation
* Offences and penalties
* Liability and redress
 | xxxxxxxxxxxxxx | Xxxxxxxxxxxxxx | xxxxxxxxxxxxxx | xxxxxxxxxxxxxx | xxx xxxxxxxxxxxx | xxx xxxxxxxxxxxx | xxx xxxxxxxxxxx | see comment above |
| COMMENT:Even though for some of the topics there are no objectives that directly link with the topics, possibilities for integrating these important aspects are vast after the development of a matrix on such issues. The matrix would enable a reasonable spread of the issues across the different subjects and levels in the school curriculum. |

**AGRICULTURE (Grade 6-7)**

| **Grade level**  |  | Grade 3 | Grade 4 | Grade 5 | Grade 6 | Grade 7 | **Extent of Coverage in the subject** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject**  | **Agriculture (Grade 6-7)**  |
| **Aspects of biotechnology**  |  |  |  |  |  |  |  |
| Definition of biotechnology  |  |  |  |  | X | X | This topic can be linked to lesson 4 on the development of agriculture in swaziland |
| Types of biotechnology |  |  |  |  | X | X |
| Traditional biotechnology |  |  |  |  | X | X |
| Modern biotechnology |  |  |  |  | X | X |
| Applications of modern biotechnology  |  |  |  |  | X | X |
| What are GMOs |  |  |  |  | X | X |  |
| What is DNA?* Replication
* Transcription
* Translation
* Genetic code
 |  |  |  |  | X | X |  |
| What is RNA? |  |  |  |  | X | X |  |
| How are GMOs developed* Stem cell culture
* Cloning
* Genetic engineering
 |  |  |  |  | X | X |  |
| Genetic Engineering* How is it accomplished
* What are the products
 |  |  |  |  | X | X |  |
| Benefits of GMOs  |  |  |  |  | X | X | This topic can be linked to the lesson on the development of agriculture in Swaziland |
| Concerns/risks linked to GMOs |  |  |  |  | X | X |  |
| **Aspects of Biosafety**  |  |  |  |  |  |  |  |
| Definition of Biosafety |  |  |  |  | X | X |  |
| Why biosafety? |  |  |  |  | X | X |  |
| * Risk assessment, risk analysis and risk management
* Socio-economic considerations
 |  |  |  |  | X | X |  |
| **Legal instruments** |  |  |  |  | X | X |  |
| International * Convention on Biological Diversity (CBD)
* Cartegena Protocol on Biosafety (CPB)
* Nagoya-Kuala Lumpur Supplementary Protocol (NKLSP)
 |  |  |  |  | X | X |  |
| Scope of CBD  |  |  |  |  | X | X |  |
| Scope of CPB |  |  |  |  | X | X |  |
| Scope NKLSP |  |  |  |  | X | X |  |
| National * Biosafety/biotechnology policy
* Biosafety Act, 2012
 |  |  |  |  | X | X |  |
| Biosafety Act, 2012 * Scope (what it regulates)
* Institutional arrangements
* Notification requirements
* Application process & decision making
* Labeling, documentation & identification
* Public participation
* Offences and penalties
* Liability and redress
 |  |  |  |  | X | X |  |
| **COMMENT:**Most of the aspects of biotechnology and biosafety are currently not included in the Agriculture materials at primary school level. This however is a subject area where such issues can be incorporated to raise awareness to learners as they deal with crops and animals. |

**CONSUMER SCIENCE (FORM 1-3)**

| **Grade level**  |  | Form 1 | Form 2 | Form 3 |  |  | **Extent of Coverage in the subject** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject**  | **Consumer Science (From 1-3)** |
| **Aspects of biotechnology**  |  |  |  |  |  |  |  |
| Definition of biotechnology  |  | c/l | c/l | c/l |  |  | This aspect of biotechnology cam be linked to topics on bread making and food security in the syllabus |
| Types of biotechnology |  | c/l | c/l | c/l |  |  |
| Traditional biotechnology |  | √ | √ | √ |  |  |
| Modern biotechnology |  | √ | √ | √ |  |  |
| Applications of modern biotechnology  |  | √ | √ | √ |  |  |
| What are GMOs |  | c/l | c/l | c/l |  |  | This can be linked to convenience foods |
| What is DNA?* Replication
* Transcription
* Translation
* Genetic code
 |  | X | X | X |  |  |  |
| What is RNA? |  | X | X | X |  |  |  |
| How are GMOs developed* Stem cell culture
* Cloning
* Genetic engineering
 |  | X | X | X |  |  |  |
| Genetic Engineering* How is it accomplished
* What are the products
 |  | c/l | c/l | c/l |  |  | This aspect can be linked to topics on Fruits and vegetables as well discussions on Cereals |
| Benefits of GMOs  |  | c/l | c/l | c/l |  |  | This topic can be linked and discussion in the syllabus about the shelf life of foods and convenience foods |
| Concerns/risks linked to GMOs |  | √ | √ | √ |  |  |  |
| **Aspects of Biosafety**  |  |  |  |  |  |  |  |
| Definition of Biosafety |  | √ | √ | √ |  |  | Basic information which could be linked to biosafety is discussed in the syllabus |
| Why biosafety? |  | c/l | c/l | c/l |  |  | This topic can be linked to discussions on disposal of waste, water and water pollution |
| * Risk assessment, risk analysis and risk management
* Socio-economic considerations
 |  | √ | √ | √ |  |  | There are some amounts of basic information on awareness in the syllabus. However, more information can be added particularly on the socio-economic considerations when dealing with topic on food safety, health and hygiene |
| **Legal instruments** |  |  |  |  |  |  |  |
| International * Convention on Biological Diversity (CBD)
* Cartegena Protocol on Biosafety (CPB)
* Nagoya-Kuala Lumpur Supplementary Protocol (NKLSP)
 |  | X | X | X |  |  |  |
| Scope of CBD  |  | X | X | X |  |  |  |
| Scope of CPB |  | X | X | X |  |  |  |
| Scope NKLSP |  | X | X | X |  |  |  |
| National * Biosafety/biotechnology policy
* Biosafety Act, 2012
 |  | X | X | X |  |  |  |
| Biosafety Act, 2012 * Scope (what it regulates)
* Institutional arrangements
* Notification requirements
* Application process & decision making
* Labeling, documentation & identification
* Public participation
* Offences and penalties
* Liability and redress
 |  | c/l | c/l | c/l |  |  | This can also be linked to discussions on food safety as well as convenience foodsThis topic can be linked to the syllabus topic dealing with purchasing goods and convenience foods such as tinned food |
| **COMMENT:**Consumer Science as a subject lands itself well onto the issues relating to biotechnology and biosafety. This is more so because the subject deals with food and food security which is an area where GMOs are commonly found. It is however worth noting that not much has been included in the present curriculum hence there is need to improve the syllabus by mainstreaming such issues into the curriculum. This can be done in sections or topics dealing with Fibres, and Fabrics (Mna-made fabrics); Nutrition and food Preparation. |

**AGRICULTURE (FORM 1-3)**

| **Grade level**  |   | Form 1 | Form 2 | Form 3 |  |  | **Extent of Coverage in the subject** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject**  | **Agriculture (form 1-3)** |
| **Aspects of biotechnology**  |  |  |  |  |  |  |  |
| Definition of biotechnology  |  | X | X | X |  |  | Applications of modern biotechnology can be linked to farming practices which are discussed in form1, 2, & 3 |
| Types of biotechnology |  | X | X | X |  |  |
| Traditional biotechnology |  | X | X | X |  |  |
| Modern biotechnology |  | X | X | X |  |  |
| Applications of modern biotechnology  |  | c/l |  |  |  |  |
| What are GMOs |  | X | X | X |  |  |  |
| What is DNA?* Replication
* Transcription
* Translation
* Genetic code
 |  | X | X | X |  |  |  |
| What is RNA? |  | X | X | X |  |  |  |
| How are GMOs developed* Stem cell culture
* Cloning
* Genetic engineering
 |  | X | X | X |  |  |  |
| Genetic Engineering* How is it accomplished
* What are the products
 |  | X | X | X |  |  |  |
| Benefits of GMOs  |  | X | X | X |  |  |  |
| Concerns/risks linked to GMOs |  | X | X | X |  |  |  |
| **Aspects of Biosafety**  |  |  |  |  |  |  |  |
| Definition of Biosafety |  | X | X | c/l |  |  | This topic can however be linked to the topic on the control of pesticides in the syllabus |
| Why biosafety? |  | X | X | X |  |  |  |
| * Risk assessment, risk analysis and risk management
* Socio-economic considerations
 |  | X | X | X |  |  | This topic can be linked to discussions on pollution and its effects on the environment  |
| **Legal instruments** |  |  |  |  |  |  |  |
| International * Convention on Biological Diversity (CBD)
* Cartegena Protocol on Biosafety (CPB)
* Nagoya-Kuala Lumpur Supplementary Protocol (NKLSP)
 |  | X | X | X |  |  |  |
| Scope of CBD  |  | X | X | X |  |  |  |
| Scope of CPB |  | X | X | X |  |  |  |
| Scope NKLSP |  | X | X | X |  |  |  |
| National * Biosafety/biotechnology policy
* Biosafety Act, 2012
 |  | X | X | X |  |  |  |
| Biosafety Act, 2012 * Scope (what it regulates)
* Institutional arrangements
* Notification requirements
* Application process & decision making
* Labeling, documentation & identification
* Public participation
* Offences and penalties
* Liability and redress
 |  | X | X | X |  |  |  |
| **COMMENT:**Biotechnology and biosafety issues are closely related and relevant in Agriculture as a subject. The subject deals with crop and animal production where such concepts can easily be integrated. It is however worth noting that in the current syllabus used at the secondary school level such issues are not directly dealt with and thus leaving more room for the infusion of such issues.  |

**DEVELOPMENT STUDIES (FORM 1-3)**

| **Grade level**  |  | Form 1 | Form 2 | Form 3 |  |  | **Extent of Coverage in the subject** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject**  | **Development Studies** |
| **Aspects of biotechnology**  |  |  |  |  |  |  |  |
| Definition of biotechnology  |  | X | X | X |  |  | This topic can be linked to Form 2 Unit 5 on improved technology and production. Types of biotechnology can be linked to Unit 1 of Form 2 on human needs & wants. It can also be linked to unit on Health Care |
| Types of biotechnology |  | X | X | X |  |  |
| Traditional biotechnology |  | X | X | X |  |  |
| Modern biotechnology |  | X | X | X |  |  |
| Applications of modern biotechnology  |  | X | X | X |  |  |
| What are GMOs |  | X | X | X |  |  | This topic can be linked to Form 2 on improved technology |
| What is DNA?* Replication
* Transcription
* Translation
* Genetic code
 |  | X | X | X |  |  |  |
| What is RNA? |  | X | X | X |  |  |  |
| How are GMOs developed* Stem cell culture
* Cloning
* Genetic engineering
 |  | X | X | X |  |  | This can be linked to Form 1 chapter 1 on human made resources |
| Genetic Engineering* How is it accomplished
* What are the products
 |  | X | X | X |  |  | This can be linked to From 1 chapter 5 on Agriculture and crops. It can also be linked to form 2 Unit 5 chapter 2  |
| Benefits of GMOs  |  | X | X | X |  |  | This topic can be linked to Form 2 human needs & wants |
| Concerns/risks linked to GMOs |  | X | X | X |  |  | This aspect can be linked to the unit on Health & diseases in Form 3 |
| **Aspects of Biosafety**  |  |  |  |  |  |  |  |
| Definition of Biosafety |  | X | X | X |  |  | This topic can be linked to form 1 unit 4 on improving products |
| Why biosafety? |  | X | X | X |  |  |  |
| * Risk assessment, risk analysis and risk management
* Socio-economic considerations
 |  | X | X | X |  |  | Can be linked to form 1 Unit 3, chapter 1, 3, 4, 5, 6, 8 |
| **Legal instruments** |  |  |  |  |  |  |  |
| International * Convention on Biological Diversity (CBD)
* Cartegena Protocol on Biosafety (CPB)
* Nagoya-Kuala Lumpur Supplementary Protocol (NKLSP)
 |  | X | X | X |  |  |  |
| Scope of CBD  |  | X | X | X |  |  |  |
| Scope of CPB |  | X | X | X |  |  |  |
| Scope NKLSP |  | X | X | X |  |  |  |
| National * Biosafety/biotechnology policy
* Biosafety Act, 2012
 |  | X | X | X |  |  |  |
| Biosafety Act, 2012 * Scope (what it regulates)
* Institutional arrangements
* Notification requirements
* Application process & decision making
* Labeling, documentation & identification
* Public participation
* Offences and penalties
* Liability and redress
 |  | X | X | X |  |  |  |
| **COMMENT:**In the current instructional materials for Development Studies in Secondary schools in the school system, biotechnology and biosafety issues have not been incorporated. However such concepts can be infused into topics such as: changes in Swazi life; government, law & the courts; International Organizations & Trade; Resources- natural & human; Agriculture, Industry & Technology; conserving Resources; Human needs & Production of goods; Government & its tasks; as well as Environment & Health  |

**AGRICULTURE (FORM 4-5)**

| **Subject**  | **Agriculture (Form 4-5)** |
| --- | --- |
|  |  |
| **Aspects of biotechnology**  |  |  |  |  |  |  |  |
| Definition of biotechnology  |  |  |  |  | X | X | Aspects of biotechnology can be linked to the topics on farming systems 1.3 page 7; environmental influences, greenhouse effects, pollution, invasive plants, soil fertility, plant processes, reproduction in plants, weed control, pest control, disease control, livestock nutrition, livestock management, health and diseases |
| Types of biotechnology |  |  |  |  | X | X |
| Traditional biotechnology |  |  |  |  | X | X |
| Modern biotechnology |  |  |  |  | √ | √ |
| Applications of modern biotechnology  |  |  |  |  |  |  |
| What are GMOs |  |  |  |  | √ | √ | This aspect can be linked to the discussion on farming systems (new trends in hydroponics and genetically modified crops (GM) |
| What is DNA?* Replication
* Transcription
* Translation
* Genetic code
 |  |  |  |  | X | X | This topic can be handled well in the science subject  |
| What is RNA? |  |  |  |  | X | X |  |
| How are GMOs developed* Stem cell culture
* Cloning
* Genetic engineering
 |  |  |  |  | c/l | c/l | This topic can be linked to the role of research in agricultural development, topic 1.5 |
| Genetic Engineering* How is it accomplished
* What are the products
 |  |  |  |  | c/l | c/l | This aspect of biosafety can be linked to the syllabus topic that deals with the principles of breeding which is topic 5.1 on page 12 |
| Benefits of GMOs  |  |  |  |  | X | X |  |
| Concerns/risks linked to GMOs |  |  |  |  | X | X |  |
| **Aspects of Biosafety**  |  |  |  |  |  |  |  |
| Definition of Biosafety |  |  |  |  | X | X |  |
| Why biosafety? |  |  |  |  | X | X |  |
| * Risk assessment, risk analysis and risk management
* Socio-economic considerations
 |  |  |  |  | Xc/l | Xc/l | This topic can be linked to the syllabus topic on Marketing, topic 7.2 on page 15 |
| **Legal instruments** |  |  |  |  |  |  |  |
| International * Convention on Biological Diversity (CBD)
* Cartegena Protocol on Biosafety (CPB)
* Nagoya-Kuala Lumpur Supplementary Protocol (NKLSP)
 |  |  |  |  | X | X |  |
| Scope of CBD  |  |  |  |  | X | X |  |
| Scope of CPB |  |  |  |  | X | X |  |
| Scope NKLSP |  |  |  |  | X | X |  |
| National * Biosafety/biotechnology policy
* Biosafety Act, 2012
 |  |  |  |  | X | X | This topic can be linked to the discussion on national and regional policies and programmes which is topic 1.5 on page 7 of the agriculture syllabus |
| Biosafety Act, 2012 * Scope (what it regulates)
* Institutional arrangements
* Notification requirements
* Application process & decision making
* Labeling, documentation & identification
* Public participation
* Offences and penalties
* Liability and redress
 |  |  |  |  | X | X | This topic can be linked to the discussion on national and regional policies and programmes which is topic 1.5 on page 7 of the agriculture syllabus |
| **COMMENT:**There is room for integrating biotechnology and biosafety issues into the Agriculture subject at High School level. Children at this level can be able to understand the concepts. However not much is reflected in the present materials although certain topics clearly have a direct linkage to biotechnology and biosafety. Students at the senior level can therefore be introduced to a wide range of biotechnology and biosafety issues. It is evident that with the finalisation of a content matrix for such issues, curriculum development for this subject would be positively guided on the extent of integration. |

**TECHICAL STUDIES (PRE-VOC FORM 4-5**

| **Grade level**  |  |  |  |  | Form 4-5 |  | **Extent of Coverage in the subject** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject**  | **Building Construction (B.C) Form 4-5** |
| **Aspects of biotechnology**  |  |  |  |  |  |  |  |
| Definition of biotechnology  |  |  |  |  | C |  | This aspect of biotechnology can be linked to syllabus objective B.C. 1.1 & 2.1 |
| Types of biotechnology |  |  |  |  | c/l |  |
| Traditional biotechnology |  |  |  |  | X |  |
| Modern biotechnology |  |  |  |  | c/l |  |
| Applications of modern biotechnology  |  |  |  |  | X |  |
| What are GMOs |  |  |  |  | X |  |  |
| What is DNA?* Replication
* Transcription
* Translation
* Genetic code
 |  |  |  |  | X |  |  |
| What is RNA? |  |  |  |  | X |  |  |
| How are GMOs developed* Stem cell culture
* Cloning
* Genetic engineering
 |  |  |  |  | X |  |  |
| Genetic Engineering* How is it accomplished
* What are the products
 |  |  |  |  | X |  |  |
| Benefits of GMOs  |  |  |  |  | X |  |  |
| Concerns/risks linked to GMOs |  |  |  |  | c/l |  | This aspect can be linked to syllabus objective B.C 6.1-2 |
| **Aspects of Biosafety**  |  |  |  |  |  |  |  |
| Definition of Biosafety |  |  |  |  | X |  |  |
| Why biosafety? |  |  |  |  | X |  |  |
| * Risk assessment, risk analysis and risk management
* Socio-economic considerations
 |  |  |  |  | X |  |  |
| **Legal instruments** |  |  |  |  | X |  |  |
| International * Convention on Biological Diversity (CBD)
* Cartegena Protocol on Biosafety (CPB)
* Nagoya-Kuala Lumpur Supplementary Protocol (NKLSP)
 |  |  |  |  | X |  |  |
| Scope of CBD  |  |  |  |  | X |  |  |
| Scope of CPB |  |  |  |  | X |  |  |
| Scope NKLSP |  |  |  |  | X |  |  |
| National * Biosafety/biotechnology policy
* Biosafety Act, 2012
 |  |  |  |  | c/l |  | This topic can be linked to 3.1 & 3.2 in the syllabus |
| Biosafety Act, 2012 * Scope (what it regulates)
* Institutional arrangements
* Notification requirements
* Application process & decision making
* Labeling, documentation & identification
* Public participation
* Offences and penalties
* Liability and redress
 |  |  |  |  | XXXXXXX |  |  |
| COMMENT:Biotechnology and Biosafety issues in this subject can only be discussed in relation to materials such as the manufacture of materials like cement, paints, fumigants which at school level might be too early to be taught. |

**TECHNICAL STUDIES (PRE-VOC FORM 4-5)**

| **Grade level**  |  |  |  |  | Form 4-5 |  | **Extent of Coverage in the subject** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject**  | **Mechanical and Building Drafting (MBD) Form 4-5**  |
| **Aspects of biotechnology**  |  |  |  |  |  |  |  |
| Definition of biotechnology  |  |  |  |  | X |  |  |
| Types of biotechnology |  |  |  |  | X |  |
| Traditional biotechnology |  |  |  |  | X |  |
| Modern biotechnology |  |  |  |  | X |  |
| Applications of modern biotechnology  |  |  |  |  | X |  |
| What are GMOs |  |  |  |  | X |  |  |
| What is DNA?* Replication
* Transcription
* Translation
* Genetic code
 |  |  |  |  | X |  |  |
| What is RNA? |  |  |  |  | X |  |  |
| How are GMOs developed* Stem cell culture
* Cloning
* Genetic engineering
 |  |  |  |  | X |  |  |
| Genetic Engineering* How is it accomplished
* What are the products
 |  |  |  |  | X |  |  |
| Benefits of GMOs  |  |  |  |  | X |  |  |
| Concerns/risks linked to GMOs |  |  |  |  | X |  |  |
| **Aspects of Biosafety**  |  |  |  |  |  |  |  |
| Definition of Biosafety |  |  |  |  | X |  |  |
| Why biosafety? |  |  |  |  | X |  |  |
| * Risk assessment, risk analysis and risk management
* Socio-economic considerations
 |  |  |  |  | X |  |  |
| **Legal instruments** |  |  |  |  |  |  |  |
| International * Convention on Biological Diversity (CBD)
* Cartegena Protocol on Biosafety (CPB)
* Nagoya-Kuala Lumpur Supplementary Protocol (NKLSP)
 |  |  |  |  | X |  |  |
| Scope of CBD  |  |  |  |  | X |  |  |
| Scope of CPB |  |  |  |  | X |  |  |
| Scope NKLSP |  |  |  |  | X |  |  |
| National * Biosafety/biotechnology policy
* Biosafety Act, 2012
 |  |  |  |  | X |  |  |
| Biosafety Act, 2012 * Scope (what it regulates)
* Institutional arrangements
* Notification requirements
* Application process & decision making
* Labeling, documentation & identification
* Public participation
* Offences and penalties
* Liability and redress
 |  |  |  |  | X |  |  |
| **COMMENT:**A majority of the topics in the Mechanical and Building drafting syllabus for Pre-Voc is not linked to biotechnology and biosafety issues. This indicates a need for integrating such issues into the curriculum. |

**TECHNICAL STUDIES**

| **Grade level**  |  |  |  |  | Form 4-5 |  | **Extent of Coverage in the subject** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject**  | **Metal Fabrication (MF) Form 4-5** |
| **Aspects of biotechnology**  |  |  |  |  |  |  |  |
| Definition of biotechnology  |  |  |  |  | c/l |  | This topic can be linked to MF1: 1.6 |
| Types of biotechnology |  |  |  |  | X |  |
| Traditional biotechnology |  |  |  |  | X |  |
| Modern biotechnology |  |  |  |  | X |  |
| Applications of modern biotechnology  |  |  |  |  | X |  |
| What are GMOs |  |  |  |  | X |  |  |
| What is DNA?* Replication
* Transcription
* Translation
* Genetic code
 |  |  |  |  | X |  |  |
| What is RNA? |  |  |  |  | X |  |  |
| How are GMOs developed* Stem cell culture
* Cloning
* Genetic engineering
 |  |  |  |  | X |  |  |
| Genetic Engineering* How is it accomplished
* What are the products
 |  |  |  |  | X |  |  |
| Benefits of GMOs  |  |  |  |  | X |  |  |
| Concerns/risks linked to GMOs |  |  |  |  | X |  |  |
| **Aspects of Biosafety**  |  |  |  |  |  |  |  |
| Definition of Biosafety |  |  |  |  | X |  |  |
| Why biosafety? |  |  |  |  | X |  |  |
| * Risk assessment, risk analysis and risk management
* Socio-economic considerations
 |  |  |  |  | X |  |  |
| **Legal instruments** |  |  |  |  |  |  |  |
| International * Convention on Biological Diversity (CBD)
* Cartegena Protocol on Biosafety (CPB)
* Nagoya-Kuala Lumpur Supplementary Protocol (NKLSP)
 |  |  |  |  | X |  |  |
| Scope of CBD  |  |  |  |  | X |  |  |
| Scope of CPB |  |  |  |  | X |  |  |
| Scope NKLSP |  |  |  |  | X |  |  |
| National * Biosafety/biotechnology policy
* Biosafety Act, 2012
 |  |  |  |  | c/l |  | This topic can be linked to syllabus topic TF01 |
| Biosafety Act, 2012 * Scope (what it regulates)
* Institutional arrangements
* Notification requirements
* Application process & decision making
* Labeling, documentation & identification
* Public participation
* Offences and penalties
* Liability and redress
 |  |  |  |  | c/l |  | This topic can be linked to MF8: 8.1 |
| COMMENT:Biotechnology and biosafety issues can be linked to pollution and/or material recycling topics, as well as finishing products like paints and acids at a later level other than at school level. |

**TECHINAL STUDIES (PRE-VOC Form 4-5)**

| **Grade level**  |  |  |  |  | Form 4-5 |  | **Extent of Coverage in the subject** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject**  | **Woodwork and Carpentry (WC) Form 4-5** |
| **Aspects of biotechnology**  |  |  |  |  |  |  |  |
| Definition of biotechnology  |  |  |  |  | c/l |  | The definition of biotechnology can be linked to syllabus topic WC 01.6Traditional biotechnology issues can be linked to syllabus topic WC2.3 and 15.4 |
| Types of biotechnology |  |  |  |  | X |  |
| Traditional biotechnology |  |  |  |  | c/l |  |
| Modern biotechnology |  |  |  |  | X |  |
| Applications of modern biotechnology  |  |  |  |  | X |  |
| What are GMOs |  |  |  |  | X |  |  |
| What is DNA?* Replication
* Transcription
* Translation
* Genetic code
 |  |  |  |  | X |  |  |
| What is RNA? |  |  |  |  | X |  |  |
| How are GMOs developed* Stem cell culture
* Cloning
* Genetic engineering
 |  |  |  |  | X |  |  |
| Genetic Engineering* How is it accomplished
* What are the products
 |  |  |  |  | X |  |  |
| Benefits of GMOs  |  |  |  |  | X |  |  |
| Concerns/risks linked to GMOs |  |  |  |  | c/l |  | This aspect can be linked to syllabus topic WC 6.5 |
| **Aspects of Biosafety**  |  |  |  |  |  |  |  |
| Definition of Biosafety |  |  |  |  | X |  |  |
| Why biosafety? |  |  |  |  | X |  |  |
| * Risk assessment, risk analysis and risk management
* Socio-economic considerations
 |  |  |  |  | X |  |  |
| **Legal instruments** |  |  |  |  |  |  |  |
| International * Convention on Biological Diversity (CBD)
* Cartegena Protocol on Biosafety (CPB)
* Nagoya-Kuala Lumpur Supplementary Protocol (NKLSP)
 |  |  |  |  | X |  |  |
| Scope of CBD  |  |  |  |  | X |  |  |
| Scope of CPB |  |  |  |  | X |  |  |
| Scope NKLSP |  |  |  |  | X |  |  |
| National * Biosafety/biotechnology policy
* Biosafety Act, 2012
 |  |  |  |  | c/l |  | This can be linked to syllabus topic TF01 |
| Biosafety Act, 2012 * Scope (what it regulates)
* Institutional arrangements
* Notification requirements
* Application process & decision making
* Labeling, documentation & identification
* Public participation
* Offences and penalties
* Liability and redress
 |  |  |  |  | c/l |  | This aspect of biosafety can be linked to syllabus topic WC08:81 |
| COMMENT:Timber technology at this level does not include the growing and breeding of timber trees and wood science. Therefore biotechnology and biosafety issues would be best linked to post-secondary level. |

**SCIENCE FORM 4-5**

| **Grade level**  |  |  |  | Form 4 | Form 5 |  | **Extent of Coverage in the subject** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject**  | **PHYSICS (Form 4-5)** |
| **Aspects of biotechnology**  |  |  |  |  |  |  |  |
| Definition of biotechnology  |  |  |  |  |  |  |  |
| Types of biotechnology |  |  |  | X | X |  |
| Traditional biotechnology |  |  |  | X | X |  |
| Modern biotechnology |  |  |  | X | X |  |
| Applications of modern biotechnology  |  |  |  | X | X |  |
| What are GMOs |  |  |  | X | X |  |  |
| What is DNA?* Replication
* Transcription
* Translation
* Genetic code
 |  |  |  | X | X |  |  |
| What is RNA? |  |  |  | X | X |  |  |
| How are GMOs developed* Stem cell culture
* Cloning
* Genetic engineering
 |  |  |  | X | X |  |  |
| Genetic Engineering* How is it accomplished
* What are the products
 |  |  |  | X | X |  |  |
| Benefits of GMOs  |  |  |  | X | X |  |  |
| Concerns/risks linked to GMOs |  |  |  | X | X |  |  |
| **Aspects of Biosafety**  |  |  |  |  |  |  |  |
| Definition of Biosafety |  |  |  | X | X |  |  |
| Why biosafety? |  |  |  | X | X |  |  |
| * Risk assessment, risk analysis and risk management
* Socio-economic considerations
 |  |  |  | X | X |  |  |
| **Legal instruments** |  |  |  | X | X |  |  |
| International * Convention on Biological Diversity (CBD)
* Cartegena Protocol on Biosafety (CPB)
* Nagoya-Kuala Lumpur Supplementary Protocol (NKLSP)
 |  |  |  | X | X |  |  |
| Scope of CBD  |  |  |  | X | X |  |  |
| Scope of CPB |  |  |  | X | X |  |  |
| Scope NKLSP |  |  |  | X | X |  |  |
| National * Biosafety/biotechnology policy
* Biosafety Act, 2012
 |  |  |  | X | X |  |  |
| Biosafety Act, 2012 * Scope (what it regulates)
* Institutional arrangements
* Notification requirements
* Application process & decision making
* Labeling, documentation & identification
* Public participation
* Offences and penalties
* Liability and redress
 |  |  |  | X | X |  |  |
| COMMENT:There seems to be nothing that is on the concepts of interest. There are not even opportunities to link them. |

**SCIENCE FORM 4-5**

| **Grade level**  |  |  |  | Form 4 | Form 5 |  | **Extent of Coverage in the subject** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject**  | **CHEMISTRY FORM 4-5** |
| **Aspects of biotechnology**  |  |  |  |  |  |  |  |
| Definition of biotechnology  |  |  |  | X | X |  | This can be linked to methods of purification e.g., filtration is used when extracting chemicals of interestSpeed of reactions can also be linked to this aspect of biotechnology |
| Types of biotechnology |  |  |  | X | X |  |
| Traditional biotechnology |  |  |  | X | c/l |  |
| Modern biotechnology |  |  |  | X | X |  |
| Applications of modern biotechnology  |  |  |  |  |  |  |
| What are GMOs |  |  |  | X | X |  |  |
| What is DNA?* Replication
* Transcription
* Translation
* Genetic code
 |  |  |  | c/l | c/l |  | This aspect can be linked to the topic on natural polymers (formation of proteins  |
| What is RNA? |  |  |  | X | X |  |  |
| How are GMOs developed* Stem cell culture
* Cloning
* Genetic engineering
 |  |  |  | X | X |  |  |
| Genetic Engineering* How is it accomplished
* What are the products
 |  |  |  | X | X |  |  |
| Benefits of GMOs  |  |  |  | X | X |  |  |
| Concerns/risks linked to GMOs |  |  |  | X | X |  |  |
| **Aspects of Biosafety**  |  |  |  |  |  |  |  |
| Definition of Biosafety |  |  |  | X | X |  |  |
| Why biosafety? |  |  |  | X | X |  |  |
| * Risk assessment, risk analysis and risk management
* Socio-economic considerations
 |  |  |  | X | X |  |  |
| **Legal instruments** |  |  |  |  |  |  |  |
| International * Convention on Biological Diversity (CBD)
* Cartegena Protocol on Biosafety (CPB)
* Nagoya-Kuala Lumpur Supplementary Protocol (NKLSP)
 |  |  |  | X | X |  |  |
| Scope of CBD  |  |  |  | X | X |  |  |
| Scope of CPB |  |  |  | X | X |  |  |
| Scope NKLSP |  |  |  | X | X |  |  |
| National * Biosafety/biotechnology policy
* Biosafety Act, 2012
 |  |  |  | X | X |  |  |
| Biosafety Act, 2012 * Scope (what it regulates)
* Institutional arrangements
* Notification requirements
* Application process & decision making
* Labeling, documentation & identification
* Public participation
* Offences and penalties
* Liability and redress
 |  |  |  | X | X |  |  |
| COMMENT:There is very little that could be linked to Biotechnology and Biosafety in this subject. However there are opportunities of integrating these concepts into the curriculum as the curriculum is being revised once the content matrix is in place. |

**SCIENCE FORM 4-5**

| **Grade level**  |  |  |  | Form 4 | Form 5 |  | **Extent of Coverage in the subject** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject**  | **BIOLOGY FORM 4-5** |
| **Aspects of biotechnology**  |  |  |  |  |  |  |  |
| Definition of biotechnology  |  |  |  | X | c/l |  | Some aspects of biotechnology presented in the biology syllabus as genetic engineering only |
| Types of biotechnology |  |  |  | X | c/l |  |
| Traditional biotechnology |  |  |  | X | c/l |  |
| Modern biotechnology |  |  |  | X | c/l |  |
| Applications of modern biotechnology  |  |  |  | X | c/l |  |
| What are GMOs |  |  |  | X | √ |  | This topic has not been explicitly addressed |
| What is DNA?* Replication
* Transcription
* Translation
* Genetic code
 |  |  |  | c/lXXX | √c/lc/lc/l |  | Concepts on DNA are implied in the syllabus topicHowever the information in the current syllabus is shallow and there is room for improvementNutrition (Synthesis of proteins from amino acids |
| What is RNA? |  |  |  | X | c/l |  |  |
| How are GMOs developed* Stem cell culture
* Cloning
* Genetic engineering
 |  |  |  | X | c/l |  | This topic can be toned down to level of the students at high school level |
| Genetic Engineering* How is it accomplished
* What are the products
 |  |  |  | X | √√ |  | Although something is discussed in relation to this topic, however it is worth noting that it is shallow |
| Benefits of GMOs  |  |  |  | X | √ |  | The coverage of such topics is very minimal in the syllabusLimits are not stipulated |
| Concerns/risks linked to GMOs |  |  |  | X | √ |  |  |
| **Aspects of Biosafety**  |  |  |  |  |  |  |  |
| Definition of Biosafety |  |  |  | X | c/l |  |  |
| Why biosafety? |  |  |  | X | c/l |  |  |
| * Risk assessment, risk analysis and risk management
* Socio-economic considerations
 |  |  |  | X | c/l |  |  |
| **Legal instruments** |  |  |  |  |  |  |  |
| International * Convention on Biological Diversity (CBD)
* Cartegena Protocol on Biosafety (CPB)
* Nagoya-Kuala Lumpur Supplementary Protocol (NKLSP)
 |  |  |  | X | c/l |  |  |
| Scope of CBD  |  |  |  | X | c/l |  |  |
| Scope of CPB |  |  |  | X | c/l |  |  |
| Scope NKLSP |  |  |  | X | c/l |  |  |
| National * Biosafety/biotechnology policy
* Biosafety Act, 2012
 |  |  |  | X | c/l |  |  |
| Biosafety Act, 2012 * Scope (what it regulates)
* Institutional arrangements
* Notification requirements
* Application process & decision making
* Labeling, documentation & identification
* Public participation
* Offences and penalties
* Liability and redress
 |  |  |  | X | c/l |  |  |
| COMMENT:There is very little that could be linked to Biotechnology and Biosafety in this subject. However a lot can be integrated in this subject as this where concepts relating to modern biotechnology can be discussed. For example topics such as Genetic engineering, cloning and DNA can best be discussed in this subject. |

**GEOGRAPHY FORM 1-5**

| **Grade level**  |  | Form 1 | Form 2 | Form 3 | Form 4 | Form 5 | **Extent of Coverage in the subject** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject**  | **Geography Form 1-5**  |
| **Aspects of biotechnology**  |  |  |  |  |  |  |  |
| Definition of biotechnology  |  | X | c/l | c/l | c/l | c/l | Some topics are already in syllabus e.g., hybrids in both plants and animals. The terms are only missingClimate change adaptation will increase the need for modern biotechnology |
| Types of biotechnology |  | X | c/l | c/l | c/l | c/l |
| Traditional biotechnology |  | X | c/l | c/l | c/l | c/l |
| Modern biotechnology |  | X | c/l | c/l | c/l | c/l |
| Applications of modern biotechnology  |  | X | c/l | c/l | c/l | c/l |
| What are GMOs |  | X | X | X | √ | √ | Addressed in Green Revolution |
| What is DNA?* Replication
* Transcription
* Translation
* Genetic code
 |  | X | X | X | X | X |  |
| What is RNA? |  | X | X | X | X | X |  |
| How are GMOs developed* Stem cell culture
* Cloning
* Genetic engineering
 |  | X | X | X | X | X |  |
| Genetic Engineering* How is it accomplished
* What are the products
 |  | X | X | X | X | X |  |
| Benefits of GMOs  |  | X | X | X | √ |  | This aspect of biotechnology is addressed in topics dealing with food production |
| Concerns/risks linked to GMOs |  |  |  |  |  |  | This is also addressed in topics dealing with food production |
| **Aspects of Biosafety**  |  |  |  |  |  |  |  |
| Definition of Biosafety |  | X | X | X | X | X | There is need to introduce this topic in the Geography syllabus |
| Why biosafety? |  | X | X | X | X | X | This topic need to be introduced as projections to the future of the environment needs to be protected against harmful LMOs |
| * Risk assessment, risk analysis and risk management
* Socio-economic considerations
 |  | X | X | X | X | X |  |
| **Legal instruments** |  |  |  |  |  |  |  |
| International * Convention on Biological Diversity (CBD)
* Cartegena Protocol on Biosafety (CPB)
* Nagoya-Kuala Lumpur Supplementary Protocol (NKLSP)
 |  | c/l | c/l | c/l | c/l | c/l | These are protocols that could be quoted when addressing these topics to globalise issues |
| Scope of CBD  |  | c/l | c/l | c/l | c/l | c/l |  |
| Scope of CPB |  | c/l | c/l | c/l | c/l | c/l |  |
| Scope NKLSP |  | c/l | c/l | c/l | c/l | c/l |  |
| National * Biosafety/biotechnology policy
* Biosafety Act, 2012
 |  | c/l | c/l | c/l | c/l | c/l | This can be linked to a number of  |
| Biosafety Act, 2012 * Scope (what it regulates)
* Institutional arrangements
* Notification requirements
* Application process & decision making
* Labeling, documentation & identification
* Public participation
* Offences and penalties
* Liability and redress
 |  |  |  |  |  |  |  |
| COMMENT:Geography as a subject that deals with issues of the environment provides a lot of opportunities for the integration of biotechnology and biosafety issues. In discussing topics under climate change adaptation, a lot of emphasis can be made to biotechnology and GMOs. Biosafety and biotechnology issues need to be introduced as a projection to the future of the environment needs to be protected against harmful LMOs. Again biosafety issues can be discussed together with the various protocols that serve as a framework for the implementation of such issues/concepts. |

**ENGLISH LANGUAGE FORM 1-5**

| **Grade level**  |  | Form 1 | Form 2 | Form 3 | Form 4 | Form 5 | **Extent of Coverage in the subject** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject**  | **English Language (Form 1-5)** |
| **Aspects of biotechnology**  |  |  |  |  |  |  |  |
| Definition of biotechnology  |  | X | X | X | X | X | This topic could be integrated as a theme of a unit whereby all these aspects could be studied. A reading passage on the topic cab the starting point from which other activities. e.g., speaking can come from |
| Types of biotechnology |  | X | X | X | X | X |
| Traditional biotechnology |  | X | X | X | X | X |
| Modern biotechnology |  | X | X | X | X | X |
| Applications of modern biotechnology  |  | X | X | X | X | X |
| What are GMOs |  | X | X | X | X | X |  |
| What is DNA?* Replication
* Transcription
* Translation
* Genetic code
 |  |  |  |  |  |  | This can be linked and done under listening and speaking activities  |
| What is RNA? |  | X | X | X | X | X |  |
| How are GMOs developed* Stem cell culture
* Cloning
* Genetic engineering
 |  | X | X | X | X | X | In the reading passages learners can be given the opportunity to read and write on this issue  |
| Genetic Engineering* How is it accomplished
* What are the products
 |  | X | X | X | X | X | Under speaking skills learners can debate such issues. |
| Benefits of GMOs  |  | X | X | X | X | X |  |
| Concerns/risks linked to GMOs |  | X | X | X | X | X |  |
| **Aspects of Biosafety**  |  | X | X | X | X | X |  |
| Definition of Biosafety |  | X | X | X | X | X | Throughout the English text books there is a theme on Environmental issues where speaking, listening, reading and writing activities are dealt with and it is under such activities that these concepts can be integrated |
| Why biosafety? |  | X | X | X | X | X |  |
| * Risk assessment, risk analysis and risk management
* Socio-economic considerations
 |  | X | X | X | X | X |  |
| **Legal instruments** |  |  |  |  |  |  |  |
| International * Convention on Biological Diversity (CBD)
* Cartegena Protocol on Biosafety (CPB)
* Nagoya-Kuala Lumpur Supplementary Protocol (NKLSP)
 |  | X | X | X | X | X | Learners can talk, listen, read and write about these issues |
| Scope of CBD  |  | X | X | X | X | X |  |
| Scope of CPB |  | X | X | X | X | X |  |
| Scope NKLSP |  | X | X | X | X | X |  |
| National * Biosafety/biotechnology policy
* Biosafety Act, 2012
 |  | X | X | X | X | X | The syllabus requires that learners are competent in speaking – speeches, presentations etc such topics come in. |
| Biosafety Act, 2012 * Scope (what it regulates)
* Institutional arrangements
* Notification requirements
* Application process & decision making
* Labeling, documentation & identification
* Public participation
* Offences and penalties
* Liability and redress
 |  | X | X | X | X | X | Lessons can be developed on these topics to cover the language skills – listen, speak, read and write |
| COMMENT:In the range of textbooks looked at, there is no evidence that these topics have been attempted. There are no lessons depicting the topic neither are there illustrations on the biotechnology and biosafety concepts being audited. When it really gets closer to the topic the environment is covered in other areas e.g., Making Friends with the Environment is a Unit theme in New Language for Life Book 1 but tackles it from the ‘Earth Hour” view. It is under such themes that biotechnology and biosafety issues can be linked and integrated into the existing English language syllabus. In all textbooks the topic is not covered even in text/story or narrative format. This goes to demonstrate the need to incorporate such concepts into the syllabus. As English language as a subject has no content, it relies on any topic that has been suggested in the scope and sequence, all these issues can easily be integrated to tackle any aspect of teaching and learning language skills, i.e., speaking, listening, reading and writing. Biotechnology and biosafety concepts can therefore be incorporate in the unit theme entitled “Making Friends with the Environment” which comprise the following activities:Activity 1 – Speaking about saving energyActivity 2 – Reading about Earth HourActivity 3 – Language in Action (grammar), related to the environmentActivity 4 – Note Making on Green Living (passage)Activity 5 – Listening to a Weather ReportActivity 6 – Formal speech on the importance of treesActivity 7 – A letter of complaint: refuse collectionActivity 8 – Enrichment: Levi Straus Blue Jeans Go Green  |

**SCIENCE FORRM 1-3**

| **Grade level**  |  |  | Form 1 | Form 2 | Form 3 |  | **Extent of Coverage in the subject** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject**  | **Science Form 1-3** |
| **Aspects of biotechnology**  |  |  |  |  |  |  |  |
| Definition of biotechnology  |  |  | X | X | X |  | This topic is covered in SGCSE. However, a base can be set for this topic including something on micro-organisms |
| Types of biotechnology |  |  | X | X | X |  |
| Traditional biotechnology |  |  | X | X | X |  |
| Modern biotechnology |  |  | X | X | X |  |
| Applications of modern biotechnology  |  |  | X | X | X |  |
| What are GMOs |  |  | X | X | X |  | This can be dealt with at a higher grade |
| What is DNA?* Replication
* Transcription
* Translation
* Genetic code
 |  |  | c/lXXXX | c/lXXXX | c/lXXXX |  | Can be discussed when the functions of organelles are discussed on page 110 in the text book. In the syllabus, it can be linked to 4(c) under cell structure and organization. |
| What is RNA? |  |  | X | X | X |  | This is basically covered in SGCSE Biology. Even here, it is not described in detail but it is mentioned in the replication of bacteria and genetic engineering. |
| How are GMOs developed* Stem cell culture
* Cloning
* Genetic engineering
 |  |  | X | X | X |  | This topic can be linked to the section on Ecology dealing with man’s effects on nature. Artificial selection can also include this aspect |
| Genetic Engineering* How is it accomplished
* What are the products
 |  |  | X | X | X |  | This is also covered in SGCSE not in JC. Some examples can be cited especially in the discussion under reproduction |
| Benefits of GMOs  |  |  | X | X | X |  | This topic can be included in the form 1 material |
| Concerns/risks linked to GMOs |  |  | c/l | X | X |  | This topic can be linked to safety in chapter 2 of Book 1 |
| **Aspects of Biosafety**  |  |  |  |  |  |  |  |
| Definition of Biosafety |  |  | c/l | X | X |  | Can be done with safety in Chapter 2 of Book 1 of the prescribed textbook. In Form 3, managing solid waste (page 91 to 92) can be improved to include Biosafety. SEA is cited in the materials. |
| Why biosafety? |  |  | c/l | c/l | c/l |  |  |
| * Risk assessment, risk analysis and risk management
* Socio-economic considerations
 |  |  | XX | XX | XX |  | This can be linked to managing solid waste on pages 91 to 92 in the prescribed textbooks. However, it is not covered in the syllabus |
| **Legal instruments** |  |  |  |  |  |  |  |
| International * Convention on Biological Diversity (CBD)
* Cartegena Protocol on Biosafety (CPB)
* Nagoya-Kuala Lumpur Supplementary Protocol (NKLSP)
 |  |  |  |  |  |  | At the present moment this aspect is not covered mainly because there has all along been no framework to guide the infusion of such concepts into the curriculum |
| Scope of CBD  |  |  |  |  |  |  |  |
| Scope of CPB |  |  |  |  |  |  |  |
| Scope NKLSP |  |  |  |  |  |  |  |
| National * Biosafety/biotechnology policy
* Biosafety Act, 2012
 |  |  |  |  |  |  |  |
| Biosafety Act, 2012 * Scope (what it regulates)
* Institutional arrangements
* Notification requirements
* Application process & decision making
* Labeling, documentation & identification
* Public participation
* Offences and penalties
* Liability and redress
 |  |  |  |  |  |  | At present there is no reference to the biosafety Act, however such topics can easily be linked to relevant sections when the materials are revised |
| COMMENT:It is generally important that every issue that has to be taught be in the syllabus first. The materials (textbooks) are supposed to dovetail to the syllabus. This is the main reason why the focus is mainly on the syllabus in my recommendations. It is also important to note that as Scientists we really do not delve much into laws, Acts and the likes. We are mainly concerned with the Science of whatever issue under consideration. There is room for including most of these issues in a spiral manner, preparing the pupils for SGCSE Biology. There is a need to have a topic on Genetics in the JC syllabus wherein all these issues can be housed and appropriately dealt with, of course in spiral form. An opportunity exists for such an inclusion of the Genetics topic because we are in the process of reviewing the JC syllabus. |

**PHYSICAL EDUCATION AND SPORT (GRADE 1-7)**

| **Grade level**  |  Grade 1 | Grade 2 | Grad 3 | Grade 4 | Grade 5 | Grade 6 | Grade 7 | **Extent of Coverage in the subject** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject**  |  | **Physical Education and Sport** |
| **Aspects of biotechnology**  |  |  |  |  |  |  |  |  |
| Definition of biotechnology  | X | X | X | X | X | X | X | This topic is not covered in the PES syllabus |
| Types of biotechnology | X | X | X | X | X | X | X |
| Traditional biotechnology | X | X | X | X | X | X | X |
| Modern biotechnology | X | X | X | X | X | X | X |
| Applications of modern biotechnology  | X | X | X | X | X | X | X |
| What are GMOs | X | X | X | X | X | X | X |  |
| What is DNA?* Replication
* Transcription
* Translation
* Genetic code
 | X | X | X | X | X | X | X | This topic is not covered in the PES syllabus |
| What is RNA? | X | X | X | X | X | X | X |  |
| How are GMOs developed* Stem cell culture
* Cloning
* Genetic engineering
 | X | X | X | X | X | X | X | Not covered in the PES syllabus |
| Genetic Engineering* How is it accomplished
* What are the products
 | X | X | X | X | X | X | X |  |
| Benefits of GMOs  | X | X | X | X | X | X | X | This topic can be discussed in relation to dietary requirements for athletes |
| Concerns/risks linked to GMOs | X | X | X | X | X | X | X |  |
| **Aspects of Biosafety**  |  |  |  |  |  |  |  |  |
| Definition of Biosafety | X |  |  |  |  |  |  |  |
| Why biosafety? | X | X | X | X | X | X | X |  |
| * Risk assessment, risk analysis and risk management
* Socio-economic considerations
 | X | X | X | X | X | X | X |  |
| **Legal instruments** |  |  |  |  |  |  |  |  |
| International * Convention on Biological Diversity (CBD)
* Cartegena Protocol on Biosafety (CPB)
* Nagoya-Kuala Lumpur Supplementary Protocol (NKLSP)
 | X | X | X | X | X | X | X | Not covered in the PES syllabus |
| Scope of CBD  | X | X | X | X | X | X | X |  |
| Scope of CPB | X | X | X | X | X | X | X |  |
| Scope NKLSP | X | X | X | X | X | X | X |  |
| National * Biosafety/biotechnology policy
* Biosafety Act, 2012
 | X | X | X | X | X | X | X |  |
| Biosafety Act, 2012 * Scope (what it regulates)
* Institutional arrangements
* Notification requirements
* Application process & decision making
* Labeling, documentation & identification
* Public participation
* Offences and penalties
* Liability and redress
 | X | X | X | X | X | X | X | This topic is currently not linked to the PES syllabus |
| **COMMENT:**It can be concluded from the audit process that there is not much biotechnology and biosafety issues in the present syllabus for Physical Education and Sport. Physical education and sport is predominantly a practical subject with the purpose of enabling pupils to make informed choices on participating in physical activity. Issues of biotechnology and biosafety could therefore be included under Activity 21 entitled “Eat Healthy, Stay Healthy” where issues of labelling in foods and sport drinks could be addressed and also the dangers of eating GMO foods including identifying labels of GMO products  |

**SISWATI (GRADE 1-7)**

| **Grade level**  |  Grade 1 | Grade 2 | Grade 3 |  Grade 4 | Grade 5 | Grade 6 | Grade 5 | **Extent of Coverage in the subject** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject**  |  | **SiSwati Grade 1-7** |
| **Aspects of biotechnology**  | X | X | X | X | X | X | X |  |
| Definition of biotechnology  | X | X | X | X | X | X | X | This topic can be linked to topics in the syllabus dealing with traditional food dishes. Such topic can also be dealt with in syllabus sections dealing with ‘eating well’ and ‘traditional siSwati food. |
| Types of biotechnology | X | c/l | c/l | c/l | c/l | c/l | c/l |
| Traditional biotechnology | X | c/l | c/l | c/l | c/l | c/l | c/l |
| Modern biotechnology | X | c/l | c/l | c/l | c/l | c/l | c/l |
| Applications of modern biotechnology  | X  | c/l | c/l | c/l | c/l | c/l | c/l |
| What are GMOs | X | c/l | c/l | c/l | c/l | c/l | c/l | This topic can be included in syllabus topics dealing with food and animals |
| What is DNA?* Replication
* Transcription
* Translation
* Genetic code
 | X | c/l | c/l | c/l | c/l | c/l | c/l | This topic can be included in syllabus topics dealing with food and animals |
| What is RNA? | X | X | X | X | X | X | X |  |
| How are GMOs developed* Stem cell culture
* Cloning
* Genetic engineering
 | XX | XX | XX | XX | XX | XX | XX | Topic can be linked to the topics on food and animals  |
| Genetic Engineering* How is it accomplished
* What are the products
 | X | X | c/l | c/l | X | c/l | X | This aspect of biotechnology can be linked to syllabus topics on food and animals |
| Benefits of GMOs  | X | X | c/l | c/l | X | c/l | X | This topic can be included in syllabus topics dealing with food and animals |
| Concerns/risks linked to GMOs | X | X | c/l | c/l | c/l | c/l | c/l | This topic can be included in syllabus topics dealing with food and animals, technology, water, environment and safety |
| **Aspects of Biosafety**  |  |  |  |  |  |  |  |  |
| Definition of Biosafety | X | X | X | X | X | X | X | This aspect can be treated within the SiSwati curriculum at secondary school level |
| Why biosafety? | X | X | X | X | X | X | X |  |
| * Risk assessment, risk analysis and risk management
* Socio-economic considerations
 | Xc/l | c/lc/l | c/lc/l | c/lc/l | Xc/l | Xc/l | c/lc/l | This aspect of biosafety can be linked to topic dealing with water, environment, safety & technology |
| **Legal instruments** |  |  |  |  |  |  |  |  |
| International * Convention on Biological Diversity (CBD)
* Cartegena Protocol on Biosafety (CPB)
* Nagoya-Kuala Lumpur Supplementary Protocol (NKLSP)
 | X | X | X | X | X | X | X | Such topics can be integrated within the SiSwati subject at secondary school level |
| Scope of CBD  | X | X | X | X | X | X | X | The aspects of biosafety may be included at secondary level |
| Scope of CPB | X | X | X | X | X | X | X | May be included at secondary level |
| Scope NKLSP | X | X | X | X | X | X | X | May be included at secondary level |
| National * Biosafety/biotechnology policy
* Biosafety Act, 2012
 | X | X | X | X | X | X | X | These can also be addressed at secondary level |
| Biosafety Act, 2012 * Scope (what it regulates)
* Institutional arrangements
* Notification requirements
* Application process & decision making
* Labeling, documentation & identification
* Public participation
* Offences and penalties
* Liability and redress
 | X | X | X | X | X | X | X | These topics can be included in the SiSwati subject at secondary school level |
| COMMENT:Generally most topics on biotechnology and biosafety can be integrated in the SiSwati curriculum at primary school level since the subject lands itself well to tackling a wide range of emerging issues in topics such as water, pollution, safety in the home environment, traditional foods, modern foods, animals and technology. These topics could be infused through stories and passages for children to read and in the process learn about GMOs. Caution would however be taken in treating such topics according to the grade level |

**INFORMATION TECHNOLOGY STUDIES**

| **FORM** |  |  |  | 4 | 5 |  | **Extent of Coverage in the subject** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **SUBJECT**  | **Information Technology** |
| **Aspects of biotechnology**  |  |  |  |  |  |  |  |
| Definition of biotechnology  |  |  |  | x | X |  |  |
| Types of biotechnology |  |  |  | x | X |  |
| Traditional biotechnology |  |  |  | x | X |  |
| Modern biotechnology |  |  |  | x | X |  |
| Applications of modern biotechnology  |  |  |  | x | X |  |
| What are GMOs |  |  |  |  |  |  |  |
| What is DNA?* Replication
* Transcription
* Translation
* Genetic code
 |  |  |  | x | X |  |  |
| What is RNA? |  |  |  | x | X |  |  |
| How are GMOs developed* Stem cell culture
* Cloning
* Genetic engineering
 |  |  |  | x | X |  |  |
| Genetic Engineering* How is it accomplished
* What are the products
 |  |  |  | x | X |  |  |
| Benefits of GMOs  |  |  |  | x | X |  |  |
| Concerns/risks linked to GMOs |  |  |  | x | X |  |  |
| **Aspects of Biosafety**  |  |  |  |  |  |  |  |
| Definition of Biosafety |  |  |  | x | X |  |  |
| Why biosafety? |  |  |  | x | X |  |  |
| * Risk assessment, risk analysis and risk management
* Socio-economic considerations
 |  |  |  |  |  |  |  |
| **Legal instruments** |  |  |  |  |  |  |  |
| International * Convention on Biological Diversity (CBD)
* Cartegena Protocol on Biosafety (CPB)
* Nagoya-Kuala Lumpur Supplementary Protocol (NKLSP)
 |  |  |  | x | X |  |  |
| Scope of CBD  |  |  |  | x | X |  |  |
| Scope of CPB |  |  |  | x | X |  |  |
| Scope NKLSP |  |  |  | x | X |  |  |
| National * Biosafety/biotechnology policy
* Biosafety Act, 2012
 |  |  |  | x | X |  |  |
| Biosafety Act, 2012 * Scope (what it regulates)
* Institutional arrangements
* Notification requirements
* Application process & decision making
* Labeling, documentation & identification
* Public participation
* Offences and penalties
* Liability and redress
 |  |  |  | x | X |  |  |
| COMMENT:Information Communication Technology is key in promoting and controlling biodiversity issues. Although nothing appears in the present Pre-Vocational syllabus on bio-safety and biotechnology; it is envisaged that with the proposed curriculum review of the whole Pre-Voc Programme such issues will be integrated into the school curriculum. These issues can be linked and discussed under each module topic. |

**AGRICULTURE PRE-VOC FORM 4-5**

| **Grade level**  |  |  |  |  | Form 4-5 |  | **Extent of Coverage in the subject** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Subject**  | **AGRICULTURE PRE-VOC FORM 4-5** |
| **Aspects of biotechnology**  |  |  |  |  |  |  |  |
| Definition of biotechnology  |  |  |  |  | X |  | This aspect of biotechnology can be linked to AAH 1 & 2 on Chicken production; AAH 04 on piglet production & AAH 06 on goat rearing  |
| Types of biotechnology |  |  |  |  | X |  |
| Traditional biotechnology |  |  |  |  | X |  |
| Modern biotechnology |  |  |  |  | c/l |  |
| Applications of modern biotechnology  |  |  |  |  | c/l |  |
| What are GMOs |  |  |  |  | X |  |  |
| What is DNA?* Replication
* Transcription
* Translation
* Genetic code
 |  |  |  |  | X |  |  |
| What is RNA? |  |  |  |  | X |  |  |
| How are GMOs developed* Stem cell culture
* Cloning
* Genetic engineering
 |  |  |  |  | X |  | This topic can be linked to crop and animal production |
| Genetic Engineering* How is it accomplished
* What are the products
 |  |  |  |  | X |  |  |
| Benefits of GMOs  |  |  |  |  | c/l |  | This topic can be linked to syllabus topic on Fruit production |
| Concerns/risks linked to GMOs |  |  |  |  | c/l |  | This topic can also be linked to fruit production |
| **Aspects of Biosafety**  |  |  |  |  |  |  |  |
| Definition of Biosafety |  |  |  |  | X |  |  |
| Why biosafety? |  |  |  |  | X |  |  |
| * Risk assessment, risk analysis and risk management
* Socio-economic considerations
 |  |  |  |  | X |  |  |
| **Legal instruments** |  |  |  |  |  |  |  |
| International * Convention on Biological Diversity (CBD)
* Cartegena Protocol on Biosafety (CPB)
* Nagoya-Kuala Lumpur Supplementary Protocol (NKLSP)
 |  |  |  |  | X |  | These protocols and conventions can be discussed in relation to crop and animal production |
| Scope of CBD  |  |  |  |  | X |  |  |
| Scope of CPB |  |  |  |  | X |  |  |
| Scope NKLSP |  |  |  |  | X |  |  |
| National * Biosafety/biotechnology policy
* Biosafety Act, 2012
 |  |  |  |  | X |  |  |
| Biosafety Act, 2012 * Scope (what it regulates)
* Institutional arrangements
* Notification requirements
* Application process & decision making
* Labeling, documentation & identification
* Public participation
* Offences and penalties
* Liability and redress
 |  |  |  |  | XXXXXXX |  |  |
| COMMENT:There is room for integrating biotechnology and biosafety issues into the prevocational Agriculture subject at high school level. This is in view of the fact that the subject deals with the production of crops and animals and biosafety and biotechnology issues can best be handled in this subject. At the present moment but much has been done in the present materials even though a lot of topics have a direct linkage to the concepts. |