Bioethics

5. Cloning

* 1. Intended Learning Outcomes

By the end of the lessons, the students will be able to:

1. Understand the meaning of cloning and its scope of applications on animals and humans.
2. Analyze the pros and cons for both therapeutic and reproductive cloning on humans, and the moral issues raised in their development.
3. Apply different ethical theories to make moral judgment on cloning.

*\*Prerequisite knowledge: Normative Ethics, the nature of morality, moral principles, moral reasoning, theory of conduct, theory of value & virtue (Refer to* [*‘NSS Ethics and Religious Studies Curriculum Support Materials - Compulsory Part: Ethics - Module 1: Normative Ethics’*](http://www.edb.gov.hk/en/curriculum-development/kla/pshe/references-and-resources/ethics-and-religious-studies/support-materials-compulsory-part-module-1-normative-ethics.html)*)*

* 1. Introduction

Cloning in biotechnology refers to processes used in creating copies of DNA fragments (molecular cloning), cells (cell cloning), or organisms. It describes the processes used to create an exact genetic duplication of another cell, tissue or organism. The copied material is a ‘clone’ which has the same genetic makeup as its original.

Over the past 6 decades, scientists have attempted to clone different kinds of animals, like frog, mouse, cow, cat, monkey, etc. In 1996, Dolly the sheep was cloned successfully out of 277 attempts. Her arrival has aroused conversations about the implications of cloning, bringing debates over human cloning and stem cell research under the public spotlight.

Should governments fund scientists to develop cloning technology? What about cloning endangered and extinct species? How about cloning animals for food? Is it moral to clone humans for therapeutic purposes? Should parents be allowed to clone their dying children? What if we clone another Albert Einstein to foster scientific advancement?

In the lessons, students will examine the legitimacy of cloning for animals and humans under different scenarios. They will also analyze and evaluate the arguments for and against the human cloning in therapeutic and reproductive ways.

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| **References:**   * Haugen, D.M. (et al) (2009). *The ethics of cloning.* Mich.: Greenhaven Press. * http://c2d.osdd.net/home/cep/intro * <http://en.wikipedia.org/wiki/Ethics_of_cloning> * http://www.kopernik.org.pl/en/special-projects/archiwum-projektow/projekt-genesis/krotka-historia-klonowania/ * http://learn.genetics.utah.edu/content/cloning/clonezone/ * <http://plato.stanford.edu/entries/cloning/> * <http://www.buzzle.com/articles/ethical-issues-of-cloning.html> * http://www.cbsnews.com/news/scientists-successfully-clone-human-stem-cells-via-skin-cells/ * http://www.did.deliberating.org/lessons/documents/DID%20Cloning\_2011.pdf * <http://www.sources.com/SSR/Docs/SSRW-Cloning.htm#Ethical_issues_of_cloning> * http://www.discoveryeducation.com/teachers/free-lesson-plans/the-clone-age.cfm |

* 1. Teaching and learning processes

Suggested teaching period: 4 lessons

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| * 1. Exploring the legitimacy of cloning in various scenarios   2. Teacher asks students the following questions. Students can write/draw/ verbally answer the questions. Ask them to share and explain their answers.      1. ‘If you can clone an animal or a person, what would you like to clone? Why?’      2. ‘Would you like to have a “cloned you”? Why or why not?’   3. Teacher separates the students into 4-7 groups (teacher can select the scenarios purposefully). Each group representative comes out to take a piece of big poster with a ‘Scenario card’ sticking on it, and a sign pen (a different colour used for each group).   4. The groups discuss the scenarios and write down their bullet points on the posters. In every 3-5 minutes, each group supplies another group with new information by passing on the poster and scenario card. Until every scenario has been circulated by all groups, teacher facilitates a class discussion.  1. What is cloning?    1. Ask students to form 5 groups. Each group is provided with a piece of ‘Jigsaw Reading Material’, with a poster-sized paper and sign-pen provided. They should read the passage and design a mind-map/poster/flowchart/drawing to show their understanding of the passage. And then all groups take turns to present their work. Teacher may clarify and substantiate whenever necessary.    2. While listening to the group presentations, students can use ‘Worksheet 1: Understanding Cloning’ to jot down notes and do a peer evaluation. 2. Ethical controversies over cloning    1. Flipped learning: Prior to the lesson, teacher asks students to watch the online video on ‘Cloning Humans – UK – Zoe Holloway’ (~30 mins) at [*https://www.youtube.com/watch?v=R4JoRy\_vNEw*](https://www.youtube.com/watch?v=R4JoRy_vNEw);   Or to watch other videos on ‘human cloning’ in Chinese.  Moreover, students are required to search for some more information regarding the pros and cons of human cloning – therapeutic & reproductive cloning.   * 1. During the lesson, teacher asks the students to form groups (3-6 students in a group), share their views on the video and present what they have gathered on ‘human cloning’. To facilitate their sharing, they can complete ‘Worksheet 2: Therapeutic VS Reproductive cloning’ together. Then, ask the groups to present their ideas.   2. Cloning debate: Teacher divides the class into 2 groups for the debate on ‘Cloning technology should be developed.’ Asks them to prepare for their arguments at home. To facilitate their preparation and consolidation, ‘Worksheet 3: Debate – Cloning technology should be developed’ can be used.   3. In the debate, students may evaluate the performance of both themselves and their peers using the evaluation tables in Worksheet 3.  1. Conclusion and students’ self-evaluation    1. Teacher reviews the key learning points of the topic on ‘cloning’ with the students.    2. Ask students to consolidate their knowledge and evaluate their learning outcomes by completing ‘Worksheet 4: Summary & self-evaluation’. |

**Scenario cards**

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| **Card A**  <http://2.bp.blogspot.com/-cD4z-hnKj_E/T8lATlpEpYI/AAAAAAAAOko/ju53RtzvuDk/s400/187711_1.jpg>  Google has been serving as a guide dog for a blind man – Mr Chan – for nearly 10 years. Mr Chan depends on Google so much that he feels he cannot live without him. However, Google is getting older and weaker day by day.  Should Mr Chan be allowed to clone Google before he dies? | **Card B**  [http://www.bing.com/images/search?q=Kobe+beef+cow&view=detailv2&&&id=B9725A7C131934E18CFA891E30591C8E52C5464F&selectedIndex=114&ccid=zYhMOWUB&simid=608038335954813562&thid=JN.Xfqy10DI3UJM2butXZuA%2bg&ajaxhist=0 zs0cOI6Sde2MaC4z2gvG7A&ajaxhist=0](http://www.bing.com/images/search?q=endangered+species&view=detailv2&&&id=B2495598E64E0B9EEFEF70C64929B15A6A9DCA0D&selectedIndex=915&ccid=P%2fpzwGTb&simid=608000089272420022&thid=JN.zs0cOI6Sde2MaC4z2gvG7A&ajaxhist=0)  Suppose there is only one polar bear left on earth. The species will extinct when it dies.  Should scientists be allowed to clone the polar bear in order to keep the species alive? |
| **Card C**  http://www.bing.com/images/search?q=Kobe+beef+cow&view=detailv2&&&id=B9725A7C131934E18CFA891E30591C8E52C5464F&selectedIndex=114&ccid=zYhMOWUB&simid=608038335954813562&thid=JN.Xfqy10DI3UJM2butXZuA%2bg&ajaxhist=0  Mr Honda owns a prize-winning Kobe beef cow. He wants to clone the cow such that more people can taste the delicious beef.  Should Mr Honda be allowed to clone the Kobe beef cow to share the taste? | **Card D**  http://www.theguardian.com/sport/2010/sep/04/cape-blanco-irish-champion-stakes  Sir Jones is the owner of a champion race horse. He wants to clone the horse to help him make money from racings.  Should Sir Jones be allowed to clone the champion race horse to make money? |
| **Card E**  [Sick Boy Clipart Sick baby clip art sick baby](http://thumbs.dreamstime.com/z/being-sick-illustration-child-hospitalized-33328931.jpg)  Tom is 12 years old, suffering from a rare DNA mutation decease. Doctors believe that stem cells found in human embryos can cure his disease.  Should scientists be allowed to clone Tom to create stem cells for medical purposes? | **Card F**  Mrs Mok gave birth to her 5-year-old daughter, Amy, at age of 45. Amy is suffering from terminal cancer which breaks the Mok’s heart, as they know it is next to impossible to bear any baby again.  Should Mrs Mok be allowed to clone Amy before she dies? |
| **Card G**  Mother Teresa, a Nobel Peace Prize winner, helped and loved countless deprived, and has stimulated many people’s benevolence.  Should scientists be allowed to clone  Mother Teresa so that her love can prevail on earth? |  |

**Jigsaw Reading**

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| **(1) What is Cloning?**  Cloning is a scientific method to create an exact genetic replica of a living being. It is the creation of a genetic copy of a sequence of DNA or of the entire genome of an organism. Two organism clones (human/animal) would have the same genetic structure.  In 1996, scientists in Scotland created Dolly, a sheep who was an identical genetic copy of her mother. Since that time, scientists in other parts of the world have produced genetic duplicates of such animals as a cow, a mouse, a cat, a dog, a horse, a pig, and even a ferret. This process, called *cloning*, has led to increased interest and concern by governments and ordinary persons. Officials and citizens around the world are discussing the uses of human cells in medical research and the prospect of reproducing people through cloning.  Sources:   * <http://plato.stanford.edu/entries/cloning/> * http://www.did.deliberating.org/lessons/documents/DID%20Cloning\_2011.pdf |
| **(2) Kinds of Cloning**  Cloning is different from other forms of assisted reproduction, such as artificial insemination or test-tubefertilization. In assisted reproduction, the sperm of a male donor is brought together with the egg of a female donor, just like in natural reproduction. Cloning, by contrast, involve transferring the genetic material from the nucleus of one adult cell of an organism and placing it into an egg whose genetic material has been removed. After receiving a careful burst of electricity, the egg begins to divide into an embryo as if sperm had fertilized it.  Regarding human cloning, scientists and policymakers generally make a distinction between ***reproductive*** and ***therapeutic*** cloning. While the same techniques are used in the initial stages of both processes (German National Ethics Council, 2004), they quickly differ in important ways (Committee on Science, Engineering, and Public Policy, 2002).  Source: http://www.did.deliberating.org/lessons/documents/DID%20Cloning\_2011.pdf |
| **(3) Reproductive Cloning**  In **Reproductive Cloning**, somatic cell nuclear transfer (SCNT) is the most common cloning technique. SCNT involves putting the nucleus of a body cell into an egg from which the nucleus has been removed. Placing this cloned embryo into the uterus of a female animal and bringing it to create a clone, with genes identical to those of the animal from which the original body cell was taken. It is the process used to create Dolly the sheep.  More than 18 cloned mammals have been produced with SCNT, but claims of having cloned a human child have been false. Human reproductive cloning is almost universally opposed. Overwhelming majorities reject it in opinion surveys. Many international agreements and countries (excluding US) formally prohibit it.  Some oppose reproductive cloning because of safety considerations. Animal cloning is seldom successful, and many scientists believe that reproductive cloning can never be made safe. Human reproductive cloning would also threaten the psychological well-being of cloned children, open the door to more powerful genetic manipulation technologies, and raise other social and ethical concerns.  Sources:   * http://www.did.deliberating.org/lessons/documents/DID%20Cloning\_2011.pdf * <http://www.geneticsandsociety.org/section.php?id=16&all=1> |
| **(4) Therapeutic cloning**  **Therapeutic cloning**does not implant an embryo into a uterus. Instead, therapeutic cloning focuses on stem cells and how they develop. These cells are multi-functional: all the specialized cells of the body—bone, blood, nerves, muscles, skin—develop from stem cells. Despite this versatility, stem cells “do not themselves have the capacity to form a fetus or a newborn animal” (COSEPUP, 2002).  Some researchers use therapeutic cloning to understand genetic defects. They also use therapeutic cloning to learn how to renew cells or tissues in people who suffer from degenerative diseases or serious injuries. The advantage to this type of cloning in medical treatment is that it would allow medical professionals to grow replacements for missing and damaged body parts for their patients. This would eliminate organ and tissue shortages, ensuring that every patient who required something like a new liver or new kidneys could get what he or she needed. Using cloned body parts would also eliminate the need for immunosuppressive drugs, and reduce the risk of rejection and other problems that are commonly associated with transplants.  Sources:   * http://www.did.deliberating.org/lessons/documents/DID%20Cloning\_2011.pdf * <http://www.wisegeek.org/what-is-therapeutic-cloning.htm> |
| **(5) Cell Sources for Cloning**  Currently, surplus embryos donated by parents undergoing test-tubefertilization are used as a source for stem cells. Fertility clinics routinely discard these unused embryos. When researchers receive embryos from a fertility lab, the embryos are only a few days old but are alive and growing. The embryos are still in the \*blastocyst stage. That means they are a hollow ball of 64 to 200 cells in two layers. The researchers remove the stem cells—the inner layer of cells—to grow them in the lab. The outer layer of cells—which would have grown into the womb, the means for nutrients to pass to a growing fetus—is discarded.  \* The **blastocyst** is a structure formed in the early development of mammals. It possesses an [inner cell mass](http://en.wikipedia.org/wiki/Inner_cell_mass) (ICM) which subsequently forms the [embryo](http://en.wikipedia.org/wiki/Embryo). The outer layer of the blastocyst consists of cells collectively called the [trophoblast](http://en.wikipedia.org/wiki/Trophoblast).  Sources:   * http://en.wikipedia.org/wiki/Blastocyst * http://www.did.deliberating.org/lessons/documents/DID%20Cloning\_2011.pdf |

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| **Worksheet 1: Understanding Cloning**  Jot down notes when listening to the presentations of the 5 groups. Write down your questions (if any) and then ask the presenters, or to find out the answers after class.   |  |  |  | | --- | --- | --- | | **Group** | **Notes** | **My questions (optional)** | | (1)  What is Cloning? |  |  | | (2)  Kinds of Cloning |  |  | | (3) Reproductive Cloning |  |  | | (4) Therapeutic Cloning |  |  | | (5)  Cell Sources for Cloning |  |  |   Peer evaluation   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  | Peer-evaluation (3=good, 2=average, 1=poor) | | | | | | **Group 1** | **Group 2** | **Group 3** | **Group 4** | **Group 5** | | Concept articulation | 3 2 1 | 3 2 1 | 3 2 1 | 3 2 1 | 3 2 1 | | Poster presentation | 3 2 1 | 3 2 1 | 3 2 1 | 3 2 1 | 3 2 1 | | Verbal presentation | 3 2 1 | 3 2 1 | 3 2 1 | 3 2 1 | 3 2 1 | | Response to questions | 3 2 1 N/A | 3 2 1 N/A | 3 2 1 N/A | 3 2 1 N/A | 3 2 1 N/A | |

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| **Worksheet 2: Therapeutic VS Reproductive cloning**  Based on the information you have gathered, compile the table below by writing the bullet points.   |  |  |  | | --- | --- | --- | |  | **Pros** | **Cons** | | **Therapeutic cloning** |  |  | | **Reproductive cloning** |  |  |   *Challenging level (optional):* Do you support human cloning? Explain your answers using the theories of ethics. |

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| **Worksheet 2: Therapeutic VS Reproductive cloning**  ***(For teachers’ reference)***  Based on the information you have gathered, compile the table below by writing the bullet points.   |  |  |  | | --- | --- | --- | |  | **Pros** | **Cons** | | **Therapeutic cloning** | * Scientists can use the embryos in 14-day limit, when it is still in a cell stage, instead of being a ‘human’. Some people regard that the embryonic cells at that stage cannot be considered as a human being because it does not have thoughts, self-awareness, memory, awareness of its environment, sensory organs, internal organs, limbs, and so on. * The latest development of cloning human stem cells via \*skin cells, instead of the traditional method of using the fertilized egg cells which theoretically can develop into fetuses, reduces the controversy. * It relieves human suffering due to illnesses, and gives hope to the patients and their families. * It can generate tissues and whole organs to treat patients who otherwise cannot obtain transplants. * It avoids the need for [immunosuppressive drugs](http://en.wikipedia.org/wiki/Immunosuppressive_drugs), and to stave off the effects of aging. * It helps in in-depth research, e.g. in the case of motor neuron disease.   \*For details, please refer to http://www.cbsnews.com/news/scientists-successfully-clone-human-stem-cells-via-skin-cells/ | * It is immoral to use an early-stage human life to ‘save’ another human life. * It is to create an embryo purposefully and does not allow it to grow, but just to destroy it. It infringes the right to survival of the ‘human-to-be’. * It involves massive destroy of human embryos – human lives. * Stem cells needed for research can be taken from other sources, such as umbilical cord blood. Thus, using cloned embryos is unnecessary. * It is costly to develop therapeutic cloning. It will benefit primarily the rich people (the minority). The money and scientific effort devoted to cloning could be better invested to fight current problems—like AIDS, malaria, and tuberculosis (the majority). | |  | **Pros** | **Cons** | | **Reproductive cloning** | * It demonstrates freedom of research. * It is a scientific breakthrough which advances human knowledge. * It enables homosexual and sterile couples to have biological offspring, which ensures their human rights. * It allows parents who have lost a child a chance to redress their loss using the DNA of their deceased child. | * It infringes human dignity and uniqueness. * It is to play God. * The technology is not yet safe. Cloned individuals would very likely be biologically damaged due to the inherent unreliability of cloning technology. * It might change the shape of family structure by confusing the role of parenting within a family of complicated kinship relations, e.g. parent-child/self relationship? * A cloned child having multiple donors might complicate parental right issues as well as inheritance and marital eligibility issues. * The expectations on the cloned individuals replace the ‘original person’ could infringe the right to self-determination. * Cloned individuals may become ‘tools’ if they were generated for specific purposes. Treating others as ‘tools’ is immoral in the Kantian view. * It is ethically wrong to control the genetic makeup of any other individual. * The alteration of gene pool will reduce the genetic diversity of humans. It may make humans suffer from infectious and unknown diseases, and eventually threats the entire human species. |   *Challenging level (optional):* Do you support human cloning? Explain your answers using the theories of ethics, ie. Deontology (D), Utilitarianism (U), theory of Value and Virtue (V) and the knowledge you have learnt in this unit of Bioethics. |

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| Worksheet 3: Debate – Cloning technology should be developed   |  |  | | --- | --- | | For | Against | |  |  |   Self-evaluation   |  |  | | --- | --- | |  | Self-evaluation  5=outstanding , 1=very poor | | Am I able to make substantial arguments? | 5 4 3 2 1 | | Am I able to give concrete examples to support my arguments? | 5 4 3 2 1 | | Am I able to employ individual ethical theory accurately with appropriate evidence? | 5 4 3 2 1 | | Am I able to present my view/arguments in a logical and systematical way? | 5 4 3 2 1 | | Am I able to respond to the arguments made by the counterpart? | 5 4 3 2 1 |   Peer evaluation   |  |  | | --- | --- | |  | Peer-evaluation  5=outstanding , 1=very poor | | Is the counterpart able to make substantial arguments? | 5 4 3 2 1 | | Is the counterpart able to give concrete examples to support their arguments? | 5 4 3 2 1 | | Is the counterpart able to employ individual ethical theory accurately with appropriate evidence? | 5 4 3 2 1 | | Is the counterpart able to present their view/arguments in a logical and systematical way? | 5 4 3 2 1 | | Is the counterpart able to respond to the arguments made by our side? | 5 4 3 2 1 | |

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| Worksheet 4: Summary & Self-evaluation – Cloning  Write down the key learning points of this module.   |  | | --- | | 1. **Exploring the legitimacy of cloning in various scenarios** | | 1. | | 2. | | 3. | | 4. | | 5. |  |  | | --- | | 1. What is cloning? | | 1. | | 2. | | 3. | | 4. | | 5. |  |  | | --- | | 1. **Ethical controversies over cloning** | | 1. | | 2. | | 3. | | 4. | | 5. |   **Evaluate how well you have learnt** (please put a ‘🗸’)   |  |  |  |  |  | | --- | --- | --- | --- | --- | |  | Very good | Good | Fair | Poor | | 1. Exploring the legitimacy of cloning in various scenarios |  |  |  |  | | 1. What is cloning? |  |  |  |  | | 1. Ethical controversies over cloning |  |  |  |  |   What question(s)/area(s) you want to learn more in this module of ‘cloning’? |