The Biology of Cloning Plants

Keywords: Asexual reproduction, Biology, Clone, Plants, Propagation, Rooting powder, Soil

Meta Description

Clone your favourite plant! Investigate how you can turn cuttings into a new plant through this form of plant reproduction.

Learning Objectives

To Introduce and understand the concept of cloning.
To grow a new plant from plant cuttings.

Key Terms

Clones
Organisms that have identical DNA.

Asexual Reproduction
The formation of offspring from a single parent.

Rooting Powder
A powder containing root hormones that enhance root development from stems.

Genotype
The genetic makeup of an organism. In other words, it is the set of genes in an organism.

Genes
Genes are information carriers that determine the traits of an individual such as the colour of the eyes, the colour of your hair, height etc.

Method

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Step 1
Choose a plant that you would like to clone and cut a part of the stem at a 45 degree angle using a knife (or scissors). Be careful!

Step 2
Remove the leaves from the cutting's lower half.

Step 3
Dip the end of the cutting (where you have just cut) in rooting powder.

Step 4
Prepare a container with soil and use your finger to make a hole in the centre for the cutting to be placed in later.

Step 5
Water the soil such that the soil is damp.

Step 6
Place the cutting in the hole and fill up any empty space with more soil.

Step 7
Cover the container with a plastic bag to keep the moisture in, and seal it. You can remove the plastic bag after a few days.

Step 8
Keep the container in a warm, well-lit area.

Step 9
Water the plant everyday.

Step 10
Observe any features of the new plant such as leaf shape, leaf colour etc. If the plant outgrows the container, transfer the plant to a larger sized pot.

Alternative Method

The method of hydroponic propagation can also be used. For this method, you can place the stem in a cup with water to observe the roots growing. Once the roots appear, the plant can then be transferred to a pot containing soil so that you have a new plant to add to your collection.

Precautions

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Adult supervision is advised when using the kitchen knife or scissors to cut the stem.

Rooting powder is not classified as hazardous but it is recommended that gloves be used when handling it.

Plant sap may be an irritantto some people.

Narrative

Let's imagine for a moment that you are in possession of a plant that is the only one of its kind in the whole world. Someone has leaked this information to the media and suddenly you're receiving hundreds of offers from people all around the world to sell the plant. Fortunately, you find out about the phenomena of cloning. That's when you decide to clone your plant and sell the clones to make a fortune!

Questions

What is cloning?
The production of genetically identical individuals.

What is the purpose of rooting powder?
To enhance root growth.

What is meant by 'genetically identical individuals'?
An identical copy of the parent – both individuals have the same genes.

Does cloning occur in nature?
Yes, this happens in the case of identical twins and even with organisms reproducing asexually, such as some bacteria.

Can you do this with every plant?
The majority of plants can be cloned.

Has an animal been cloned by humans?
Yes, most famously Dolly the Sheep.

Brief Explanation

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Farmers have been cloning plants for thousands of years.
Plant cloning is the production of a cell, cell component, or a whole plant that is genetically identical to the unit/individual from which it originated from.

http://thekeep.eiu.edu/cgi/viewcontent.cgi?article=1144&context=bio_fac

Rooting powder was used in this experiment to induce the growth of roots, as the powder contains a plant hormone known as auxin, used by the plant to stimulate root development. Hormones are chemical signals that the organism usually produces itself to control specific functions, like controlling growth. Auxin is important for the plant for a number of developmental stages, Such as the development of roots and formation of leaves. We can use these hormones to promote new growth in a plant cutting which will ultimately form a new plant.

http://www.biology-pages.info/A/Auxin.html

This mode of producing new individual plants is called vegetative reproduction. This requires only a single plant to produce multiple offspring which are clones of the original plant, since they have the same exact genetic makeup of the parent plant. This is also known as asexual reproduction.

The end of the cut stem forms a collection of non-specialized cells (called a callus). The callus can develop into lots of different types of cell and will grow the cells needed to produce a new plant by developing roots and stems.

http://science.howstuffworks.com/life/genetic/cloning1.htm

Cloning is important as it allows a specific variety of a plant to be obtained when there are no seeds available.

Detailed Explanation

Vegetative propagation is the production of new plants from only a single plant, using cuttings from the original plant; including leaves and stems. This is a form of asexual propagation as only a single parent is needed and results offspring which is genetically identical to the parent plant. Many plants reproduce by vegetative propagation, can also be artificially induced using rooting hormones.

https://www.sciencelearn.org.nz/resources/1662-vegetative-plant-propagation

Hormones are chemicals found in the plant that regulate plant growth. The main class of plant hormones are auxins, such as the important Indole Acetic Acid (IAA) which promotes cell elongation.

https://www2.estrellamountain.edu/faculty/farabee/biobk/BioBookPLANTHORM.html

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After we made the plant cutting and it was placed into the soil, adventitious roots grew from the buried end. These are roots that develop from unusual places such as stems and leaves.

The ability to produce roots at the end of the cut stem and leaves at the part exposed to the air and the sun is due to the ability of the plant cells to re-differentiate (change to a different cell type with a new role within the plant) , otherwise known as totipotency. This is a characteristic of certain plant cells that are capable of regenerating a whole new plant. This can arise when the mature plant cells re-enter the cell cycle to resume cell division. A callus, a mass of non-specialized cells, forms at the base of the cut stem. This callus then allows for the development of new roots, shoots etc and can eventually form a new plant.

http://plantsinaction.science.uq.edu.au/edition1/?q=content/10-2-1-concept-totipotency
http://science.howstuffworks.com/life/genetic/cloning1.htm

Advantages of cloning include the mass production of plants without the need to use seeds. Additionally, as all of the plants would be genetically identical, any desirable traits present in the first plant would be expressed in all of the plants produced in this way. However, there are downsides to having all of your plants being genetically identical, as this would lead to a reduction in genetic variation within your plant population. If these plants were to be exposed to a new threat (such as a new virus, environmental change etc.) all of the plants would share the same weaknesses to these changes.
http://www.bbc.co.uk/schools/gcsebitesize/science/add_ocr_gateway/living_growing/cloningrev1.shtml

Applications and Research

Applications

An interesting possible branch of cloning is reproductive cloning, although this has not yet been legalised or properly carried out. This essentially allows for the duplication of any existing organism (including humans).
http://science.howstuffworks.com/life/genetic/cloning1.htm

Another branch of cloning is therapeutic cloning. This allows specific cells, genes and tissues to be generated rather than whole organisms. This advancement in technology can be used to generate skin, cartilage and bone tissue and can be used where skin grafts or transplants are not an option. Also, therapeutic cloning offers significant potential in the cure of genetic disorders.
https://www.bio.org/articles/value-therapeutic-cloning-patients
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2323472/

Research

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The process of cloning has also allowed the preservation of endangered animals. In research carried out by Mizutani et al. (2016), the process of nuclear transfer was applied, using urine-derived cells to clone mice. This method seemed to be relatively successful and produced cloned mice with normal fertility, proving that urine-derived cells can be used as a non-invasive cloning method for protecting endangered mammals.
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4817122/

Investigation

Try rooting the plants from other plant parts such as the leaves and see if it is possible, you might just be surprised from where the roots can develop.



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Subject

Biology

Education

Primary
Secondary

Time Required

1 day or more
Preparation: 1 hour
Conducting: 1-2 days
Clean Up: 30 minutes

Cost

10 – 25 €

Recommended Age

6 – 9
10 – 12
13 – 16

Number of People

4 participants

Supervision

Required

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Location

Indoors
Outdoors
Laboratory

Materials

Plant to take cuttings from
Kitchen knife or scissors
Rooting Powder
Soil
Plastic box
Plastic Bag

Contributors

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Sources

Introducing gene technology

Regrow Cabbage: Vegetative Reproduction and Cloning Plants

Mitosis and cell specialisation

Advanced-Level Science Projects: Botany

Reproduction in Plants e learning science Asexual Reproduction

Vegetative Reproduction – Artificial Propagation

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Reproduction in Plants

Human Cloning

Animal Cloning

Additional Content

The Science Behind Dog Cloning
(Beginner)

Why plant ‘clones’ aren’t identical
(Intermediate)

The Science Of Human Cloning: How Far We’ve Come And How Far We’re Capable Of Going
(Intermediate)

Variation
(Intermediate)

Cloning Could Save Endangered Giant Pandas, Researchers Say
(Intermediate)

Human stem cells created by cloning
(Advanced)

Human cloning: can it be made safe?
(Advanced)

The future of cloning
(Advanced)

Cloning humans? Biological, ethical, and social considerations
(Advanced)

Cite this Experiment

Aquilina, M. C., Fenech Salerno, B., & Ghirxi, D. (2020, August 11). The Biology of Cloning Plants. Retrieved from http://steamexperiments.com/experiment/the-biology-of-cloning-plants/

First published: **August 11, 2020**
Last modified: **August 11, 2020**

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