

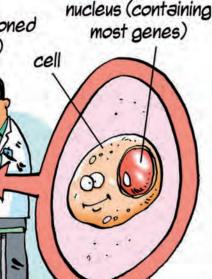


MOST ORGANISMS RECEIVE THEIR GENES FROM TWO PARENTS, IN AN EGG CELL AND A SPERM OR POLLEN CELL. CLONES RECEIVE ALL THEIR GENES FROM ONLY ONE PARENT.

> A CELL IS TAKEN FROM

THE ORGANISM TO BE CLONED.

organism to be cloned (e.g. a human)



THE NUCLEUS IS REMOVED AND THE REST OF THE CELL IS THROWN AWAY.



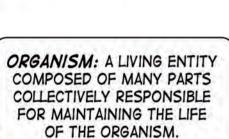
nucleus From organism to be cloned

AN EGG CELL IS TAKEN AND THE NUCLEUS REPLACED WITH THE NUCLEUS OF THE ORIGINAL ORGANISM.

> nucleus removed From egg cell

THE EGG NOW CARRIES THE GENES OF THE ORIGINAL ORGANISM.

egg cell



DESPITE HAVING IDENTICAL GENES, CLONES ARE NOT IDENTICAL. THIS IS DUE TO DIFFERENT LIVING ENVIRONMENTS AND SMALL DNA CHANGES DURING CELL DIVISION.

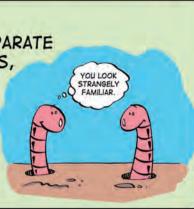




**EMBRYO** cells dividing

**GENES** ARE SECTIONS OF THE MOLECULE, DEOXIRIBONUCLEIC ACID (DNA). THEY PASS INFORMATION ABOUT HOW WE ARE MADE, FROM ONE GENERATION TO THE NEXT.

NATURAL CLONES: EMBRYOS DIVIDE AND SEPARATE FORMING IDENTICAL TWINS, SEVERED EARTHWORMS REGENERATE, YEASTS BUD AND SOME PLANTS AVOID POLLINATION AND GROW COPIES OF THEMSELVES.



## THERAPEUTIC CLONING

(GROWING PART OF AN INDIVIDUAL)







I CAN GROW INTO ANY CELL I LIKE.

stem cell

CELLS CAN BE TAKEN FROM THIS EMBRYO. THEY ARE CALLED EMBRYONIC STEM CELLS. THEY CAN BE GROWN INTO ANY OF THE BODY'S MANY CELL TYPES.

STEM CELLS CAN POTENTIALLY BE USED TO REPAIR ORGANS SUCH AS THE LIVER, SPINAL CORD AND BRAIN. THEY CARRY THE ORGANISM'S OWN GENES AND ARE THUS LESS LIKELY TO BE REJECTED.

ADULT STEM CELLS ARE FOUND IN FULLY DEVELOPED ORGANISMS (FOR EXAMPLE IN THE BONE MARROW BLOOD AND LIMBILICAL CORD). THESE CAN BE STORED FOR LATER TREATMENTS.

## REPRODUCTIVE CLONING

IF THE EMBRYO IS PLACED IN A NATURAL ENVIRONMENT (LIKE A WOMB), IT WILL GROW AND DEVELOP AS NORMAL.

FUTHI IS A CALF CLONED FROM A DAIRY COW IN SOUTH AFRICA. IT IS EXPECTED THAT FUTHI WILL BE A GOOD MILK PRODUCER, JUST LIKE HER OLDER TWIN.



CLONING CAN BE USED TO INCREASE POPULATION NUMBERS OF ENDANGERED SPECIES: THE COELACANTH IS ONE SUCH POSSIBILITY.

(GROWING A WHOLE INDIVIDUAL)



HOWEVER, THE LACK OF GENETIC DIVERSITY MAKES THE SPECIES VULNERABLE TO ENVIRONMENTAL CHANGES LIKE NEW DISEASES.

## WHAT DO YOU THINK ABOUT CLONING?



ARE YOU DESTROYING LIFE IF TAKING STEM CELLS RESULTS IN THE EMBRYO DYING?

DOES A CLONE HAVE ITS OWN SOUL?

CLONING REQUIRES LOTS OF EGGS. WILL WOMEN BE EXPLOITED FOR THEIR EGGS FOR HUMAN CLONING?



INFERTILE COUPLES MAY SOON BE ABLE TO CLONE THEMSELVES .

WHO WILL DECIDE WHO IS CLONED - ONLY THE VERY RICH?

SHOULD THERE BE A GLOBAL BAN ON CLONING? REPRODUCTIVE, OR THERAPEUTIC TOO?









