Title: bio-medi English

Genetic Engineering

- ✓ **Instructor:** 트래비스 피터
- ✓ **Institution:** 충남대학교
- ✓ **Dictated:** 김은비, 박원정, 한소영, 김보미

[00:00]

I think same difficulty level and from this scores there's no [00:39] scores there's no one tests higher scores another tests, there about the same.

All the questions both quest come right from here lectures right from the power point or the lecture note.

I think most difficulty probably was vocabulary, I think so. Vocabulary showed most problems.

So, next time, I'll show you new studied the vocabulary.

Today's lesson, no vocabulary list but in the lesson I underline some words, in the lecture I underline some words so studied those words.

Okay, I will collect the papers, and I will give you the today's lecture note. Today we'll talk about bio-technology genetic engineering specifically today we'll going to just talk about cloning method.

Okay, today … today we will talking about cloning. Just to let everyone know the lecture material I get I told you it's from Korean professors and actually you should some of the material they gave me, actually what they gave me much much more difficult I think than what I am giving you.

So , I take that material they give and then I am picking and choosing just one small part and we do one part of it because they give, they're giving you a lot of information

So, I think that'll be little difficult so I'm trying to make this a little easier for you guys.

Today, so today we're just going to be talking about cloning and the different types of cloning and then some of the problems and some of the ethical concerns about cloning and societal problems.

[03:05]

Okay, anyway today I told you we're going to be talking about three types of cloning.

You can see on the overview here, what is the first type? …

What is the first type? You. You can see the first type of cloning. Look at your notes.

Embryo, embryo cloning. What is the embryo cloning? Do you know what the embryo is?

Very good, embryo is beginning stages of a growing animal, it is embryo okay?

So, today we're going to be ease that word and we're going to be hearing that word the embryo, bring the talking about different stages of a growing animal or growing organism.

And that is part of one of this cloning processes okay?

Alright so embryo cloning, what is this? Embryo cloning we're going to find out today is kind of easy cloning if there is easy cloning, this is very long-take cloning way to clone.

And this is done and a laboratory pretty easily. We're going to talking about another type, another method of cloning okay?

Which is used in these two types of cloning, right what is the next type of cloning? Okay that was better.

Adult DNA cloning, Adult DNA cloning now this type of cloning is the cloning that a lot of people are very skeptical or they're worry about this type of cloning.

There're a lot of ethical issues about this type of cloning because adult DNA cloning means cloning another exact replica living thing.

So, making two of something right? For example, many of you today we were talking about Dolly the sheep, you guys familiar with that? Cloning experiment?

Right, Dolly the sheep was an exact replica or an exact clone of an adult living sheep.

The DNA exactly the same was a living animal, living sheep.

[06:00]

Ah we're going to find out today again there was some problems with that cloned animal.

That is adult DNA cloning also called reproductive cloning it says … reading here. As of January, so going back January 2002, it's in not been tried on humans not that we

know of.

However, there were rumors which means we're not sure of it is ture or not ture but there were some rumors out there that this scientist or doctor his name in here Severino Antinori, he is an Italian doctor.

And there were some rumors that this doctor has done cloning on humans and actually cloned humans okay?

He had got some consent from some women who were willing to do this type of cloning and he has reported that he has been able to do this.

Of course, no one really knows for sure he's keeping everything very secret, who the women are, where they are living, and the details.

So, these rumors out there what I really sure it's ture or not ture.

Anyway um … like I said adult cloning or cloning humans of course some serious legal issues, there are serious ethical issues about this, we're going to talk about today.

And the third type of cloning, sir? Very good, yes, therapeutic cloning. Therapy what does that mean? What does therapy mean?

Yes therapy meaning is giving you some help for a problem right? You go to the doctor you get therapy so therapy is healing some sickness.

So, therapeutic cloning, what are they cloning? Anybody have a guess? Therapeutic cloning, what do they clone? Organ

Therapeutic cloning basically is a cloning organs cloning specific parts right?

So, it's not cloning entire living thing but it's cloning just parts. Huh! That sounds very good, sounds very useful hah?

As you know many people get sick or people get some sort of a health problem maybe their heart is not good.

[09:04]

Many people of heart failure heart problems, some people have kidney problems right? Or liver problems or other organ problems.

Therapeutic cloning wow! We can clone someone's organs your organs my organs, we can take stem cell and we can take organs and then if we get sick or we have some diseases we just go to our organ bank and take heart please and they'll give you a heart.

And what is so great about this? Well, these days if you have a … if you need a kidney or you need a heart what happens?

If you needed a heart, what do you have to do? Where would you go? You go to hospital and they will do some tests oh yes, oh your heart is terrible, you are going to die 6 months, you need to get a heart.

So, you say well yes, I want one. How do I do it? Oh well, you have to wait. On this list, and there is belong list.

And your name has gone to bottom right? Oh no, 6 months?

Do, you can see there is a lot of people not just you that need a heart right? There are many people who are on this list, or on this list organ donation list.

So, the chances of getting a heart not so good, and then another part is that can you have any heart? Any ones heart? Can you get? No, what do you … what is the problem?

Maybe your name comes up on the list yes hey, your name and we have a heart. Yes~! Oh nope, sorry what's the problem?

Blood? Blood type, so there is a different thing right? The heart has to be a perfect kind of, a perfect match for you, the blood type has to be the same.

Many things have to be the same, has to be like a younger person, and … many things have to look at.

So, even you get your chance comes up, you still might not be getting the heart quickly.

[11:55]

So, Therapeutic cloning, Therapeutic cloning we have your stem cells we clone your organs right?

So, of course blood type is perfect, everything is perfect. It's going to be a perfect match for you.

Many scientists, many doctors Therapeutic cloning is definitely need it, it will save lives it's perfect we never have to wait an waiting list for organs.

We don't have to make a match any more people can have their own organs already, when they need them hum … sounds very good right?

Probably, but this still many people, maybe you go to the nearest 교회, right?

My family is catholic my brother my younger brother is a priest and I tell them, I teach cloning.

Of course, I tell them I teach both scientific and religious parts but yeah people who believe in religion or believe in God, Christians and Catholics especially believe strongly that any embryo or after a um … conception [13:25] and you have an [13:29] or growing embryo that is a life a human life.

And if you damaged or killed that life then you are committing murder, seriously have a very hard line on it, murder it's a worst thing you can do.

And when you do therapeutic cloning we are going to find out today therapeutic cloning you have you using what are you using to get this cells, you using stem cells but you growing in embryo.

So, what happens you have an embryo, and then you separate those cells and which kills the embryo so the embryo dies.

And so my brother or strong faith people will say that you are murdering you are murderer and so that very strong about that and against it.

Scientist some scientists and many doctors are saying therapeutic cloning is the thing of the future that is going to save lives which in theory yes, saving lives but killing lives.

Hum, very interesting. Okay so those three types of cloning.

And now let's go to the reading, first of all you can see in all of our lessons I put in the learning objectives.

[15:00]

Learning objectives what do I you do learn from the lesson so I want you do identify three types of cloning we just talked about.

I want you to know the different between embryo cloning and STNT we were talked about that today's lecture.

I hope that you can explain different points of view on cloning issues and for homework today you'll be doing a little bit of that. Don't worry nor difficult.

I want you to be able to describe the impact in risks of cloning we're talk about that later and also we're going to investigate the various issues associated with cloning.

Okay, we'll start reading with what is cloning we're start in the back. You. What is cloning?

[Student Speaking]

Okay, wow that would be great, I want to go … I want to go play with my friends, I don't want to be teaching here at this lecture so I just need my clone.

To come in and teach my class you think it's professor Travis, I'm actually out that the skate park playing with my friends.

Interesting, can that be true? Well, let's find out what exactly is cloning? Next.

[Student Speaking]

A-ha. Really? There are clones around us now? Are you a clone? No? Are you sure? Alright.

Well basically, cloning, what is cloning? Cloning just means you have the exact same DNA as another living thing. That means that you're a clone.

So are there clones around us these days now? Yeah. What do we call them? Twins. Identical twins.

[17:58]

So, maybe you know someone who is identical twin. So you can call them a clone. Well, probably they won't like that, maybe you shouldn't. But it's true.

A clone just means they have the same exact DNA of someone else. Alright.

Well, how is cloning done?

So there are two methods. Two methods of cloning, artificial embryo cloning, talk about it little bit more, and SCNT. Somatic Cell Nuclear Transfer.

Somatic Cell Nuclear Transfer is used for reproductive cloning. And for therapeutic cloning. We'll talk about that more detail today too.

Dolly the sheep. 1997 Dolly came. Many of you know about Dolly. Why is she so much attention about Dolly? What was so special about Dolly the sheep? Where is one of my genuius student?

Why was Dolly so special? First animal clone. That was close. First mammal. Dolly was the first mammal to be cloned from an adult cell. So they took the cell, they took Dolly, the cell that they used to clone Dolly, was taken from an adult sheep.

The Sheep was already old. Already grown up. And they took one of this cells from

that sheep and they were able to clone it. And grow this new sheep. Which was exactly the same as this older one.

And that was very amazing. So many people “Oh my gosh!” I could clone myself. You guys are university student, clone yourself. Interesting. It was very.. almost.. I remember when I heard it, I think you guys were probably little young. You don’t remember exactly the day but I remember hearing on the day that happened.

I was in my room at home and I heard it on the radio. “Oh my gosh!” I could clone myself! And then I could have someone do my homework. Something like that.

[21:06]

That was very amazing. Because it was the first time that mammal have been cloned from an adult cell.

Anyway, we’re going to talk more about these cloning techniques. So let’s go to artificial embryo cloning. Where are we? You.

[Student reading textbook]

This type of cloning is just exactly the same how identical twins are created in nature. But, the differences that they’re done in the laboratory, this type is done in the laboratory.

Here we can see identical twins here two girls. And we’re going to find out what is happening during identical twins naturally. Next reading.

[Student reading textbook]

Zygote. Ok? There’s a vocabulary word for you. Zygote. What is a zygote? When the egg and the sperm come together we have a new cell. That is called the zygote. So it’s a very very beginning stage of this growing being. And that is called the zygote.

Here you can see. Here’s zygote. Zygote, what happens if the zygote stars to divide? The cells divide and grows into an embryo and then grows finally into a human. This is a human baby.

[24:00]

During natural identical twins, what happens is the egg and sperm come together we have a zygote the cells starts to divide but for some reason, we don’t really know why, some women more than others, the two cells separate for some reasons.

They separate and they continue growing on their own. And then what happens is you have two identical twins with the same DNA because they came from the same zygote. The zygote was the same.

So same zygote, and so then we get, they split apart, and they grow into two different individuals, same DNA. Ok. Good. Next reader.

[Student reading textbook]

Alright. So artificial embryo cloning, or embryo twinning, this is done in vitro. So this is done in laboratory. That's where we have a main difference between these two types of cloning. They are manually separated.

So the cells, zygote, when it is dividing, two cells, four cells, 8 cells, in the laboratory they just separate those cells. They pull them apart manually.

So depending on how many cells they pull apart is how many clones you're going to have. So they can make two, or four, or six, depending how many they separate. And how many actually keep growing.

So, once they separate the cells, they grow them in the laboratory, they continue dividing and growing until the certain point.

[26:58]

And at the right time, they will then put these embryos, growing embryos into a surrogate mother. And there is a vocabulary for you. Surrogate mother. What does a surrogate mother do?

What does surrogate mean? Anybody? Why do you, why do we need surrogate mother? What does she do? Surrogate mother. Right. pregnant. madam.

She is only, surrogate mother is only used for carrying this growing embryo until it can be born. So there doesn't have to be any genetic resemblance to this growing embryo, all we need is her body parts. Her womb. And her ability to grow one of these embryos.

So that is artificial embryo cloning.

The next method, we're going to find out is SCNT. Next reading.

[Student reading textbook]

So this is how Dolly was created. Same thing we're getting a clone, it's like embryo

cloning but different method. Ok. Next. What does SCNT mean.

[Student reading textbook]

So we're talking about SCNT cloning. SC, Somatic Cell. What is somatic cell? Somatic cell, any cell in your body except for the reproductive cells, reproductive cells also called germ cells, and those cells are sperm cell and egg cell.

[30:06]

Sperm cell and egg cell only have one set of chromosomes right? But somatic cells have both sets. Two sets. So in SCNT we need a somatic cell which has two sets of chromosomes. Alright. Next.

[Student reading textbook]

Unique. Special. Your DNA is only for you. Right? No one else has your DNA. Right? Unless you are.. are you identical twin? Are you a clone? Yes? Are you an identical twin? Are you twins? No. Ok. You are not a clone.

Alright. Everyone has their own special DNA. And DNA is found where? In the nucleus of your cells, right? And the nucleus of the cells have your DNA.

So SCNT cloning we need DNA, because we're cloning something and that means we need nucleus. We get to use the nucleus of our cell. Ok. Very good. Next.

[Student reading textbook]

Well, first of all, we have SCNT so T is transfer and that just means moving. What do we going to be moving? What do we going to be transferring? In this cloning, what do we think we are transferring? DNA. So we're transferring and we know DNA, we find in a nucleus so transferring a nucleus. Ok. Good. Continue.

[Student reading textbook]

[33:22]

Ok. Good. So to make Dolly the sheep, they used SCNT cloning, first they needed somatic cell, they got it where? For Dolly, they got the somatic cell from an adult female sheep.

And then they needed an egg cell, they took an egg cell where they removed nucleus from the egg cell, they didn't need that, and they put the somatic cell nucleus into the egg cell and they took some chemical, because this egg cell, now

this egg cell needs to grow.

So they had to get some chemical, put chemical on there and then…
Now this egg cell needs to grow.

So they had to kick some chemical, put chemical on there and then it starts to grow.

At a certain point, they took that growing embryo, they put it into surrogate mother and after some time, dolly is born.

And now we have dolly, who is a clone of this adult sheep.

Ok. This is SCNT cloning.

Dolly was an exact generic [?34:34] of the adult female sheep that donated the somatic cell nucleus to the egg.

She was the first ever mammal to be cloned from an adult somatic cell.

Ok, that's why dolly is special.

First mammal to be cloned from an adult somatic cell.

But, how those SCNT differ from natural way of making an embryo.

How is SCNT different from naturally.

Well, the difference, all of you can probably understand, the difference is just where are they you get your chromosomes, the origin of the chromosomes, of course.

Naturally, when in nature when you have something born or animal born, half of the chromosomes come from the father, right, from sperm cell, half of the chromosomes come from the mother, from the egg cell.

But with SCNT cloning, all of the chromosomes are coming from the somatic cell, so all of the chromosomes are coming from one living organism.

And in the case of dolly, it was some adult female sheep.

Ok. Where the chromosomes are coming from?

[36:01]

One donor.

Now, to wake you guys up a little bit, we're going to do a little activity in the classroom.

This is cloning, we are going to be cloning, we are going to online laboratory, and we are going to clone a mouse.

We're going to clone this mouse using SCNT cloning.

I'm going to need your help.

You're going to be my laboratory assistants.

And first will be you, sir.

So, this is a generic experiment, university of Utah, hopefully it works.

This will help you guys, kind of get a visual of what's happening with SCNT cloning.

Ok. Here we go.

Using what you now all of you know about SCNT cloning, maybe you knew about this before, but we are going to try it out, our mission is to create a genarically identical clone of this mouse, Mimi.

Mimi is, as you can see, Mimi is a female brown mouse.

We're going to be cloning her.

Ok. So, sir, can you come up here?

And I need you to click on Mimi starting our experiment.

Click on Mimi to begin. Very good.

Now we are going to our laboratory, this is a, the mouse cloning lab, and when we do SCNT cloning, this is what we'll need now.

Remember this is adult DNA cloning, when you do, when you're making a new living animal, you're going to need three animals to do it, ok?

Depending on what you're cloning, with dolly, they needed three sheep.

With our cloning mice, we're going to need three mice. Why? Why do we need three?

Well, first we need this mouse.

Why? What do we need from this mouse?

Somatic cell, we need a somatic cell.

This mouse will give us a somatic cell.

So we need this mouse, somatic cell donor.

Then we need this mouse.

[39:00]

Why do we need Magdo? Here's Magdo. Why do we need Magdo?

Right. Remember we need an egg cell, right? We need an egg cell.

We don't get the egg cell from Mimi.

Already we're taking cells from her, so we need Magdo to get an egg cell, so we're going to take an egg cell from Magdo.

You can see Magdo is a black mouse.

And then we need a third mouse.

Why do we need Momi?

Right, we talked about this, we need a surrogate mother.

We need some mother to carry this clone that we're going to make.

So we need Momi, will be our surrogate mom, ok.

You can see she's white.

But then in our laboratory also to do this SCNT cloning, we're going to need some tools, we need our microscope, we need Petri dishes, we need a sharp pipette, we need a blunt pipette which means this blunt pipette is going to give us some suction or air, and remember we talked with dolly, when they're making dolly, they needed chemical to start mitosis, cell division.

So we have this chemical called [?40:26] and that's going to help the clone start to grow, mitosis.

Sir, can you click 'let's clone Mimi'?

Ok, there was some sound effect but we don't have volume.

Ok, sir, thank you very much. You did a great job so far. No problems.

Alright, why don't we have a, why don't you come up? We need a female lab

assistant.

Here we can see that there are six steps, we're going to follow today, six steps.

The first step, we need to isolate our donor cells.

Now remember the cells that we need donor cells, we need a somatic cell, and we need an egg cell.

So, our beautiful lab assistant is going to help us remove a somatic cell from Mimi, and then egg cell from Magdo, and put them in the correct Petri dish.

Very good.

You're a professional scientist.

That's very excellent. Ok. You're done. Thank you.

Alright, let's have a, why don't you come up?

[42:01]

Get you some exercise, you're little sleepy today.

Alright, we go to step two.

Alright, already we're at step two. Good job.

Remove and discard, discard means throw away, the nucleus from the egg cell.

We have an egg cell, but we don't need the egg cell nucleus.

They only has one set of chromosomes, we don't want that.

So, we're going to take out the nucleus, so put the Petri dish with the egg cell under the microscope.

Very good.

Alright. Calm down. Easy, don't want to make a mistake.

Alright, we're going to hold the egg cell with the blunt pipette, so use the suction to hold it. Good.

And now, you're going to remove the nucleus with the sharp pipette.

Nice. Alright.

So now we have an egg cell with no nucleus.

That is called e-nucleated egg cell.

So we have an e-nucleated egg cell. Very good.

You're also A+ today. Yes, you can sit. Very good job.

Alright, sir, come on up.

You're a next lab assistant.

What he is going to do, step three, now you can see here is our transfer, what is he transferring, well he's going to transfer the somatic cell nucleus into the e-nucleated egg cell.

This is a very big step.

I don't know if he can do this, but we'll see.

Ok, so, you have to move the e-nucleated egg cell from the Petri dish to the nuclear transfer dish.

Almost a big mistake.

Ok. Now move the somatic cell to the nuclear transfer dish.

Ok. Now move the transfer dish under the microscope.

Alight. Good.

We have to move this nucleus from the somatic cell, we have to put it into the egg cell, so hold the somatic cell with the blunt pipette. Good.

Now, remove the somatic cell nucleus with the sharp pipette.

Keep going up.

Sharp pipette. Up here.

Nice. Good.

[44:59]

Now we keep that nucleus, we want that nucleus, so now put it into the egg cell.

Great.

Alright. You did it. it's working.

Alright. Now that you've substituted, so we change the nucleus, this egg cell now has a new nucleus.

You can see the timer was going around for time.

What's happening?

When you put in the new nucleus, you put in the somatic cell nucleus into an egg cell, it takes some time for that egg cell to understand that it now has a different nucleus.

So take some out of couple of hours for it to kind of to reprogram the cell to understand that this is, the somatic cell is now in an egg cell.

Ok. So couple of hours goes by, very good, sir. Excellent job.

That was the most difficult step and you succeed it.

Ok. Now let's go to a, how about you, come on up.

Now we're going to go to the next step, the next step is, we have our zygote here, right?

This is like our new egg cell, it has a somatic cell nucleus with two sets of chromosomes, so it's ready to start growing.

So, it doesn't grow by itself, though.

We have to stimulate it.

So we're going to stimulate cell division, proceed to next step.

So, we need our chemical, we're going to stimulate the cell division.

So, go get some of the chemical, up to the top, yep, good.

Now put some of that on to our egg cell. Alright.

Now we're going to wait, it's going to start to grow.

Two cells. Mitosis, four cells. Eight cells, it's working. Sixteen cells. it's finished.

So we wait, takes a few hours maybe like seven or eight hours, but after seven or eight hours, we have sixteen cells, it has grown into a sixteen cell ball that is called a morula.

So now we have a morula.

So first we started with a zygote, now we have morula, also this is a stage of the embryo.

So we're doing very good. You're done. You did it. Congratulations. Professional mitosis grower.

[48:04]

Now we'll go to the next step.

Come on up.

We have our morula, we have this embryo, what do we do now at this stage, what do you think? What do we have to do?

Who is going to come out?

The surrogate mother. We're going to see Momi. Ok.

Proceed to next step.

Oh, this is difficult, how can we get this embryo into Momi.

Why don't you try. I don't know.

Wow, that's very easy.

It takes about nineteen days with a mouse.

For mice, nineteen day pregnancy.

Well, how convenient. Very fast.

For humans it is ten months, right?

We're waiting for a long time, but here, nineteen days, after nineteen days, this embryo has grown now, it is ready to come out.

Thank you. Very good job.

I'm sorry, we don't need a scientist.

Now we need a doctor because we are going to deliver this baby mouse.

Sir, you look like a doctor. You come out up.

And we're going to deliver the baby mouse.

Here comes our clone if we succeed it. We'll see if we succeed it or not.

Click on Momi.

Oh my goodness, that's a big one.

Alright. Congratulations. We did it. You've created a baby mouse.

This is a clone of Mimi.

Now, what colors is this clone, sir?

Is it going to be white, brown, or black?

Well, yes, he is correct.

Why is it brown?

Well, because the generic material, we got all of our DNA from the somatic cell, the somatic cell came from the brown mouse Mimi.

So she is too brown. We'll call her mini mimi.

Alright. Did this really happen?

Click on 'did this really happen?'

Ok, and yes. Actually this is actual true cloning experiment.

This exact experiment happened.

The egg cell donor was a black mouse, here you can see, the somatic cell nucleus donor was a brown mouse, the surrogate mother was a white mouse.

They made two clones of this somatic cell donor.

And you can see they're both brown.

University of Hawaii 1998. Ok?

[51:05]

Today in our mouse cloning laboratory, we were successful and of course, it was very quick and it looks pretty easy, right?

Just transferring some nucleuses and working with some cells.

But, of course, with cloning, there are many risks and it's not easy.

Out of… for example, there's a high, high failure rate with this type of cloning.

Out of a thousand times, maybe you have nine hundred and seventy failures out of a thousand which is about… so the success rate is 0.1 percent to 3 percent success.

Not very good, right?

So that's why many people, they disagree with cloning.

Because there are so many times, like you heard about dolly the sheep.

"Wow, dolly, amazing!"

Well, nine hundred and seventy dollies died.

And finally they got one, right?

So we have to remember that the success rate of cloning is not good.

Why?

Well, many times the egg cell and the new nucleus, the somatic cell nucleus, don't match and so it dies.

Sometimes the egg cell, the egg does not divide properly.

They give it the chemical, the mitosis is not correct, it dies.

In plantation, they put it into the surrogate mother.

Ok, when they do that part, it dies. It doesn't work.

And the last part, during pregnancy, when the pregnancy, when the surrogate mother is giving birth, there's a problem and it fails and dies.

So, very high failure rate.

Other problems are after, even after the clone comes out of the surrogate mother, there can be problems during later development.

For example, LOS.

LOS called Lard Offspring Syndrome.

For some reason, scientist noticed that many of these clones, they have LOS which means their organs and body parts are much larger than normal.

Strange. Why?

They don't know exactly why.

But it causes many breeding problems, blood problems and many other problems.

So the clone will die early or have many problems during life.

It's a little unpredictable.

[53:59]

Sometimes it happens, sometimes it doesn't.

And then there are also problems.

Clones can have kidney or brain malformations.

So developmental problems and impaired immune systems.

If you remember dolly the sheep, dolly the sheep did not do very well.

Dolly the sheep was getting old very quickly.

Ok, they noticed her cells were showing signs of aging.

And dolly the sheep got osteoporosis which is a disease of your bones and your joints.

Ok, we talked about problems.

We talked about large offspring problems, problems after, late after the baby is born.

Alright.

Next is abnormal gene-expression.

Ok, remember we took the cell, in SCNT cloning, the cell, the nucleus the DNA comes from the somatic cell.

And we putting it into an egg cell.

So the gene expression is going to be different, right?

Everything they have to re-program.

That nucleus has to be reprogrammed to think it is now the nucleus of an egg cell

that now has to grow into an embryo and grow into a new living creature.

So they have to re-program the DNA.

And make sure that the genes are being expressed at the right time and in the right sequence.

So you can imagine this is very difficult.

Scientist must re-program the nucleus to behave like it's a growing embryo, alright.

So a lot of times that is incomplete.

There're not, they can't do it completely.

And so you have failure, the clone never, never makes it

If they can't completely re-program this cell, then it's not going to develop properly.

It's going to die.

So gene expression can cause a lot of problems in cloning.

And another one of the problem, the last problem we'll talk about is telomeric differences.

Telomeres, what are telomeres?

If we look over here, you can see here is a chromosome. Ok.

Chromosome looking like a X here.

And at the ends of the chromosome, here, these are called telomeres.

Why we're talking about them?

Well, every time cells divide, anytime a cell divides, the chromosomes get shorter, the telomere length gets shorter and shorter.

[57:00]

So for example, my telomeres are shorter than my son's, ok?

Because his cells are still dividing.

Every time they divide, they get a little bit shorter.

So remember in SCNT cloning, if we take a somatic cell from an adult like in dolly's

case, the telomeres are going to be shorter.

Then they should be.

Usually in an egg cell, it's a new cell, right?

So the telomere length would be very long.

But when we take a somatic cell, those telomere lengths are going to be shorter.

Does that make a difference?

Well, what happened with dolly, what we saw with dolly, scientist noticed that dolly's cells, her telomere length would much shorter than normal, than a normal sheep.

And dolly, like I told you guys, dolly what showing was getting old very quickly.

Her cells were aging very quickly.

And she got osteoporosis and she died early.

But it's very strange because scientists are confused because other cloning experiments they do with mice or with cows, they did the cloning, the clones showed longer than normal telomeres.

Um, very strange.

So the telomere lengths were longer with mice and cows and showed signs of youth, acting younger than normal, than the normally conceived cows or mice.

So scientists are little confused but we know we definitely know that there is some issues with telomere length.

Ok. So that is, these are all some of the risks of cloning.

And the last part today, we are going to talk about, are the issues, some of the issues.

Now we talked cloning, all three of these types of cloning, reproductive cloning especially, but embryo cloning and also therapeutic cloning, there are many issues.

And we talked about like religion, for example, it has very strong stands on cloning.

Different political leaders have different views about this.

I'm not sure about in Korea, but how does you president, Lee myung park, think about cloning?

Is it legal to practice?

Does he support therapeutic cloning?

Anybody know?

Does anybody care?

Well, for example in America, George Bush, not president anymore, George Bush against the cloning.

[1:00:04]

One hundred percent against therapeutic cloning and against of course, any kind of cloning practices.

However Obama, now Obama is in office, he is a different political party.

He is democrat.

Obama is supporting therapeutic cloning.

He is supporting doing some scientific investigation into therapeutic cloning.

So he supports it in a way whereas George Bush did not.

George Bush is strong Catholic. Ok?! Christian believes.

So when we think about cloning we have to think about the benefits.

One of the benefits of cloning.

But we also have to understand the risks.

So we cannot have to weigh it out.

And remember cloning some people agree some don't.

I'd like to know what is your opinion on this.

But when we think about benefits, what are some of the good things about cloning?

What are some of the benefits that cloning has for us?

Can you tell me one good thing about cloning?

No? Do you want to try?

What is good, what can cloning be good for?

[Student Speaking]

I didn't hear you.

[Student Speaking]

Medicine, right.

Why is cloning good… anybody what do we say, one thing.

Helping sick people? Ok.

You have some sickness. You have a heart problem, you have a liver damage, you need to get an organ.

Cloning, therapeutic cloning can help us get organs quickly and that are matching our body.

Ok. So that's a good thing.

What's another benefit of cloning? Anybody?

[Student Speaking]

People who can't get pregnant.

Some women, they cannot have babies.

There is something wrong with their body.

They are unable to have their own child.

Does that mean if their body is not able to have a child, does that mean they can't ever have a, they can't carry their family or their genetic information?

That doesn't seem very fair.

[1:03:00]

So cloning could help a person who cannot have children, have a child with their DNA.

So they could pass on their family line or their special DNA.

Ok. That's true. Very good.

Any other benefits?

[Student Speaking]

Good. Or animals, right?

Yeah, did you hear what she said?

We can preserve endangered plants or animals.

That is a very strong argument for cloning, right?

Let's think about this.

In Korea, one example, you have that bear, the crescent moon bear.

There are, is it endangered?

Yeah, very seriously endangered species.

Using cloning methods, we could take some of those cells from one of these living bears.

There're not many.

And clone the bear.

And that make more, more and pretty soon we can save that species from extinction.

Yes, that's a good benefit, right?

Ok, so we know there are some benefits.

All of the ones you talked about very good benefits for cloning, alright?

Stem cells for research and medicine.

We talked about infertility which means you can't have a baby.

We talked about this.

Alright, but we also found out that there are a lot of risks.

And anytime we try cloning, we are killing, you are going to have a high failure rate, a lot of them don't make it.

So we talked about religion is strongly against it.

So we know kind of whom will it help? And whom will it hurt?

Well it hurts although clones that don't make it.

We have to think about how can it affect our lives?

How do others feel about it?

Say that we clone like with dolly, we clone and make the sheep, who is the parent?

Who is the mother and father of this clone?

Does clone have the family?

We have to think about that, right?

Who is responsible for this clone?

Is it the person that gave the somatic cell?

Is it the surrogate mother?

Is it the egg cell donor?

Who is the parent?

Who is responsible for a clone?

Ok.

[1:06:00]

So, in your notes here, you can see that we have several types of issues to consider.

There are ethical issues, ok?

In Korea, Dr. Hwang, doing research in Korea, using stem cells, right?

And ran into many ethical and legal issues and also a little dishonesty not telling everybody what was really happening.

But anytime you are working with stem cells or cloning, you're going to be some strong legal issues and ethical issues to think about.

And that's how professor Hwang got in trouble.

We talked about the social issues.

How this affects society?

For example, for making clones, how do they fit into society?

Are they equal to us?

Or are they just kind of like slaves?

You know, is there equality?

So we can see wow, this could cause some major social issues, right?

Is it clone the same?

What if a clone you, there were, cloning was legal and you go to get a job and your competition is a clone and the clone gets the job and you don't.

Is it fair for the clone?

Is it clone equal to you?

We have to think about that.

So in the notes, there are seven questions here.

These questions are all opinion questions asking you your opinion on cloning.

And I want you to choose two, only two, random, any two that you want to answer.

You just choose two of them and give me your opinion.

You have to write it in English.

But I think these questions are kind of interesting.

And you thinking a little bit, ok?

To answer these questions, I want you to try to, just answer the question fully, I think half of page for each answer should be plenty.

But if you want to write more, that's, of course, that's ok.

If you think that you answer the question a little bit just one sentence or two sentences, that's ok.

But maybe, I don't agree.

But that's your opinion.

So choose any two and answer that is for homework.

Ok?! We are finished. Very good. Thank you guys.