Why study plants

內蒙古農大普通生物學雙語課程

當代農業生技

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Lecture 7 biotechnology

- Campbell biology: Biotechnology
- Chapter 20 (but also RNAi in Ch 18)

1. Write the topic and concluding sentence
2. Turn the whole paragraph into a sentence of question and a an answer.

Building a Structural Model of DNA: *Scientific Inquiry*

Once most biologists were convinced that DNA was the genetic material, the challenge was to determine how the structure of DNA could account for its role in inheritance. By the early 1950s, the arrangement of covalent bonds in a nucleic acid polymer was well established (see Figure 16.5), and researchers focused on discovering the three-dimensional structure of DNA. Among the scientists working on the problem were Linus Pauling, at the California Institute of Technology, and Maurice Wilkins and Rosalind Franklin, at King's College in London. First to come up with the correct answer, however, were two scientists who were relatively unknown at the time—the American James Watson and the Englishman Francis Crick.

How to determine the structure of DNA, given DNA was convinced the genetic material?

Building a Structural Model of DNA: *Scientific Inquiry*

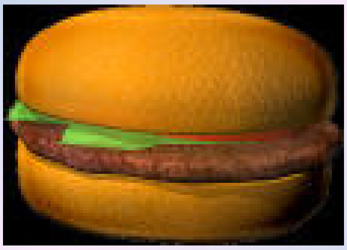
Once most biologists were convinced that DNA was the genetic material, the challenge was to determine how the structure of DNA could account for its role in inheritance. By the early 1950s, the arrangement of covalent bonds in a nucleic acid polymer was well established (see Figure 16.5), and researchers focused on discovering the three-dimensional structure of DNA. Among the scientists working on the problem were Linus Pauling, at the California Institute of Technology, and Maurice Wilkins and Rosalind Franklin, at King's College in London. First to come up with the correct answer, however, were two scientists who were relatively unknown at the time—the American James Watson and the Englishman Francis Crick.

topic

concluding

The arrangement of covalent bonds and three-dimensional structure of DNA were the focus.

Hamburger Paragraphs



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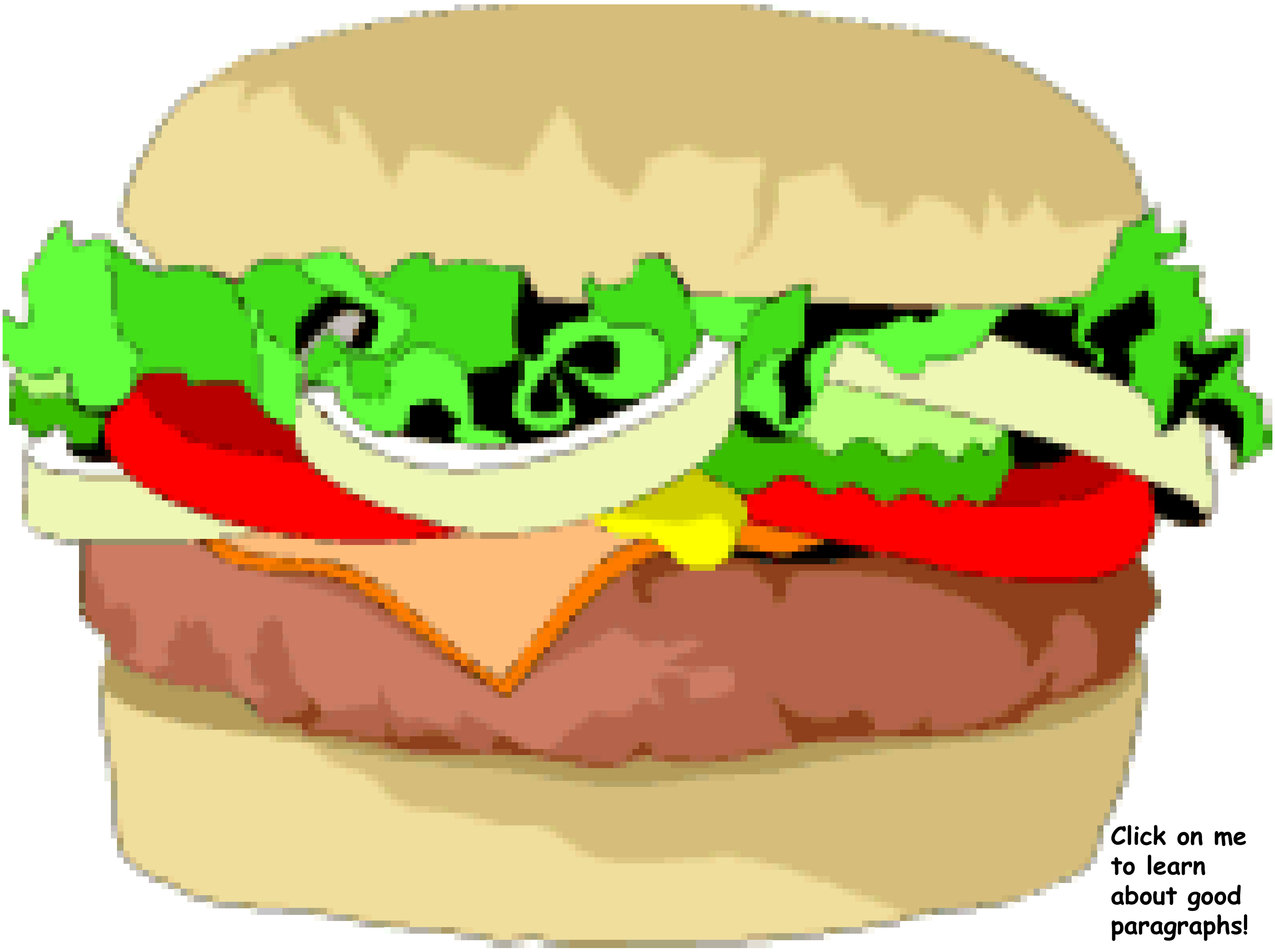
Paragraph Hamburger

The "paragraph hamburger" is a writing organizer that visually outlines the key components of a paragraph. Topic sentence, detail sentences, and a closing sentence are the main elements of a good paragraph, and each one forms a different "piece" of the hamburger.

When to use:	○ Before reading	○ During reading	● After reading
How to use:	● Individually	● With small groups	● Whole class setting



The Topic Sentence (Top Bun)

- **Very first sentence of your paragraph.**
- **<u>Always</u> needs to be indented.**
- **Tells what your paragraph is going to be about.**

There are many reasons that I love to teach. First of all, I love to teach because I love being at school. Another reason I love teaching is that the days go by quickly. A third reason I love to teach is because I love seeing a student understand something new. Finally, I love to teach because I love to be around kids. These are just a few reasons I love to teach.

Click here to return to the hamburger

The First Detail (Lettuce)

- Should **not** be the most important detail.
- Needs to follow directly after the topic sentence.
- Needs to be full of good "lettucy" details!

There are many reasons that I love to teach. **First of all, I love to teach because I love being at school.** Another reason I love teaching is that the days go by quickly. A third reason I love to teach is because I love seeing a student understand something new. Finally, I love to teach because I love to be around kids. These are just a few reasons I love to teach.

Click here to return to the hamburger

The Second Detail (Tomato)

- Still should **not** be the most important detail.
- Needs to follow directly after the lettuce sentence.
- Needs to be full of good "juicy" details!

There are many reasons that I love to teach. First of all, I love to teach because I love being at school. **Another reason I love teaching is that the days go by quickly**. A third reason I love to teach is because I love seeing a student understand something new. Finally, I love to teach because I love to be around kids. These are just a few reasons I love to teach.

Click here to return to the hamburger

The Third Detail (Cheese)

- Still **not** be the most important detail.
- Needs to start differently than other sentences.
- Needs to be full of good "cheesy" details!

There are many reasons that I love to teach. First of all, I love to teach because I love being at school. Another reason I love teaching is that the days go by quickly. **A third reason I love to teach is because I love seeing a student understand something new**. Finally, I love to teach because I love to be around kids. These are just a few reasons I love to teach.

Click here to return to the hamburger

The Last Detail (Meat)

- **Finally!! The most important detail.**
- **Should start differently than most of the other sentences.**
- **Needs to be full of good "meaty" details!**

There are many reasons that I love to teach. First of all, I love to teach because I love being at school. Another reason I love teaching is that the days go by quickly. A third reason I love to teach is because I love seeing a student understand something new. **Finally, I love to teach because I love to be around kids**. These are just a few reasons I love to teach.

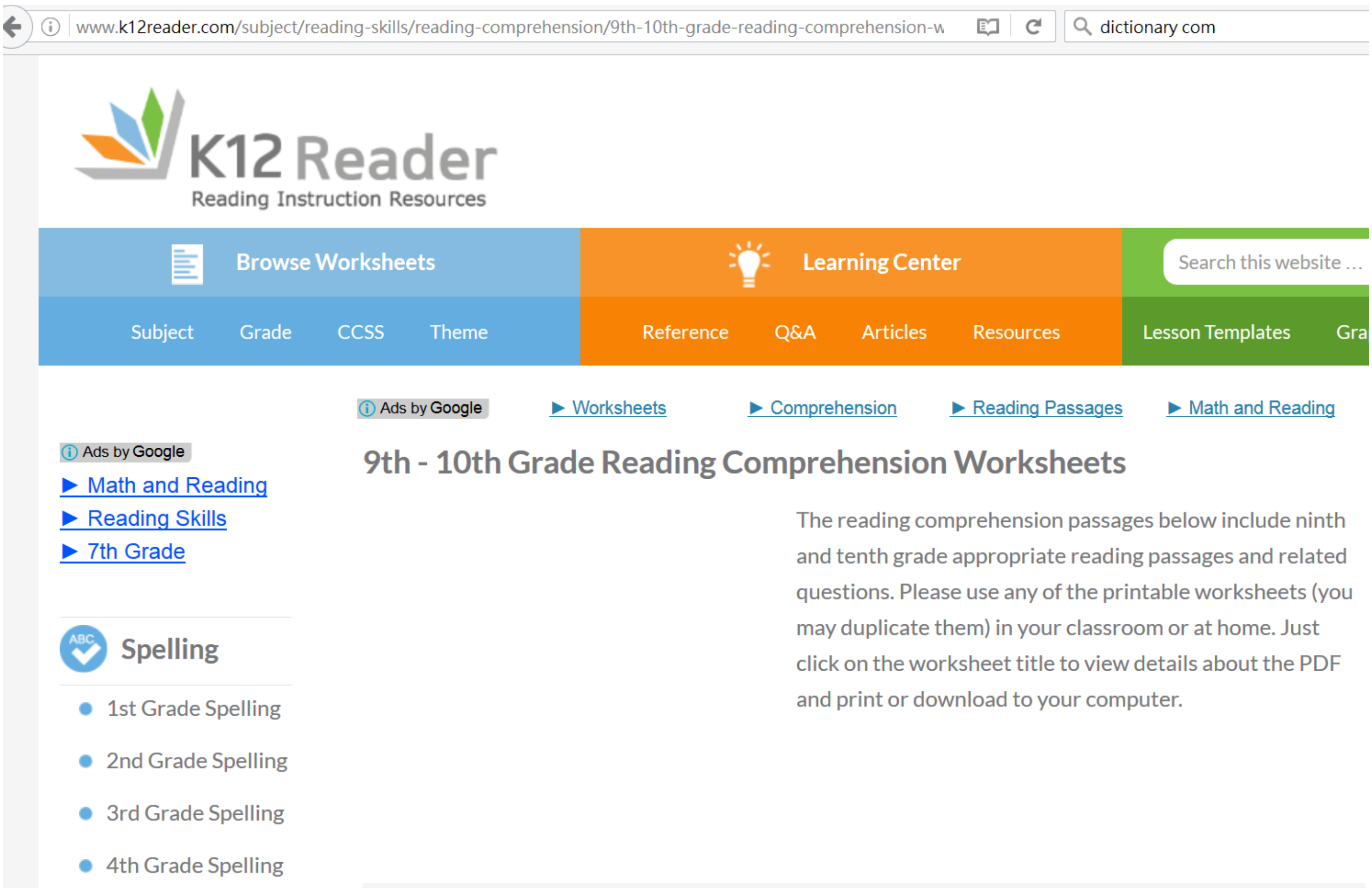
Click here to return to the hamburger

The Closing Sentence (Bottom Bun)

- Should look a lot like the topic sentence.
- Needs to summarize the topic.
- Needs to be an obvious end to the sentence.

There are many reasons that I love to teach. First of all, I love to teach because I love being at school. Another reason I love teaching is that the days go by quickly. A third reason I love to teach is because I love seeing a student understand something new. Finally, I love to teach because I love to be around kids. **These are just a few reasons I love to teach.**

Click here to see a good paragraph on the web!



Reading Skills

- Reading Comprehension
- Cause and Effect
- Character Descriptions
- Character Traits
- Context Clues
- Drawing Conclusions
- Fact and Opinion
- Figurative Language
- Literature
- Main Idea
- Making Inferences
- Point of View
- Story Elements
- Text Features Posters

http://www.k12reader.com/subject/reading-skills/

Grammar

- Parts of Speech
- Mechanics
- Parts of a Sentence
- Word Usage
- Punctuation
- Sentence Structure

Vocabulary

- Alphabet
- Dictionary Skills
- Dolch Sight Words
- Fry Words
- Phonetics
- Homographs
- Homophones
- Prefixes

- Homophones
- Prefixes

- Proverbs and Adages
- Root Words
- Shades of Meaning
- Suffixes
- Synonyms Antonyms

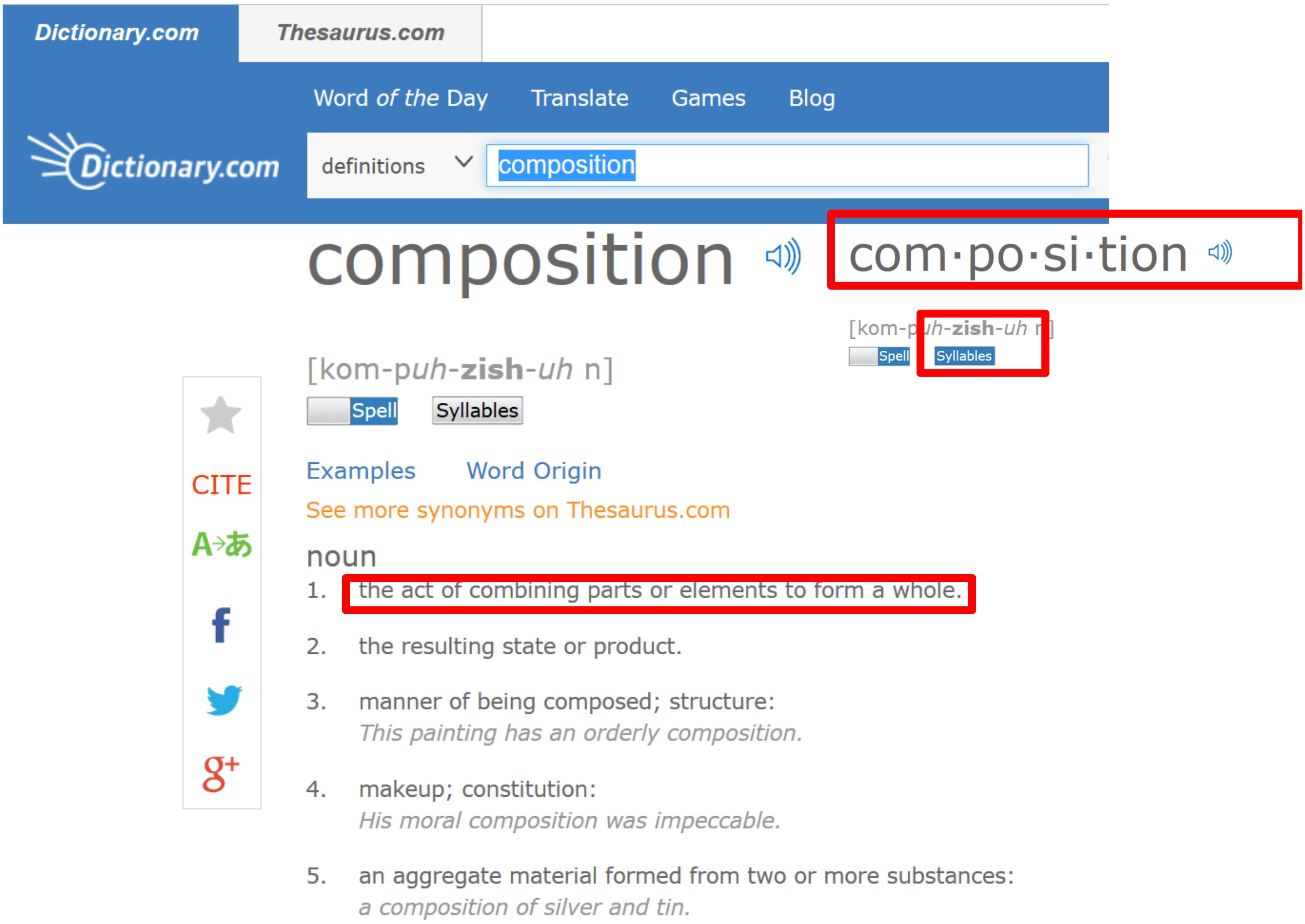
Composition

- Editing and Proofing
- Handwriting
- Lined Paper
- Sentence Patterns
- Topic Sentences
- Transition Words
- Writing Introductions
- Writing Conclusions
- Writing Prompts

Don’t know a word?

- Check English-English dictionary

MUST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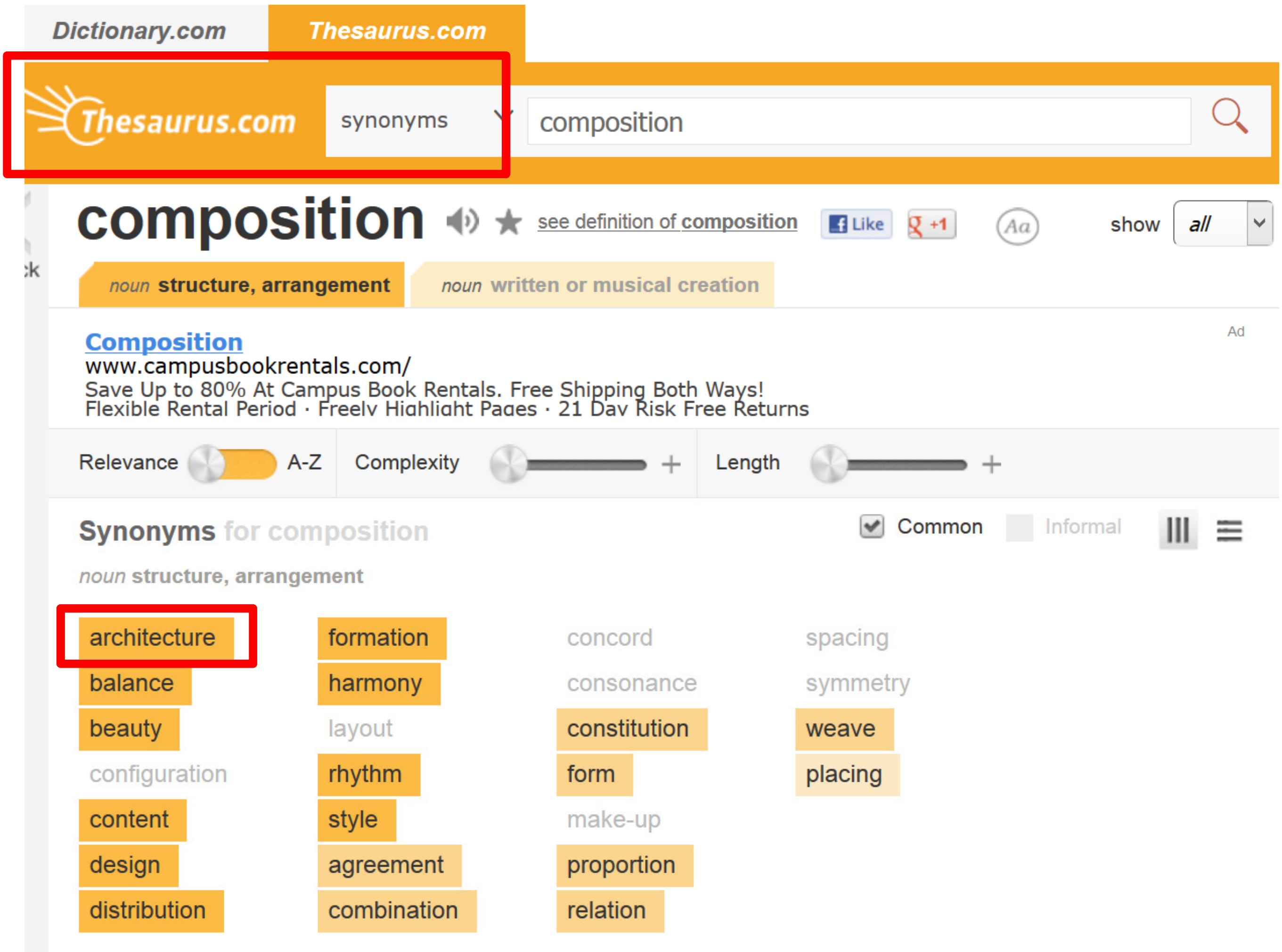
Word of the Day
Translate
Games
Blog
Dictionary.com
definitions
composition
composition
com·po·si·tion
[kom-puh-zish-uh n]
Spell
Syllables
[kom-puh-zish-uh n]
Spell
Syllables
CITE
A→あ
Examples
Word Origin
See more synonyms on Thesaurus.com
noun
1. the act of combining parts or elements to form a whole.
2. the resulting state or product.
3. manner of being composed; structure:
This painting has an orderly composition.
4. makeup; constitution:
His moral composition was impeccable.
5. an aggregate material formed from two or more substances:
a composition of silver and tin.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composition
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Like
+1
show
all
noun structure, arrangement
noun written or musical creation
Composition
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Ad
Relevance
A-Z
Complexity
Length
Synonyms for composition
Common
Informal
noun structure, arrangement
architecture
balance
beauty
configuration
content
design
distribution
formation
harmony
layout
rhythm
style
agreement
combination
concord
consonance
constitution
form
make-up
proportion
relation
spacing
symmetry
weave
placing

Contemporary Examples

Then he went to the University of Chicago as a graduate assistant, teaching three sessions of English *composition*.

THE DAILY BEAST

Pete Dexter's Indelible Portrait of Author Norman Maclean
Pete Dexter
March 22, 2014

"This has a lot to do with the current *composition* of the White House," says Lee.

THE DAILY BEAST

Secession Fever Sweeps Texas, Maryland, Colorado, and California
Caitlin Dickson
September 11, 2013

Because of the speed of its *composition*, it was a fairly slapdash piece of work.

THE DAILY BEAST

Benjamin Franklin, America's First Storm Chaser
Lee Sandlin
April 13, 2013

composition

Also found in: Thesaurus, Medical, Legal, Finan

com·po·si·tion (kŏm′pə-zĭsh′ən)

n.

1.
- **a.** The combining of distinct parts or elements to form a whole.
- **b.** The manner in which such parts are combined or related.
- **c.** General makeup: *the changing composition of the electorate.*
- **d.** The result or product of composing; a mixture or compound.

2. Arrangement of artistic parts so as to form a unified whole.

3.
- **a.** The art or act of composing a musical or literary work.
- **b.** A work of music, literature, or art, or its structure or organization.

4. A short essay, especially one written as an academic exercise.

5. *Law* A settlement whereby the creditors of a debtor about to enter bankruptcy agree, in return for some financial consideration, usually proffered immediately, to the discharge of their respective claims on receipt of payment which is in a lesser amount than that actually owed on the claim.

6. *Linguistics* The formation of compounds from separate words.

7. *Printing* Typesetting.

[Middle English composicioun, from Old French composition, from Latin compositiō, compositiōn-, from compositus, past participle of compōnere, *to put together*; see **component**.]

com′po·si′tion·al *adj.*

com′po·si′tion·al·ly *adv.*

www.merriam-webster.com/dictionary/composition composition

Merriam-Webster SINCE 1828 MENU Dictionary composition

composition

noun | com·po·si·tion | \ˌkäm-pə-ˈzi-shən\

Simple Definition of COMPOSITION

Popularity: Top 30% of words

: the way in which something is put together or arranged : the combination of parts or elements that make up something

: a piece of writing; *especially* : a brief essay written as a school assignment

: a written piece of music and especially one that is very long or complex

Source: Merriam-Webster's Learner's Dictionary

Examples of COMPOSITION in a sentence

the changing *composition* of the country's population

the *composition* of a chemical compound

The teacher reminded us to hand in our *compositions* at the end of class.

composition (ˌkɒmpəˈzɪʃən)

Collins Dictionaries › Thesaurus › Translator › Scrabble › Word Lovers' blog › New ›

English › English for Learners › French › German › Spanish › Italian › Chinese ›

English Dictionary
Pioneers in dictionary publishing since 1819

English I
British
B

▸ Definitions

noun

1. the act of putting together or making up by combining parts or ingredients
2. something formed in this manner or the resulting state or quality; a mixture
3. the parts of which something is composed or made up; constitution
4. a work of music, art, or literature
5. the harmonious arrangement of the parts of a work of art in relation to each other and to the whole
6. a piece of writing undertaken as an academic exercise in grammatically acceptable writing; an essay
7. (*printing*) the act or technique of setting up type
8. (*linguistics*) the formation of compound words
9. (*logic*) the fallacy of inferring that the properties of the part are also true of the whole, as *every member of the team has won a prize, so the team will win a prize*
10. a. a settlement by mutual consent, esp a legal agreement whereby the creditors agree to accept partial payment of a debt in full settlement

Unity: supporting sentences

https://www.youtube.com/watch?v=NLzKqujmdGk&index=11&list=PLN3kZ8bfmMJN2-EdLyE7_rOZo8o3IpFlv

Taking too many college courses at once can have potentially serious consequences.

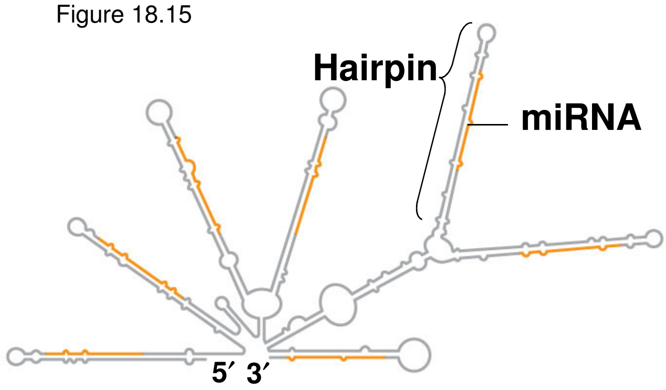
1. Student can become overwhelmed with the workload, and their GPA can suffer as a result.
2. Some student can get so stressed that they burn out and unable to finish their degree
3. Other students can be tempted by the use of illegal prescription drugs to help them focus and keep them awake onto the night.
4. Taking more than the average number of courses at the same time can be beneficial for students who want to graduate early.
5. The pressure of a overly busy schedule can tempt student into committing academic fraud, which can lead to expulsion.
6. Taking on too many responsibilities at work can have similar negative effects.

- Example from textbook
- Fig. 18.15, page 365

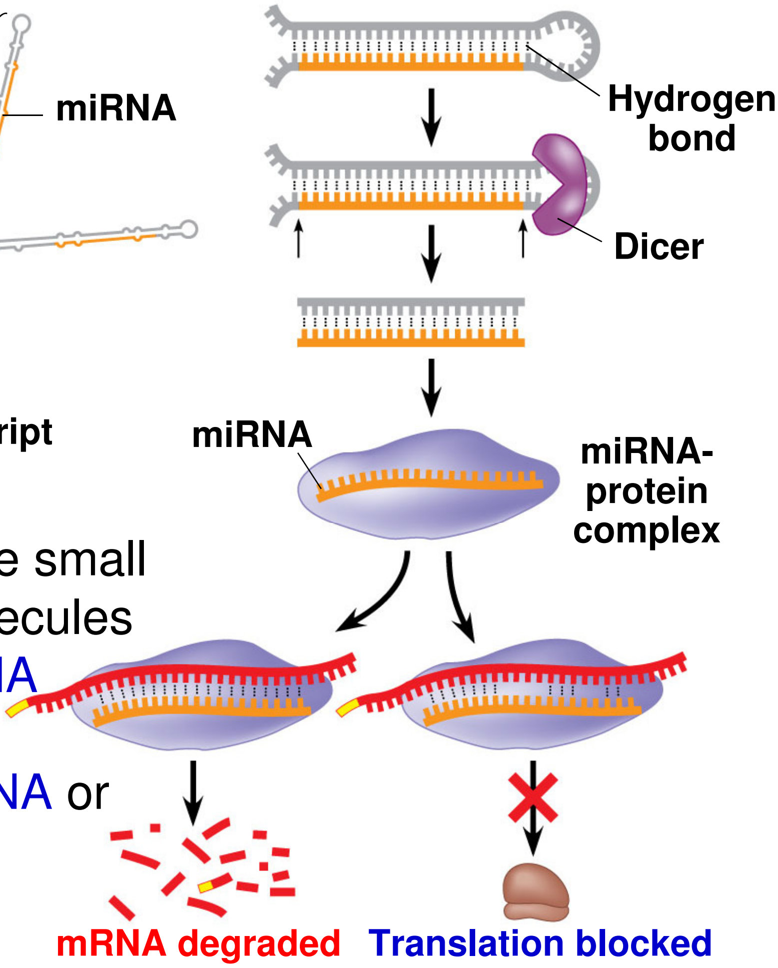
Effects on mRNAs by MicroRNAs and Small Interfering RNAs

- **MicroRNAs** (**miRNAs**) are small single-stranded RNA molecules that can bind to mRNA
- These can degrade mRNA or block its translation

Figure 18.15



(a) Primary miRNA transcript



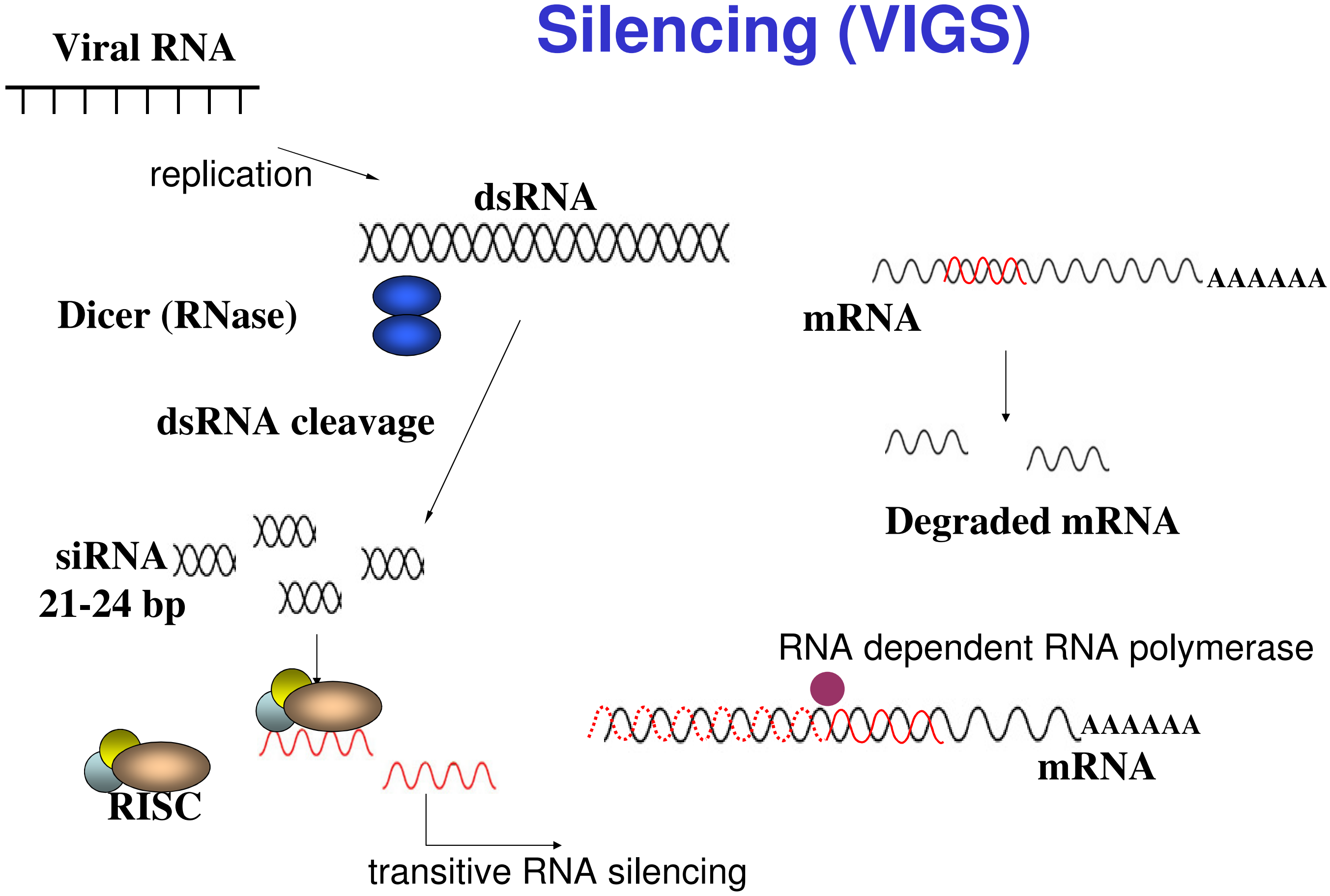
(b) Generation and function of miRNAs

MicroRNAs (miRNAs) are small single-stranded RNA molecules that can bind to mRNA

These can degrade mRNA or block its translation

- The phenomenon of inhibition of gene expression by RNA molecules is called **RNA interference (RNAi)**
- RNAi is caused by **small interfering RNAs (siRNAs)**
- siRNAs and miRNAs are similar but form from different RNA precursors

Mechanism of Virus-Induced Gene Silencing (VIGS)



人工合成的RNAi可以互補於癌症基因產生的mRNA而分解掉癌症訊息

The Nobel Prize in Physiology or Medicine 2006

"for their discovery of RNA interference - gene silencing by double-stranded RNA"

Photo: L. Cicero/Stanford

Andrew Z. Fire

1/2 of the prize

USA

Stanford University
School of Medicine
Stanford, CA, USA

Photo: R. Carlin/UMMAS

Craig C. Mello

1/2 of the prize

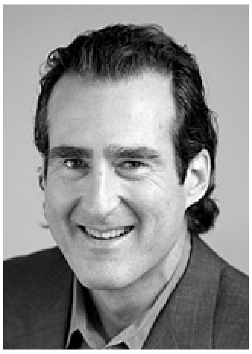
USA

University of
Massachusetts Medical
School
Worcester, MA, USA

他們利用病毒載體靜默應用在人類疾病控制，起初以線蟲做模式

The Nobel Prize in Physiology or Medicine 2006

Andrew Z. Fire



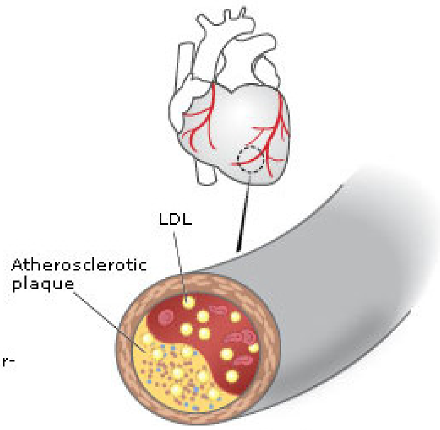
Craig C. Mello

The Nobel Prize in Physiology or Medicine 2006

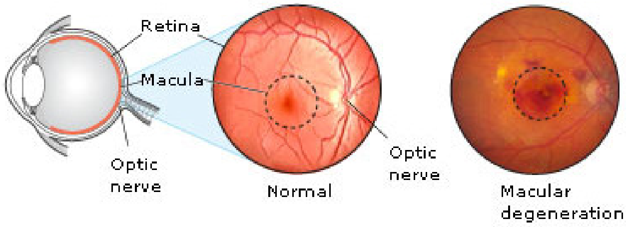
BACK

RNAi based therapy – future opportunities
RNAi may become an important principle underlying medical therapy in the future. Clinical trials are already underway for RNAi treatment of RS virus infection and macular degeneration (an eye disease).

Promising results have also been obtained in preclinical studies of influenza, HIV, hypercholesterolemia and several other medical conditions.



Age-related macular degeneration
Small blood vessels grow into the macular area and interfere with vision. RNAi is used to block production of the vascular endothelial growth factor, VEGF, which causes blood vessel growth.



Hypercholesterolemia
An excess of cholesterol-containing LDL particles leads to accumulation of cholesterol in blood vessel walls and causes atherosclerosis. RNAi is used to block production of the LDL particles.

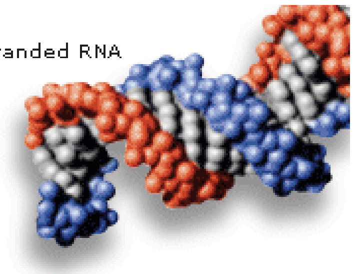
Contents:

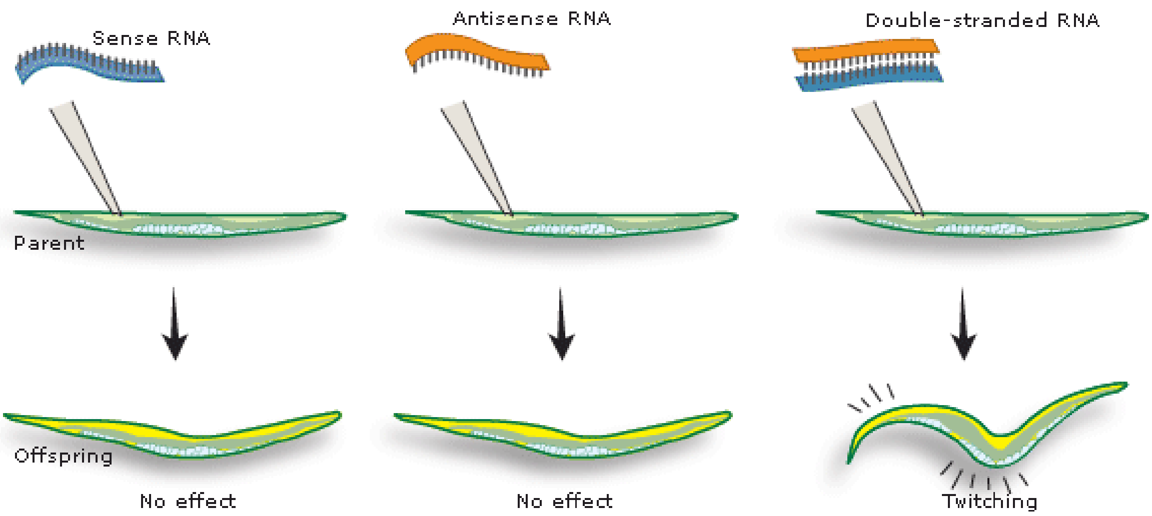
Key experiments

Gene silencing
Fire and Mello injected RNA corresponding to a gene important for muscle function in the worm *C. elegans*.

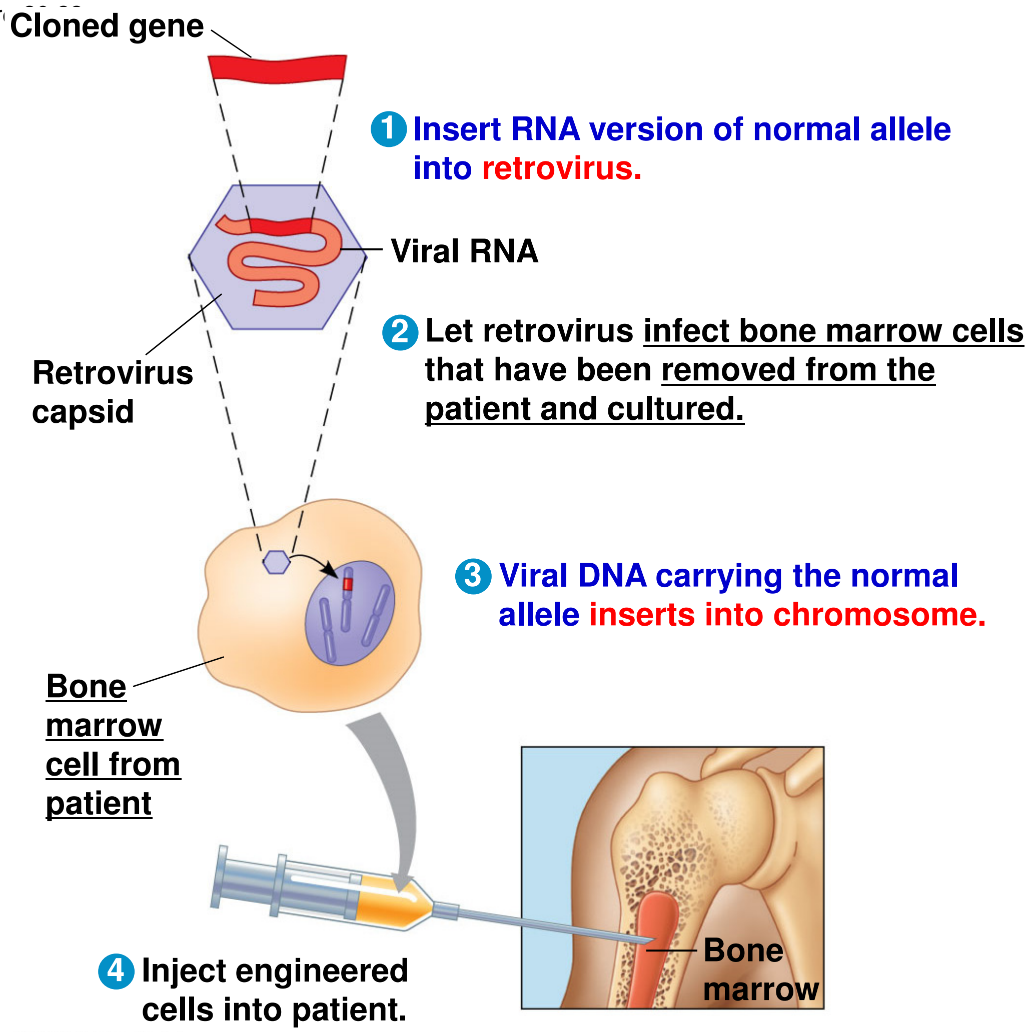
Single-stranded RNA (sense or antisense) had no effect. But double-stranded RNA caused the worm to twitch in a similar way to worms that lack a functional gene for the muscle protein.

Double-stranded RNA





Figur



A growing understanding of the miRNA pathway provided an explanation for a perplexing observation: Researchers had found that injecting double-stranded RNA molecules into a cell somehow turned off expression of a gene with the same sequence as the RNA. They called this experimental phenomenon **RNA interference (RNAi)**. It was later shown to be due to **small interfering RNAs (siRNAs)**, which are similar in size and function to miRNAs. In fact, subsequent research showed that the same cellular machinery generates miRNAs and siRNAs and that both can associate with the same proteins, producing similar results. The distinction between miRNAs and siRNAs is based on the nature of the precursor molecule for each. While an miRNA is usually formed from a single hairpin in a precursor RNA (see Figure 18.15), multiple siRNAs are formed from a much longer, linear, double-stranded RNA molecule.

Topic and concluding

Supporting sentences (highlighted)

A growing understanding of the miRNA pathway provided an explanation for a perplexing observation: Researchers had found that injecting double-stranded RNA molecules into a cell somehow turned off expression of a gene with the same sequence as the RNA. They called this experimental phenomenon **RNA interference (RNAi)**. It was later shown to be due to **small interfering RNAs (siRNAs)**, which are similar in size and function to miRNAs. In fact, subsequent research showed that the same cellular machinery generates miRNAs and siRNAs and that both can associate with the same proteins, producing similar results. The distinction between miRNAs and siRNAs is based on the nature of the precursor molecule for each. While an miRNA is usually formed from a single hairpin in a precursor RNA (see Figure 18.15), multiple siRNAs are formed from a much longer, linear, double-stranded RNA molecule.

We mentioned that laboratory investigators had injected double-stranded RNAs into cells, and you may wonder whether such molecules are ever found naturally. As you will learn in Chapter 19, some viruses have double-stranded RNA genomes. Because the cellular RNAi pathway can lead to the destruction of RNAs with sequences complementary to those found in double-stranded RNAs, this pathway may have evolved as a natural defense against infection by such viruses. However, the fact that RNAi can also affect the expression of nonviral cellular genes may reflect a different evolutionary origin for the RNAi pathway. Moreover, many species, including mammals, apparently produce their own long, double-stranded RNA precursors to small RNAs such as siRNAs. Once produced, these RNAs can interfere with gene expression at stages other than translation, as we'll discuss next.

Topic

Supporting sentences (highlighted)

concluding

We mentioned that laboratory investigators had injected double-stranded RNAs into cells, and you may wonder whether such molecules are ever found naturally. As you will learn in Chapter 19, some viruses have double-stranded RNA genomes. Because the cellular RNAi pathway can lead to the destruction of RNAs with sequences complementary to those found in double-stranded RNAs, this pathway may have evolved as a natural defense against infection by such viruses. However, the fact that RNAi can also affect the expression of nonviral cellular genes may reflect a different evolutionary origin for the RNAi pathway. Moreover, many species, including mammals, apparently produce their own long, double-stranded RNA precursors to small RNAs such as siRNAs. Once produced, these RNAs can interfere with gene expression at stages other than translation, as we'll discuss next.

Tell me why you choose life science as your major?

播放

點選進行計時播放

隨機抽點 顯示資訊 答案管理 自訂 匯出結果 編輯題目

全班人數：118 作答人數：58 已作答 未作答

李雪梅 李娜 郭恒 郑晓帆 赵家乐 王芙美 汪瑜 张宇 张静 龙雪 侯前 胥洁 张玉 邓茹 爽 高凤芝
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全班人數：118 作答人數：58

Because I like it

I like biology in my high school period

Because the virious biology attract me deeply and I wanna explore it with my whole effort.

Icomplete idea, how?

I am so regret that life science wasn't my first major,I 'm here just because a mistake,I lost my opportunity to access to another major.The system turned me here finally.

Then?

I want to be a famous person who like Darwin.

How ? Too broad

I like it

At first I did not understand the subject of life science, but I saw the introduction of this subject, I feel more interested in the subject, and I served as a representative of biology class in high school, so I chose this subject.

First,I think life science is very magic;
Second,my major can study two languages,I think it can make me do a successful women.
That's all!

because I like it very much.I am interested in life science.I want to know more about biology.

Because I like biology when my high school,and to be curious biology,andI want to become a biological and technical personnel,so I choose life science as my major.

學生回饋

My examination scores didn't allowed me to choose the major that I want . I think your teaching is very good. And my English is very poor.

I chose life science as a professional,because I love it.then,want to be a biology teacher,so would have been further education. in the process ,constantly, improve myself, to realize myself.

Because I am interested in it since I began to study Biology.I want to learn the life habit of plants and animals.The subject involves much kownledge about different fields.I hope it can be very helpful in the future.

Because my biology teacher in high school is an interest man.He always lead us think problems from simple to difficult. And the explainations he gives are very great. His lessen let me like biology gradually,but I want to be a teacher in primary school at first.Than I were not admitted to the university which I dreamed.Finally I choose life science.

Here are some reasons about why I choose life science as my major:
First of all,I made a big mistake in the national college entrance examination,which makes it impossible to get into a better major.
And then,for me,I am interested in biology.
Here comes the chance,why not have a try?
What's more?The world is so big that I want to have a look.For what?Maybe for sampling,researching and studying.
For all the reasons above,I chose it.
Thank you

better be m
concise:
I chose biolog
because my h
school teache
the field for m
explain creatu
interesting wa
with details.
this made me
like to join him
explore the bi

學生回饋

Because the college entrance examination is not high，and i prefer biology to other subjects.

I like life science in high school,and I like animal very much,so I choose it.

I chose this subject because I want to study biomedical in the future. And I'm trying to apply for a be tter foreign university in the next semester.

I am a Mongolian girl and I like everything about prairie.In my opinion ,the nature is mysterious and amazing.So I chose life science.Thanks

At the beginning,I think it is a chosing choice,because of my low score.But when i tell my english tea cher,she said,don not confuse,just do it.after that,i decide to look forward to be a biologic teacher.

To be honest.I don't like the life science as my major.Because the result is not ideal.leading to the ch oice of the professional. But later i find it is not difficult to try to like the life science. No matter what Now that I have chosen it. I will try my best to learn it and do it best.

Because I want to be a biology teacher, I will have a stable job in the future.

Because I more like creatures

I've chosen a lot of major,but life science.But in the end，Because the score is too low，After consult ing a lot of information，I chose the biological sciences in the rest of my profession.I have confidenc e in this major.

Because in high school,I chose to learn sciences,but in it,I only learnt Biology well.I was interested in i t very much.It is said that the 21th century is the era of Biology.I w

Because in high school,I chose to learn sciences,but in it,I only learnt Biology well.I was interested in i t very much.It is said that the 21th century is the era of Biology.I want to try my best to learn some a dvanced technologies about Biology.And I hope I will get some achievements in this field.So I chose life science as my major.

Because I really like biont.So I hope I can put my heart and soul into research, and explore the magic world. And at university,the most meaningful thing is to discover and challenge myself.

When I was in middle school,I found I was intersted in biology.At the same time,I think the nature of all life is amazing.I want to know more about the knowledge of life.So I choose life science as my m ajor.

Just entered university.I want to become a biological teacher.slowly understanding of the subject.I f ound I like to do biological experiment and research on biology.so I believe my choice is right.I will s tudy this major hard.

better present your idea on how you gonna to achieve so

To be honest,because my college entrance examination result is not very high,I couldn't go to my id eal university or major.I had to choose the subject which I like best in high school ,so I choosed life s cience. I'm thankful for the decision I made. Because now I like the subject very much.

In the beginning, I want to major in chemitry, but because of my scare is lower than the st andard line in chenmitry,So I deside choose the life science finally, though it is not my prime ch oose,I will like the subject and will learn it hardly !

I love animals and plants when I was in childhood ,and I'm always i se/index/26803/chapter_list/50081/console/2665279/single/ 搜尋

I love animals and plants when I was in childhood ,and I'm always interested in science fiction films. With the growth of age,I increasingly want to know more details about life ,even I want to do some research about science in the future . So,I hope one day my dream will come true.

steps

I wanna make a robot because I fell in love with a cartoon character called Doraemon. Firstly, I want to be a mechanician but I founded the most significant part is how to make the robot alive.It is not concerned about the technology but the biology and mental philosophy. Secondly, I am good at medicine gradually, I want to care for the animals and human been. My favorite thing is about panda. Therefore I choose the biology.然而重要的是，是生物專業選擇了我，而不是我選擇了生物專業。我志願與病魔抗爭的職業，願意成為一位享有醫德的醫師，可是條件並不允許我在中國學醫。因此我不得不努力去通過其他方向間接完成我的夢想。不論製造機器人也好，學醫也罷，哪怕照顧動物，都是我自己的選擇，三條路都不好走，未來工資很差，還不如修機車，但是我覺得努力是可以改變自己的，只要朝著自己喜歡的方向努力下去就一定會取得進步。我英語水平並不好，偶爾才會去看看ted和外翻的一些視頻來擴充視野。但是我希望不論我將來發展如何，做我喜歡的事，哪怕嘗試過，就不後悔青春少年狂，就不會問心有愧。

i like life science,and i want to be biologist.

Try make your goals clearly

I like Medical Science and i think medical and biology have contact。
I also like learning biology.

Because my favourite subjects are English and biology from junior school. I think biology is very interesting and fascinating.I want to learn more about it.And I want to be knowledgeable.

Because I didn't study well in high school，my college entrance ex...
y good. And I was good at biology and English so I chose life scien...

學生回饋

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Because I didn't study well in high school，my college entrance examination's final scores wasn't very good. And I was good at biology and English so I chose life science with English which i ensured to enter.

Because I like biology.And I want to learn more life science.So I choose it.

As long as I can remember,I have seen many people who died of diseases on TV.At that time,I wanted to know why we do not have the solution to the illness.I truly want to find the solution.Later,I realize what job I will do.I dream of being a pharmacist .

Because I think life science is a colorful profession .We search life from animals,plants microbes and cells.I have learn more knowledge in this process .so I choose life science as my major.

I am interested in gene and brain science.Ln fact,L hope to do some research to develop human potential.

I think every life is nature's most perfect work in micro.I enjoy it，the life not like machine，the machine is died but the life is not like machine .All the biology is life，I love it，I want to research it

First,I have a strong interest in English and be good at it.Second,I think life science to me is much easier than physics,chemistry and so on.And most important of all,I think life science is a subject full of connotation and it can widen my my horizon.That's all.thank you.

When I was a kid,I used to want to be a chef.However,I chosed to continue learning and get the admission notice of a good university for parent.Beacuse they have gre...
thinking for a long time that I worked hard is for parent.But,I foun...

學生回饋

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When I was a kid,I used to want to be a chef.However,I chosed to continue learning and get the adm ission notice of a good university for parent.Beacuse they have great ambitions for me.At least,I was thinking for a long time that I worked hard is for parent.But,I found that I was wrong later.I started se lf reflection,and I thought about how my life is going.I want to be a scientist for my country.Beacuse I like quiet and I have great ambitions.Of course,I like biological,too.I hope to be able to combine the physical and biological together.

Because biology is closely related to life. I want to know myself · understanding of living organis ms. It makes me think it's interesting.

As for me,life science is more like a confiment of my life.Maybe i won't work on it in future · but i will tell you the turth that i feel happiness when i choose it.Not about other else ,just because i love it,so I want to study it at a deeper level.

Because I think this subject is so interesting that it can improve my knowledge

Life science contains multiple subjects such as physics, chemistry, geography, life science is als o widely used, such as the deepening of application of bionics and biological chemistry, life science as the foundation of many disciplines, therefore, and because I personally prefer biology in high sch ool, I think interest is the best teacher!So,i choose it.

Firstly, I am interested in biology all the time. Secondly, I intend to improve my English level through the major because it is a bilingual major. The most important of all , I think the life science will have a bright future and I want to contribute my own for life science in

學生回饋

Because I like biology.In my opinion life is amazing,it makes me cr

dex/26803/chapter_list/50081/console/2665279/single/ 搜尋

Firstly, I am interested in biology all the time. Secondly, I intend to improve my English level through the major because it is a bilingual major. The most important of all , I think the life science will have a bright future and I want to contribute my own for life science in our country.

Because I like biology.In my opinion life is amazing,it makes me crazy.So that why choose it.

I like plants and animals,and i think life science is closely connect with our life ,so i choose this subje ct.

Incomplete idea

I like it very much.Curiosity let me chose it.

In high school, learning biological is the most interesting. and studying biological allows myself to ac cess unknown creatures.

I am fond of life science, and I think biology can broaden my knowledge and improve myself.

First,my college entrance examination scores are poor,which cannot reach demand of ideal major.
Second,I am interested in biology.When I was a senior high school student,I studied biology well an d I felt very easy.
Third,nowadays,the state pays attention to the agricultural development.Maybe I will find a job easil y in the future.

Because biology was my favourite subject over the past 6 years.I am so interested in it,especially in L amarch's use and disuse theory and Darwin's theory of evolution.

Because biology prospect is good, the employment side wide.
And feel life is amazing, very interesting.

學生回饋

When selecting a professional I don't like this major, then gradually I became interested in cells,I hop e to be able to learn the professional...

Because there is a great influence on my high school biology teacher.She told me that no subjects ca n give you joy and wisdom except life science.And I like tiny things which the existence people can't see in the world.I also want to know that how the body works so that let everyone away from diseas es.That's all

LECTURE PRESENTATIONS

For CAMPBELL BIOLOGY, NINTH EDITION

Jane B. Reece, Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Robert B. Jackson

Chapter 20

Biotechnology

Lectures by
Erin Barley
Kathleen Fitzpatrick

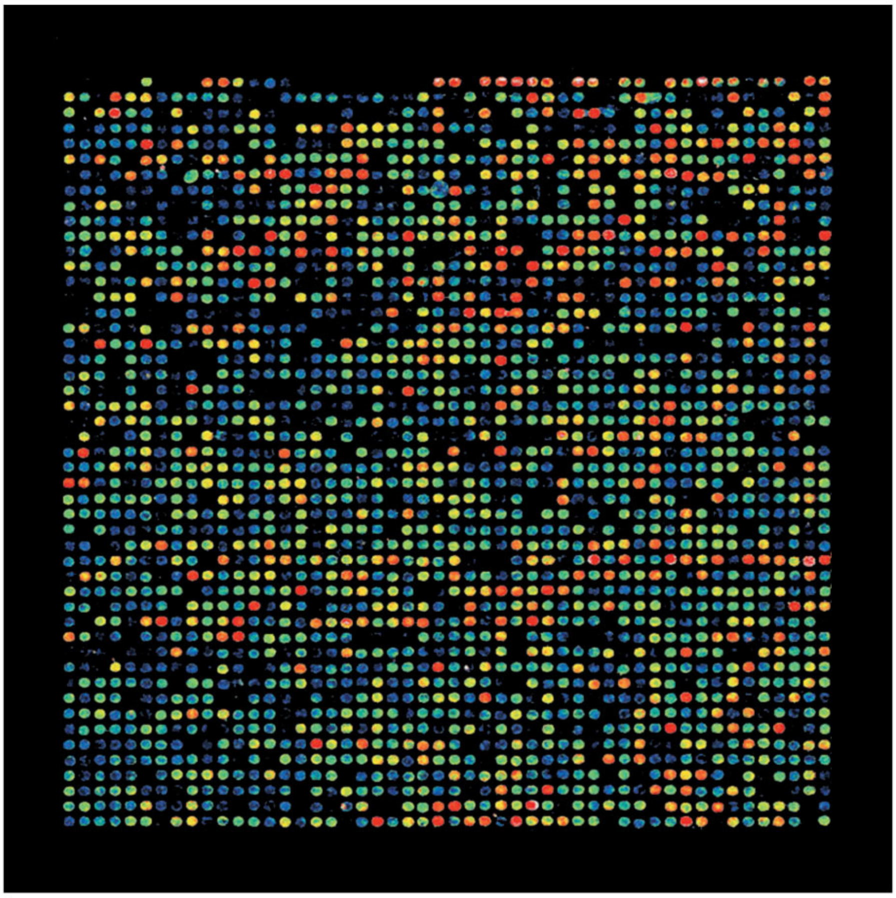
Overview: The DNA Toolbox

- DNA sequencing has depended on advances in technology, starting with making recombinant DNA
- In **recombinant DNA**, nucleotide sequences from two different sources, often two species, are combined *in vitro* into the same DNA molecule
- Methods for making recombinant DNA are central to **genetic engineering**, the direct manipulation of genes for practical purposes
- DNA technology has revolutionized **biotechnology**, the manipulation of organisms or their genetic components to make useful products

Figure 20.1

An example of DNA technology is the microarray, a measurement of gene expression of thousands of different genes

array of spots be used to compare normal and cancerous tissues



Concept 20.1: DNA cloning yields multiple copies of a gene or other DNA segment

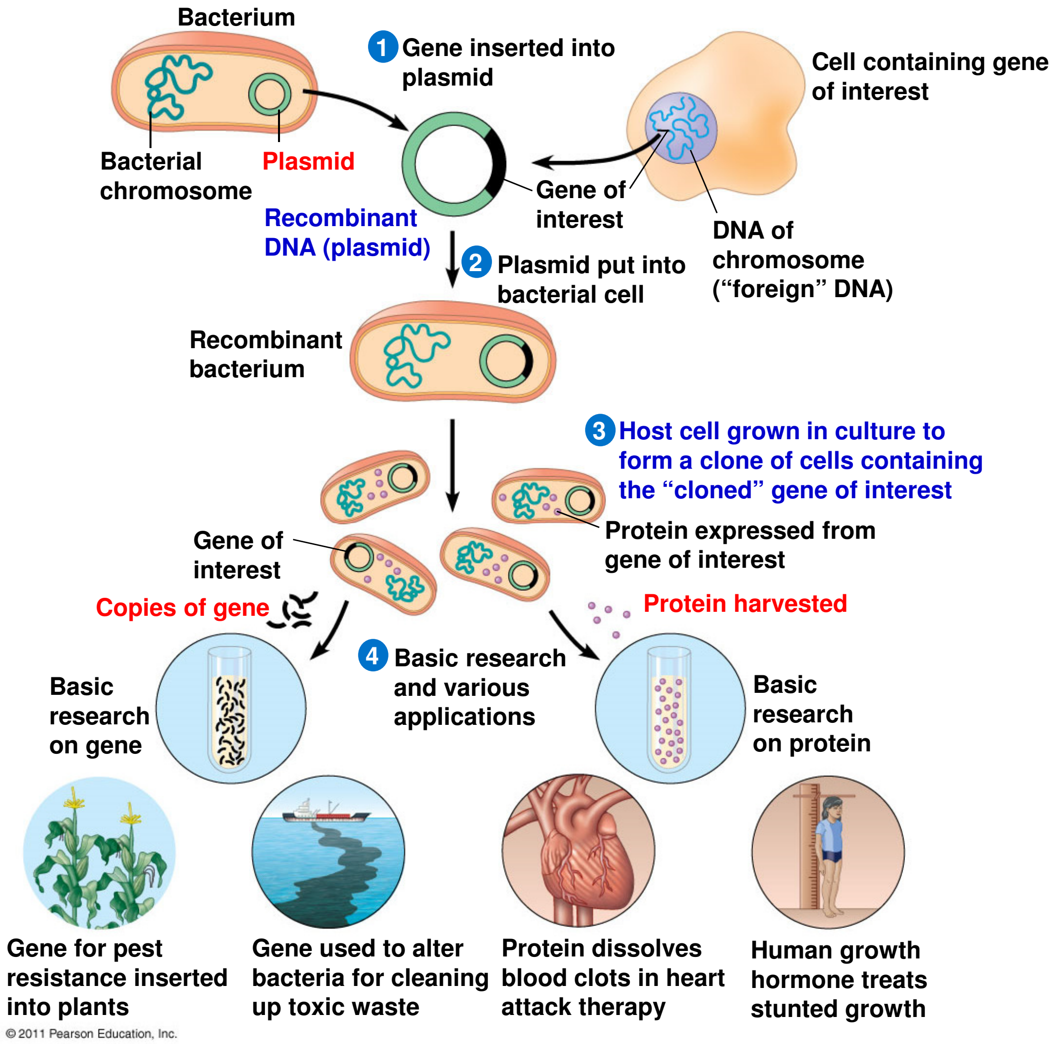
- To work directly with specific genes, scientists prepare well-defined segments of DNA in identical copies, a process called *DNA cloning*

- How to achieve so?

DNA Cloning and Its Applications: *A Preview*

- **Plasmids** are small circular DNA molecules that replicate separately from the bacterial chromosome
- **Gene cloning** involves using bacteria to make multiple copies of a gene
- Foreign DNA is inserted into a plasmid, and the recombinant plasmid is inserted into a bacterial cell
- Reproduction in the bacterial cell results in cloning of the plasmid including the foreign DNA

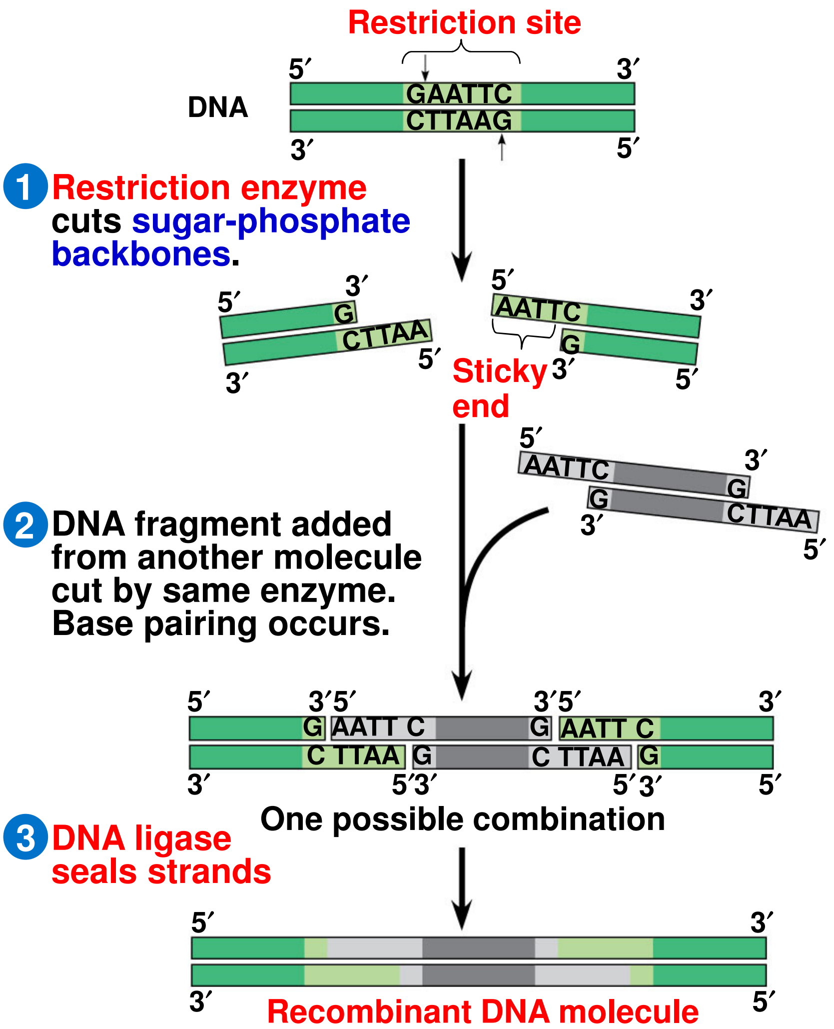
Figure 20.2



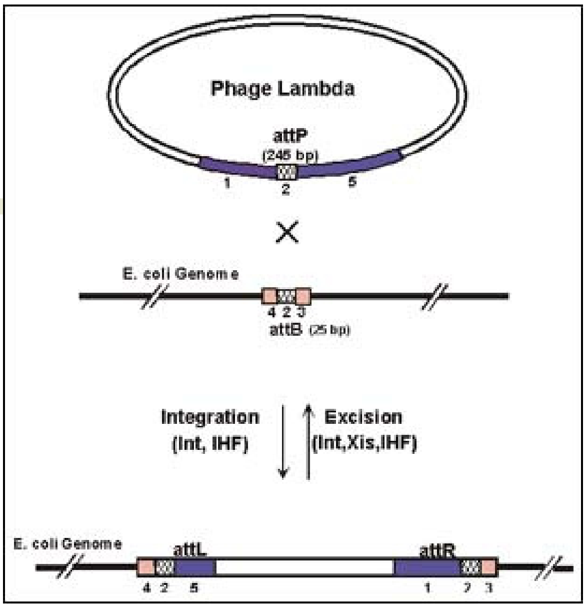
Using Restriction Enzymes to Make Recombinant DNA

- Bacterial **restriction enzymes** cut DNA molecules at specific DNA sequences called **restriction sites** (but its own DNA can be protected from methyl $-CH_3$ group addition to adenines or cytosines)
- A restriction enzyme usually makes many cuts, yielding **restriction fragments**
- The most useful restriction enzymes cut DNA in a staggered way, producing fragments with "**sticky ends**"
- **DNA ligase** (join Okazaki fragment) is an enzyme that seals the bonds between restriction fragments

Figure 20.3-3

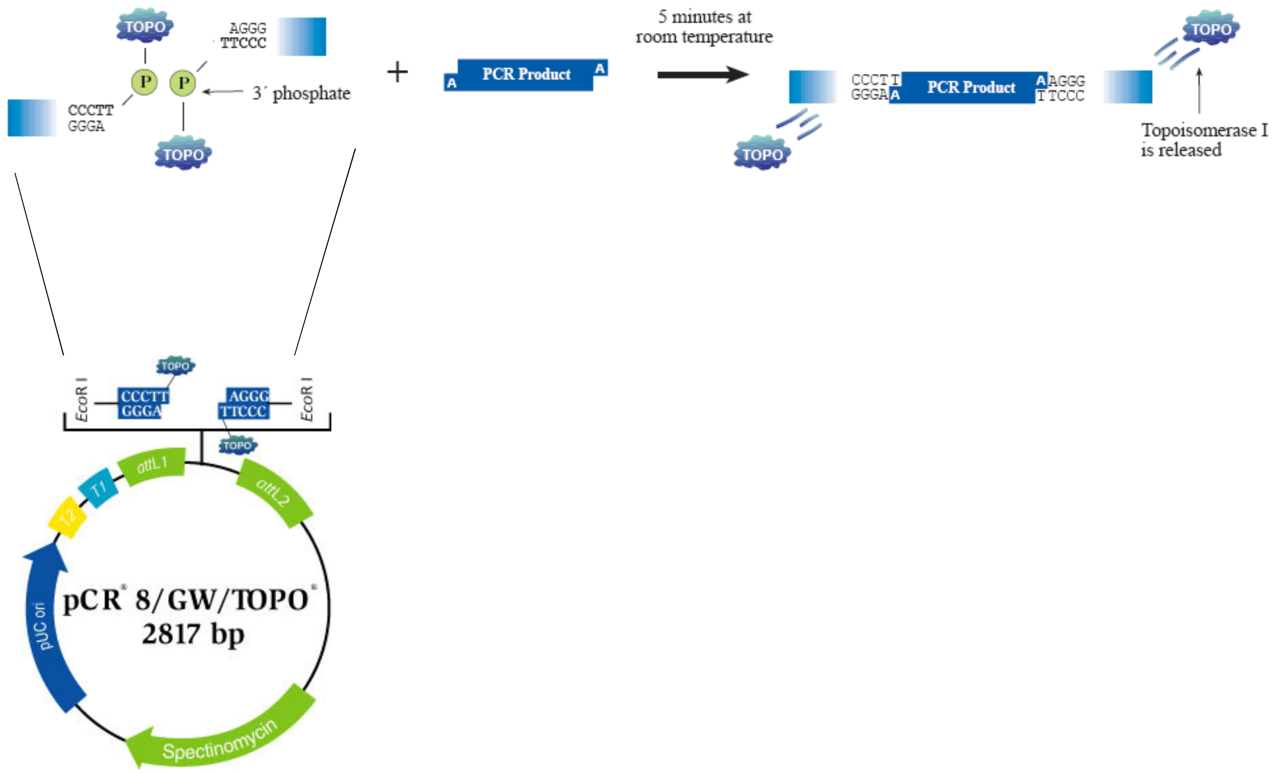


What is Gateway



- The sit-specific recombination reactions mediated by the λ integrase family of recombinases are conservative and highly specific (Landy A, 1989)
- *unequal crossing over*
- Hartley designed a method called recombinational cloning that uses in vitro site-specific recombination to accomplish the directional cloning of PCR products and the subsequent automatic subcloning of the DNA segment into new vector backbones at high efficiency. (Hartley et al., 2000)

2. TOPO® Cloning -TOPO®TA



invitrogen

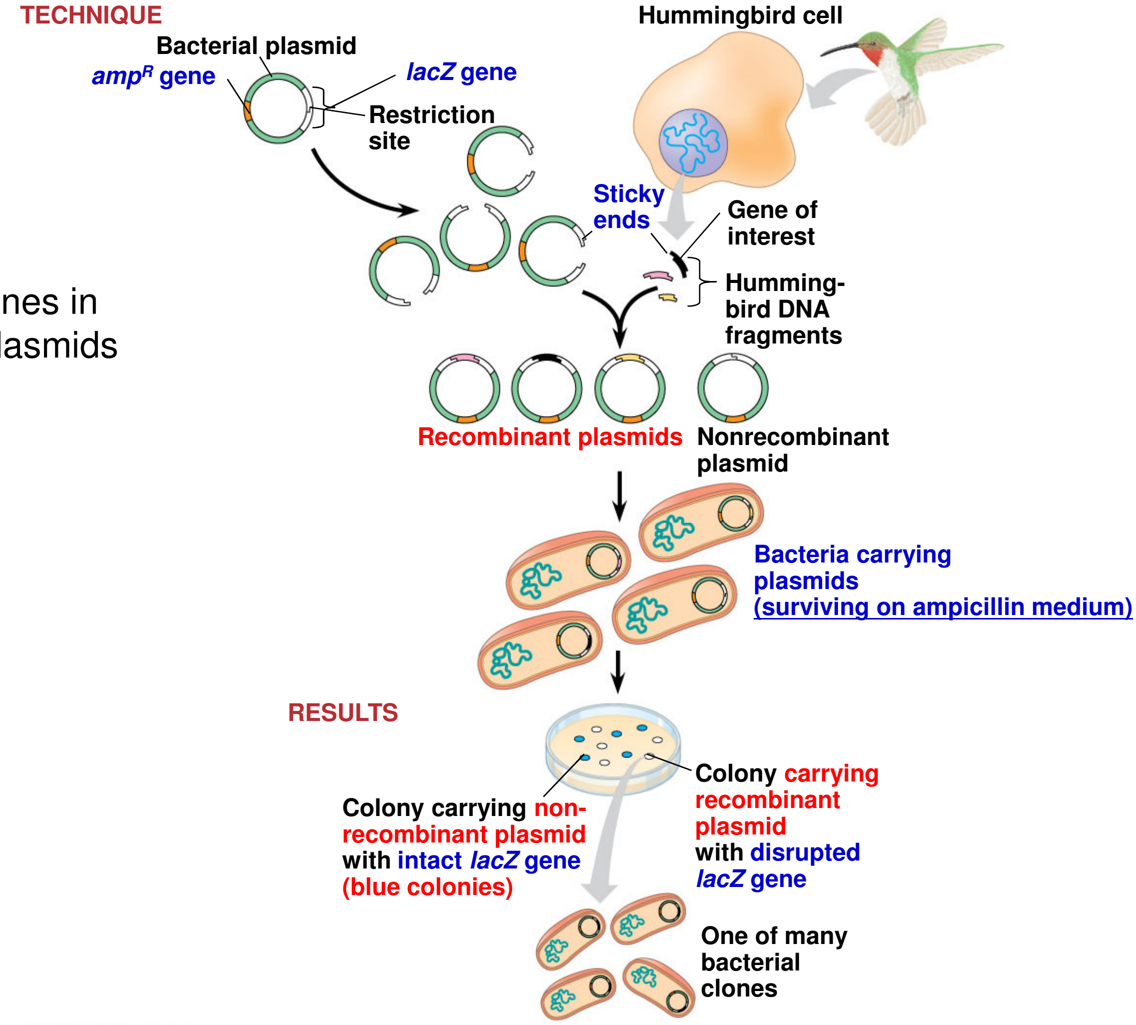
Invitrogen

Producing Clones of Cells Carrying Recombinant Plasmids

- In gene cloning, the original plasmid is called a **cloning vector**
- Several steps are required to clone the hummingbird *β*-globin gene in a bacterial plasmid
  - The hummingbird genomic DNA and a bacterial plasmid are isolated
  - Both are cut with the same restriction enzyme
  - The fragments are mixed, and DNA ligase is added to bond the fragment sticky ends

Figure 20.4

Cloning Genes in Bacterial Plasmids



Storing Cloned Genes in DNA Libraries

- A **genomic library** that is made using bacteria is the collection of recombinant vector clones produced by cloning DNA fragments from an entire genome
- A **bacterial artificial chromosome (BAC)** is a large plasmid that has been trimmed down and can carry a collection of large foreign DNA insert (BAC library)

Figure 20.5

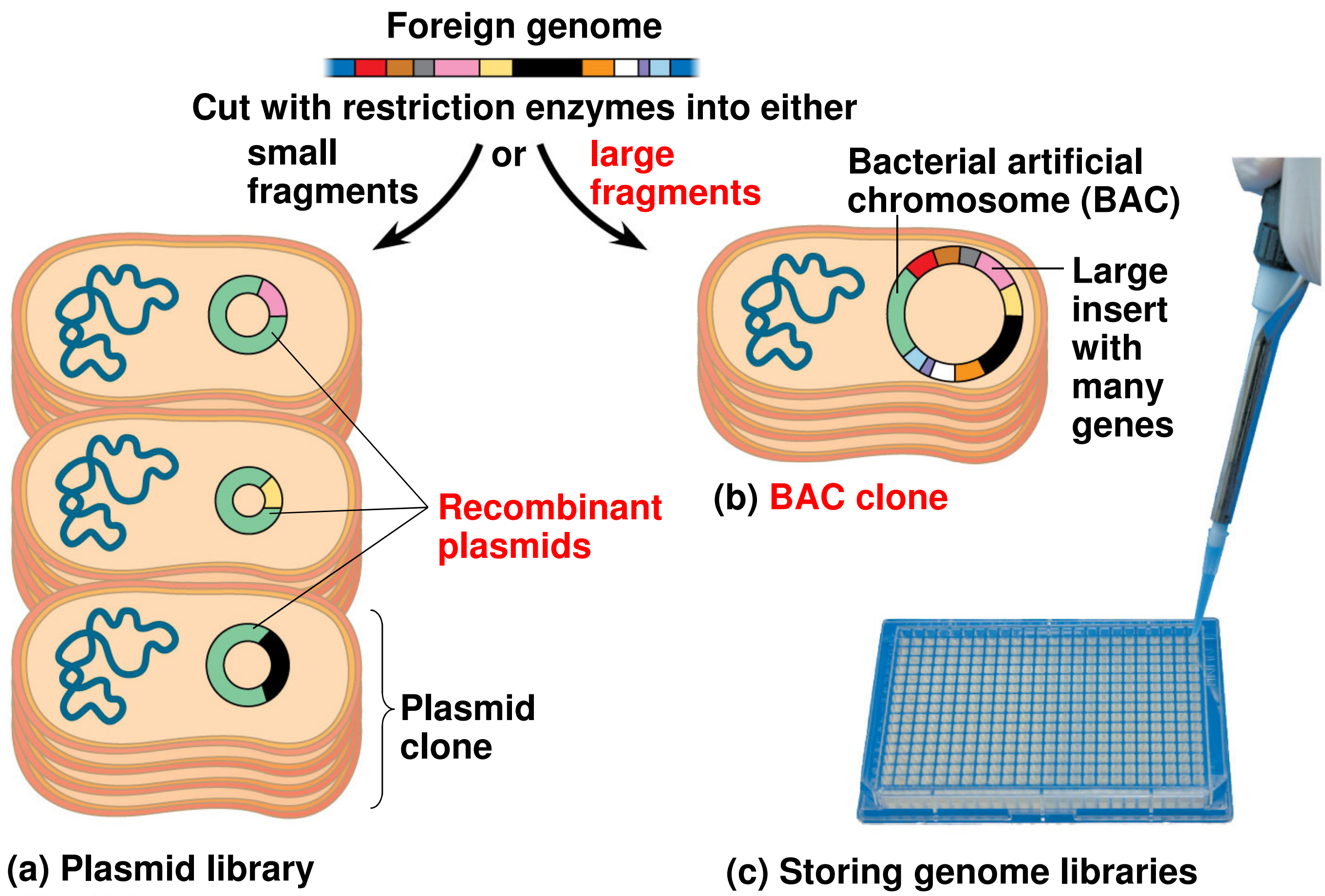
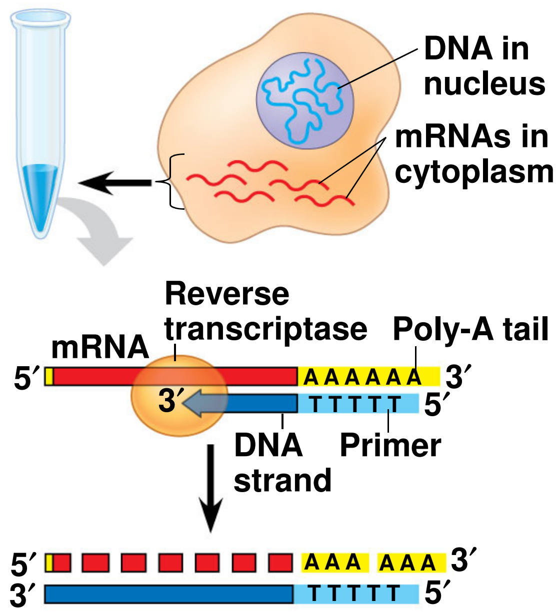
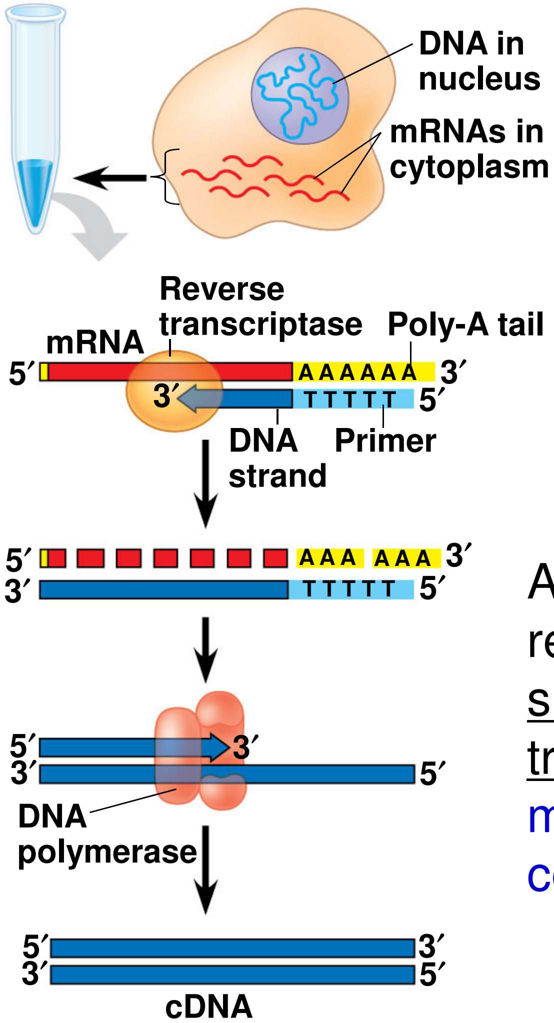


Figure 20.6-3



A **complementary DNA (cDNA)** library is made by cloning DNA made *in vitro* by reverse transcription of all the mRNA produced by a particular cell

Figure 20.6-5



Tissue specific cDNA

A **cDNA library** represents only the subset of genes transcribed into mRNA in the original cells

Screening a Library for Clones Carrying a Gene of Interest

- A probe can be synthesized that is complementary to the gene of interest
- For example, if the desired gene is

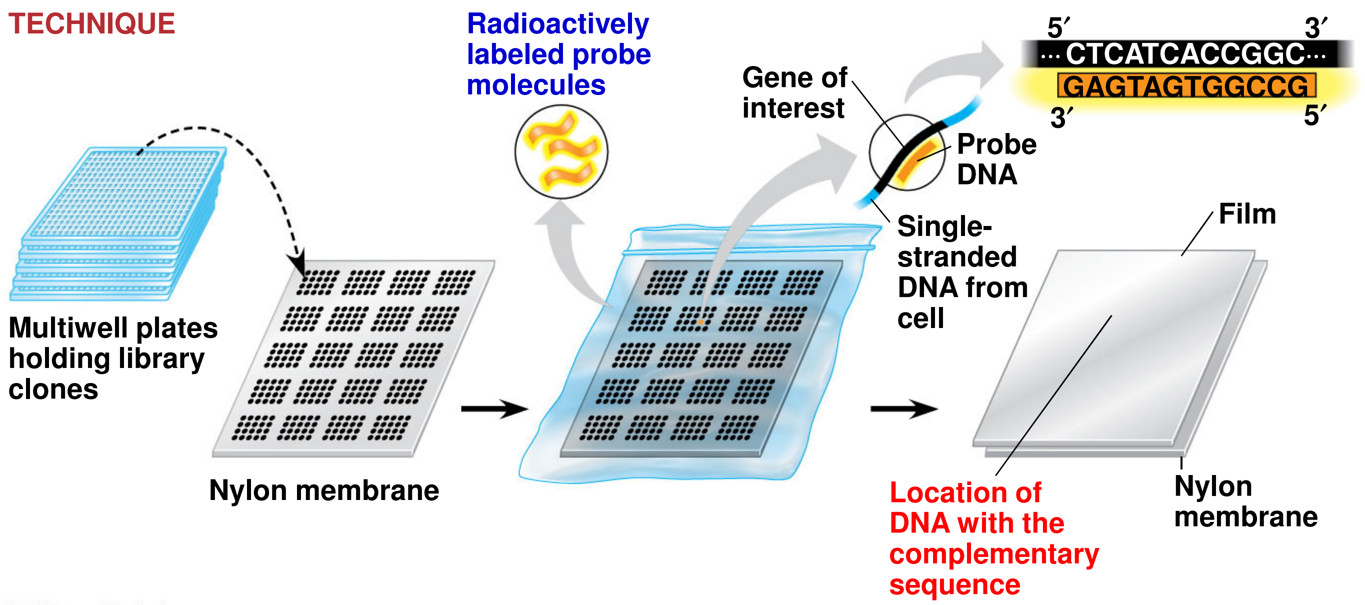
  – Then we would synthesize this probe

The DNA probe can be used to screen a large number of clones simultaneously for the gene of interest

Figure 20.7

Detecting a Specific DNA Sequence by Hybridization with a Nucleic Acid Probe

Or non-radio chemical labelled probe



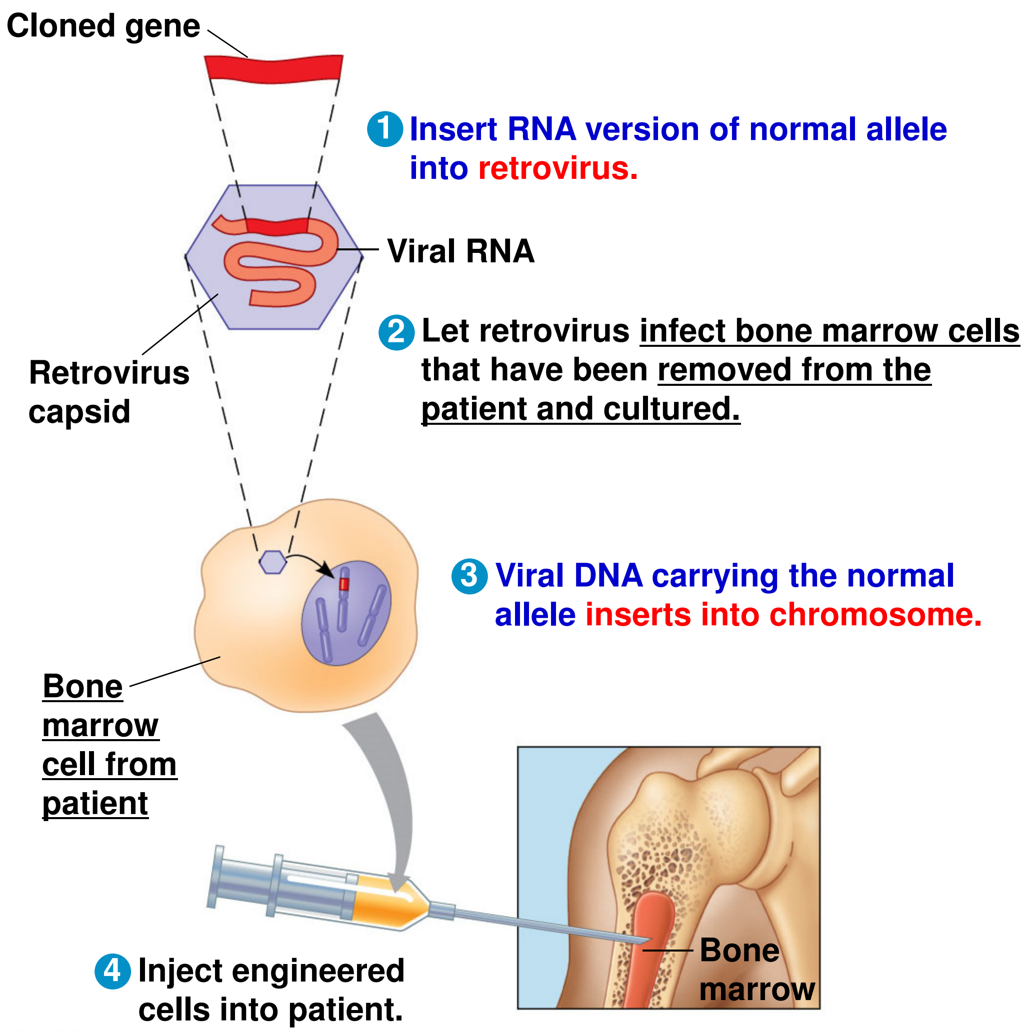
Expressing Cloned Eukaryotic Genes

- After a gene has been cloned, its protein product can be produced in larger amounts for research
- Several technical difficulties hinder expression of cloned eukaryotic genes in bacterial host cells
- To overcome differences in promoters and other DNA control sequences, scientists usually employ an **expression vector**, a cloning vector that contains a highly active bacterial promoter (just upstream of the restriction sites)

Eukaryotic Cloning and Expression Systems

- Molecular biologists can avoid eukaryote-bacterial incompatibility issues by using eukaryotic cells, such as yeasts, as hosts for cloning and expressing genes
- Even yeasts may not possess the proteins required, cultured mammalian or insect cells may be used to express and study proteins
- One method of introducing recombinant DNA into eukaryotic cells is **electroporation**, applying a brief electrical pulse to create temporary holes in plasma membranes (by Virus vector)

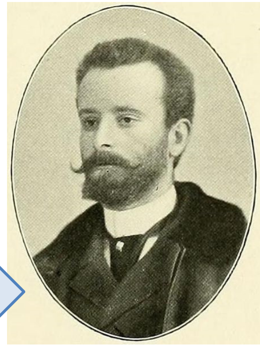
Figure 20.23



Crown gall disease and the tumor-inducing principle

The first written record of crown gall disease, on grape, dates from 1853

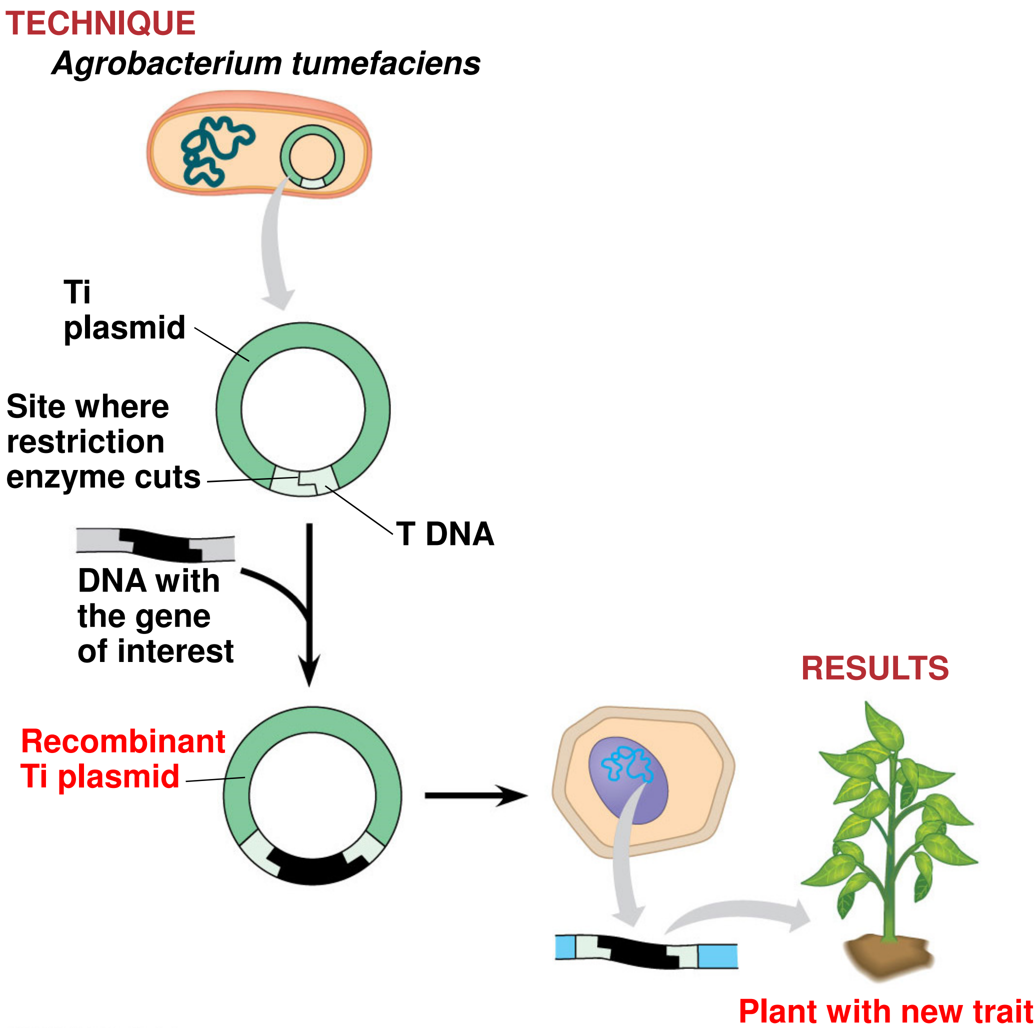
Fridiano Cavara (1897) found that a bacterium causes crown gall in grape



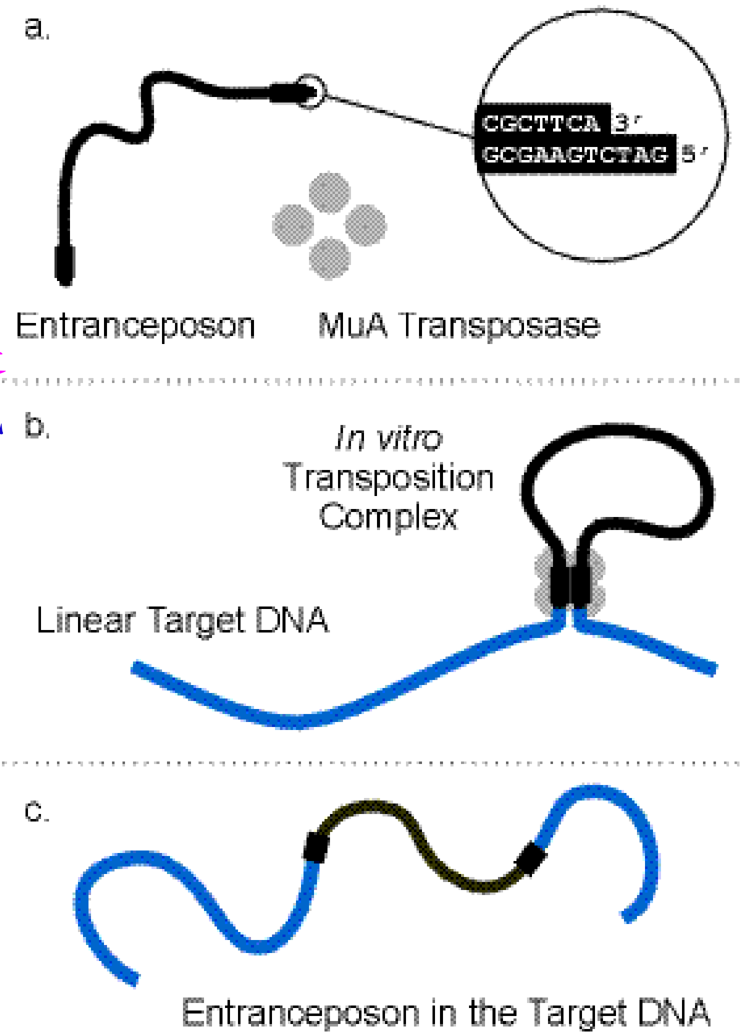
Crown gall induces growths at wound sites and severely limits crop yields and growth vigor

Edward L. Barnard, Florida Department of Agriculture and Consumer Services, Bugwood.org; Mike Ellis, Ohio State University; University of Georgia Plant Pathology Archive, University of Georgia, Bugwood.org; Wikimedia commons

Figure 20.26

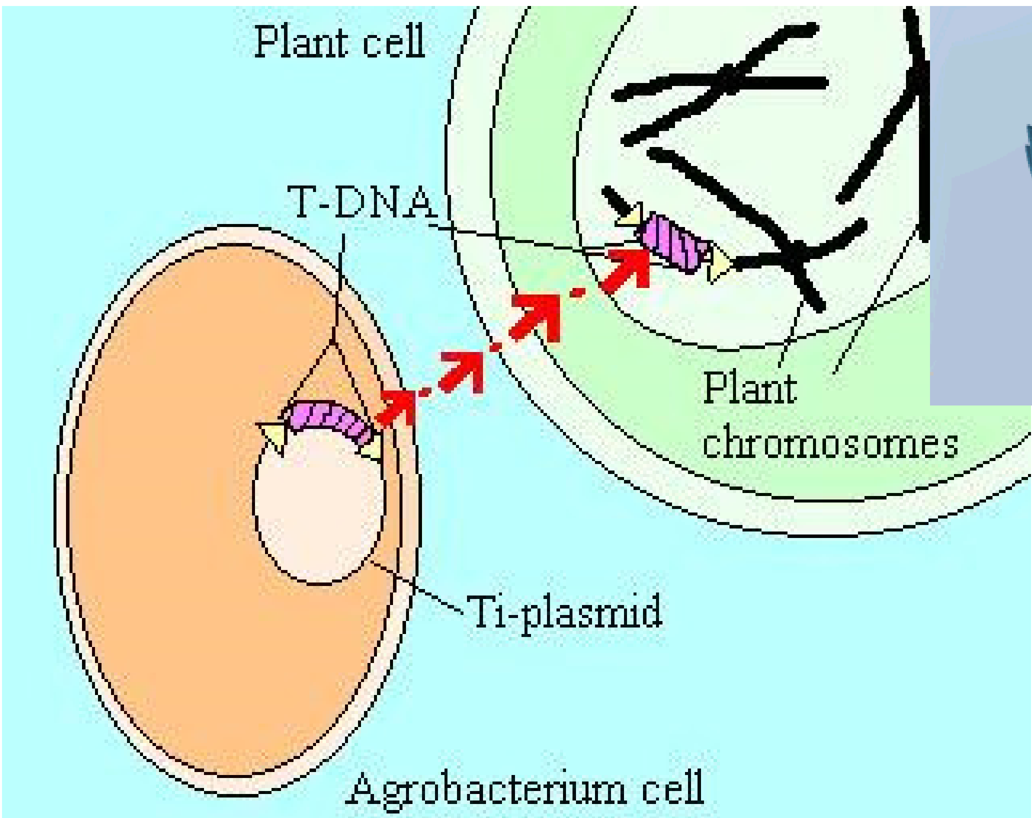


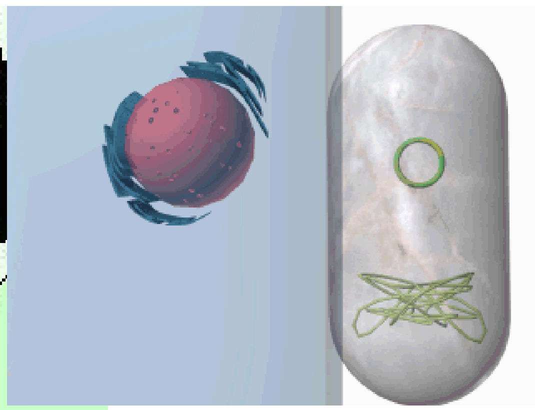
利用跳躍轉座子插入植物造成基因喪失功能的觀察而找到控制開花等的基因



TDNA (tumer DNA) usage in plant transformation

利用農桿菌將植物腫瘤內分離出之具有轉座能力DNA攜帶基因到植物體內





www.ppws.vt.edu/~sforza/prokaryote.html

http://library.thinkquest.org/C004033F/TDNA_transfer.jpg

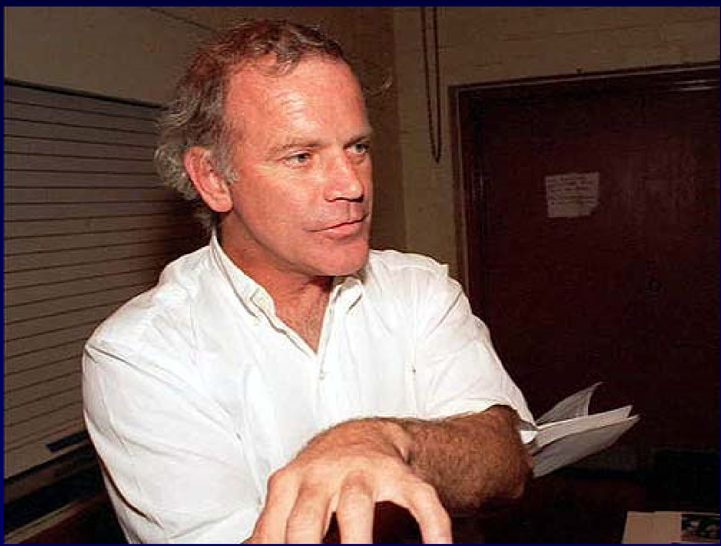
Cross-Species Gene Expression and Evolutionary Ancestry – from E.coli to elephant

- The remarkable ability of bacteria to express some eukaryotic proteins underscores the shared evolutionary ancestry of living species
- For example, *Pax-6* is a gene that directs formation of a vertebrate eye; the same gene in flies directs the formation of an insect eye (which is quite different from the vertebrate eye)
- The *Pax-6* genes in flies and vertebrates can substitute for each other (to verify homologous gene function)

Amplifying DNA *in Vitro*: The Polymerase Chain Reaction (PCR)

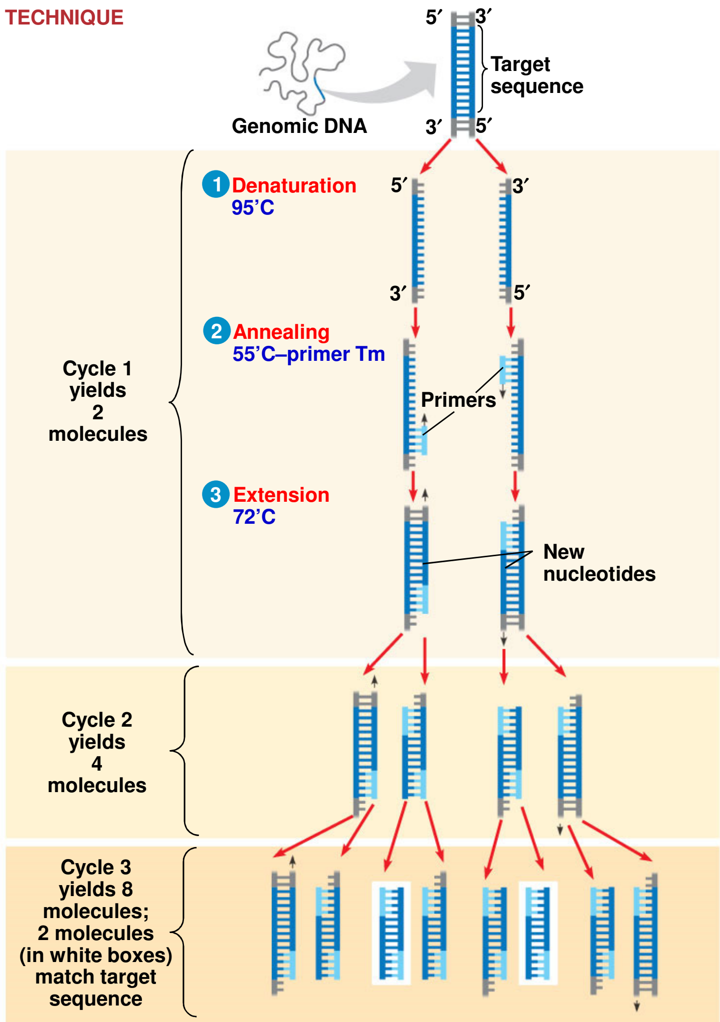
- The **polymerase chain reaction**, **PCR**, can produce many copies of a specific target segment of DNA
- A three-step cycle—heating, cooling, and replication—brings about a chain reaction that produces an exponentially growing population of identical DNA molecules
- The key to PCR is an unusual, heat-stable DNA polymerase called Taq polymerase.

Kary Mullis - Polymerase chain reaction (1983)
Nobel Prize (1993)



http://www.quarks.de/dyn/pics/8842-9037-2-kary-mullis.jpg

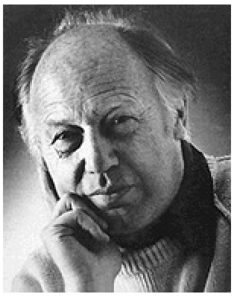
Figure 20.8

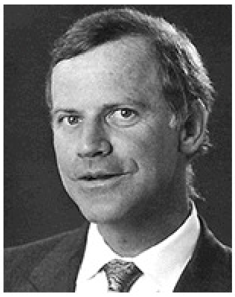


BACK

The Nobel Prize in Chemistry 1993

The Royal Swedish Academy of Sciences awards this year's Nobel Prize in Chemistry to



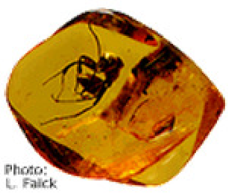


Michael Smith
Canada, for his fundamental contributions to the establishment of oligonucleotide-based, site-directed mutagenesis and its development for protein studies

Kary B. Mullis
USA, for his invention of the polymerase chain reaction (PCR) method

The PCR method already of great use

In Mullis's method, gene technology has gained a new tool. The sequencing of DNA, for example in the HUGO (Human Genome Organization) project, which aims to determine each individual DNA code in the human genetic material, has been dramatically simplified. There are already many medical applications. Since very small quantities of foreign DNA can be detected, the diagnosis and analysis of, for example, viruses (such as HIV) in clinical samples can be done very rapidly.

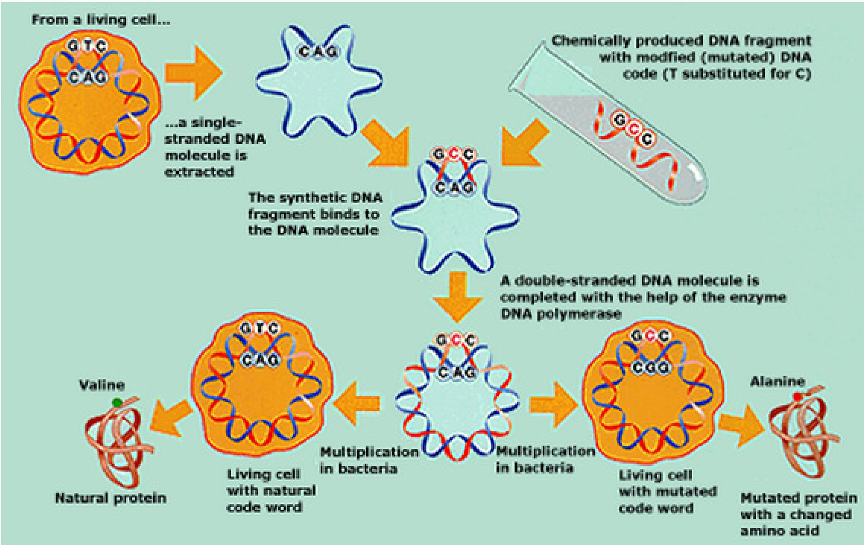


DNA from fossil remains can be mass-produced by PCR. Researchers have succeeded in amplifying genetic material from insects trapped in amber that have been extinct for more than 20 million years.

In PCR the police have a new and very reliable fingerprinting method, since the DNA content can be analysed from a single drop of blood or a single hair found at the site of a crime.

Site-directed mutagenesis reprograms DNA

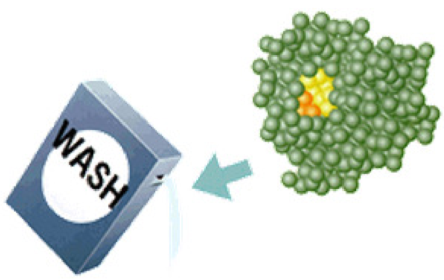
Using site-directed mutagenesis the information in the genetic material can be changed. A synthetic DNA fragment is used as a tool for changing one particular code word in the DNA molecule. This reprogrammed DNA molecule can direct the synthesis of a protein with an exchanged amino acid. **Michael Smith's** method has become one of biotechnology's most important instruments.



Protein design

Tailor-made proteins

Enzymes can now be adapted for different industrial processes. Researchers can exploit new strategies for developing pharmaceuticals. Attempts are being made by modifying plant proteins to develop strains which can utilize atmospheric carbon dioxide more efficiently during photosynthesis.



With **protein design**, it has for example been possible to improve the stability of an enzyme which is an important component of detergents, by specifically changing an amino acid (orange) close to the catalytic region (yellow). The enzyme can thereby survive the chemicals also needed to make our clothes clean.

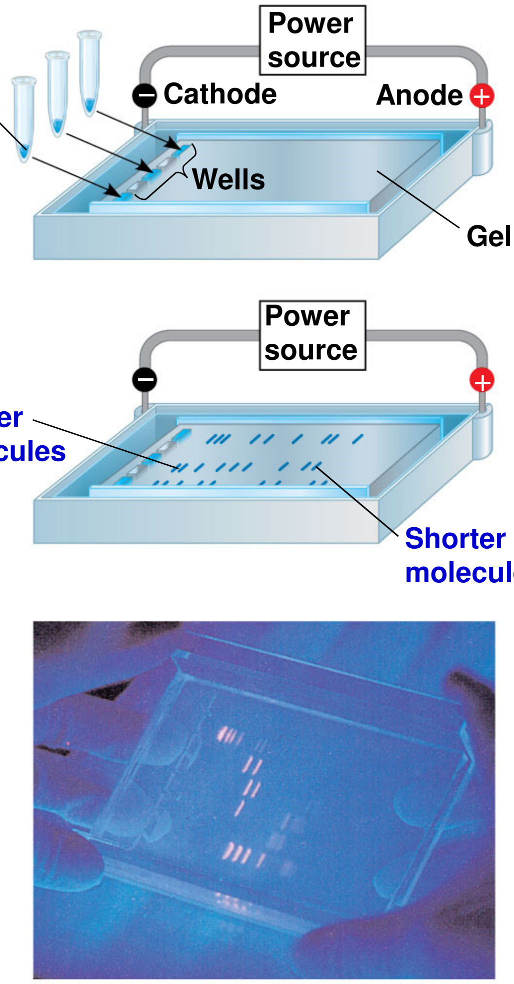
Concept 20.2: DNA technology allows us to study the sequence, expression, and function of a gene

- DNA cloning allows researchers to
  - Compare genes and alleles between individuals
  - Locate gene expression in a body
  - Determine the role of a gene in an organism
- Several techniques are used to analyze the DNA of genes

Gel Electrophoresis and Southern Blotting

- One indirect method of rapidly analyzing and comparing genomes is **gel electrophoresis**
- This technique uses a gel as a molecular sieve to separate nucleic acids or proteins by size, electrical charge, and other properties
- A current is applied that causes charged molecules to move through the gel
- Molecules are sorted into "bands" by their size

Figure 20.9

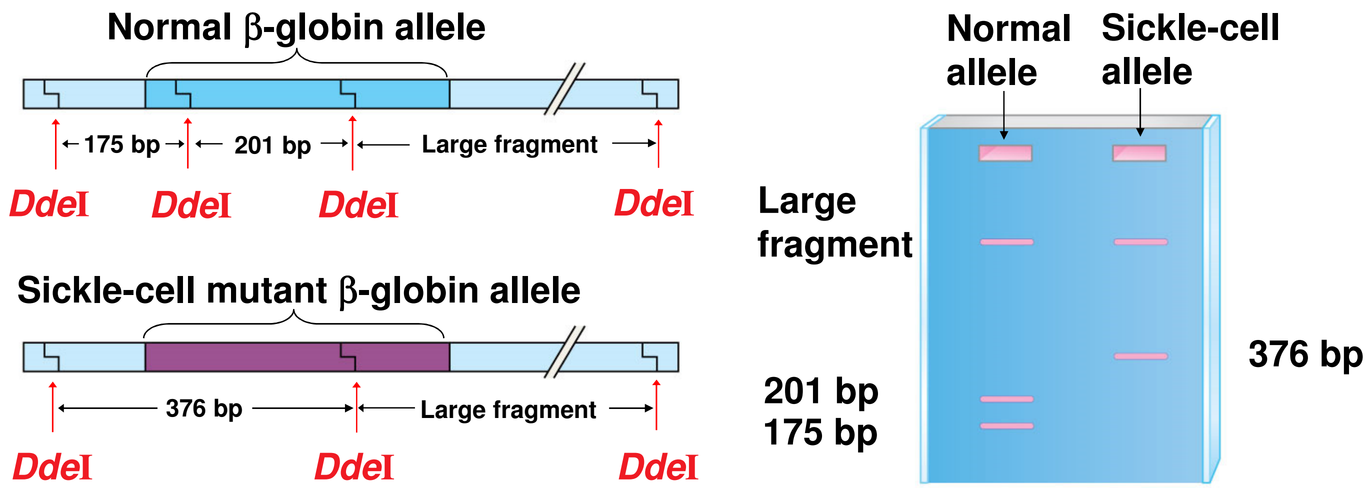


Gel Electrophoresis

- Sequence changes that alter restriction sites are called **RFLPs** (**restriction fragment length polymorphisms**)
- In restriction fragment analysis, DNA fragments produced by restriction enzyme digestion of a DNA molecule are sorted by gel electrophoresis
- Restriction fragment analysis can be used to compare two different DNA molecules, such as two alleles for a gene if the nucleotide difference alters a restriction site

Figure 20.10

Using restriction fragment analysis to distinguish the normal and sickle-cell alleles of the human β-globin gene



(a) *Dde*I restriction sites in normal and sickle-cell alleles of the β-globin gene

(b) Electrophoresis of restriction fragments from normal and sickle-cell alleles

- A technique called **Southern blotting** combines gel electrophoresis of DNA fragments with nucleic acid hybridization
- Specific DNA fragments can be identified by Southern blotting, using labeled probes that hybridize to the DNA immobilized on a "blot" of gel

Figure 20.11

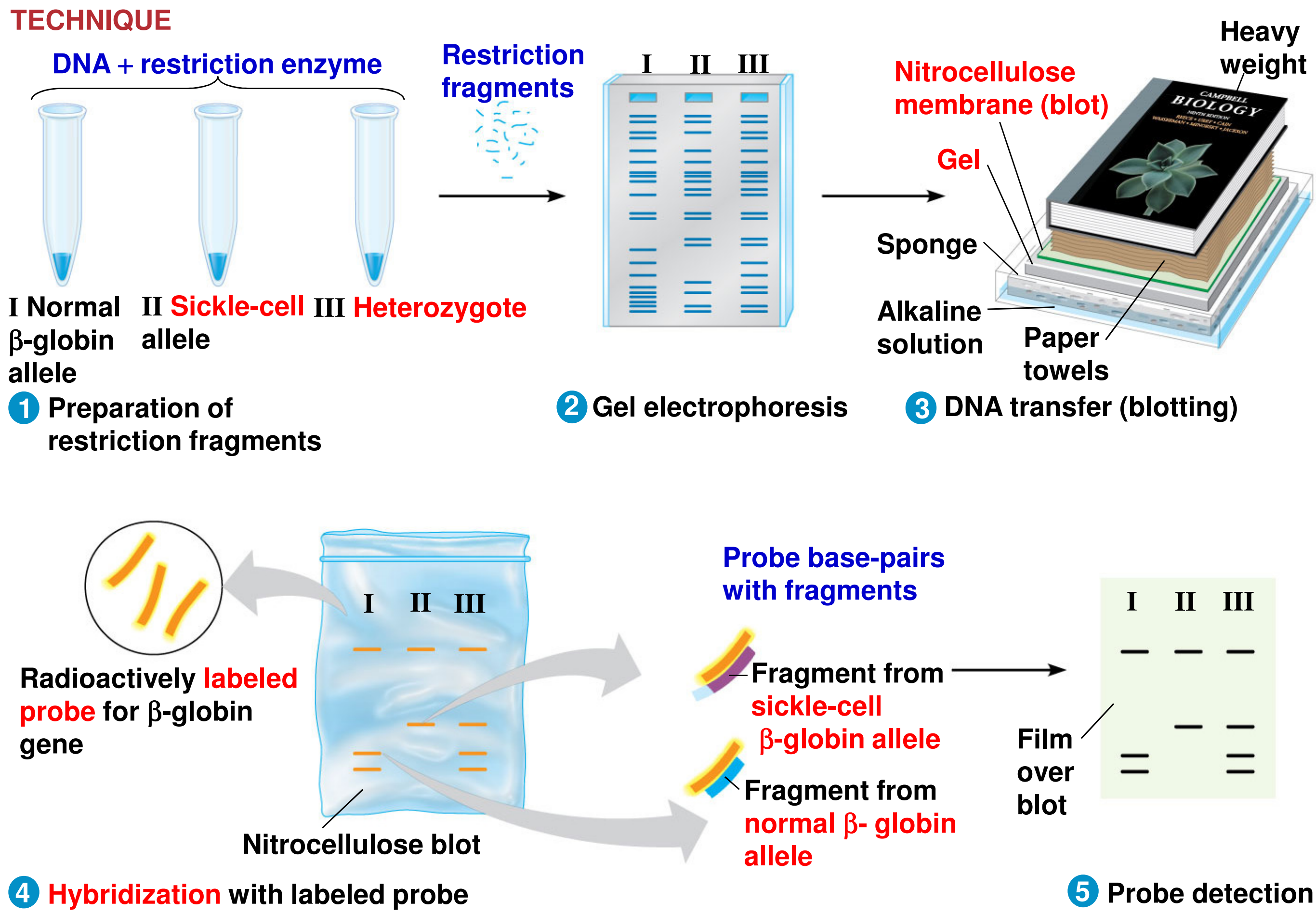


Fig. 16.12(TE Art)

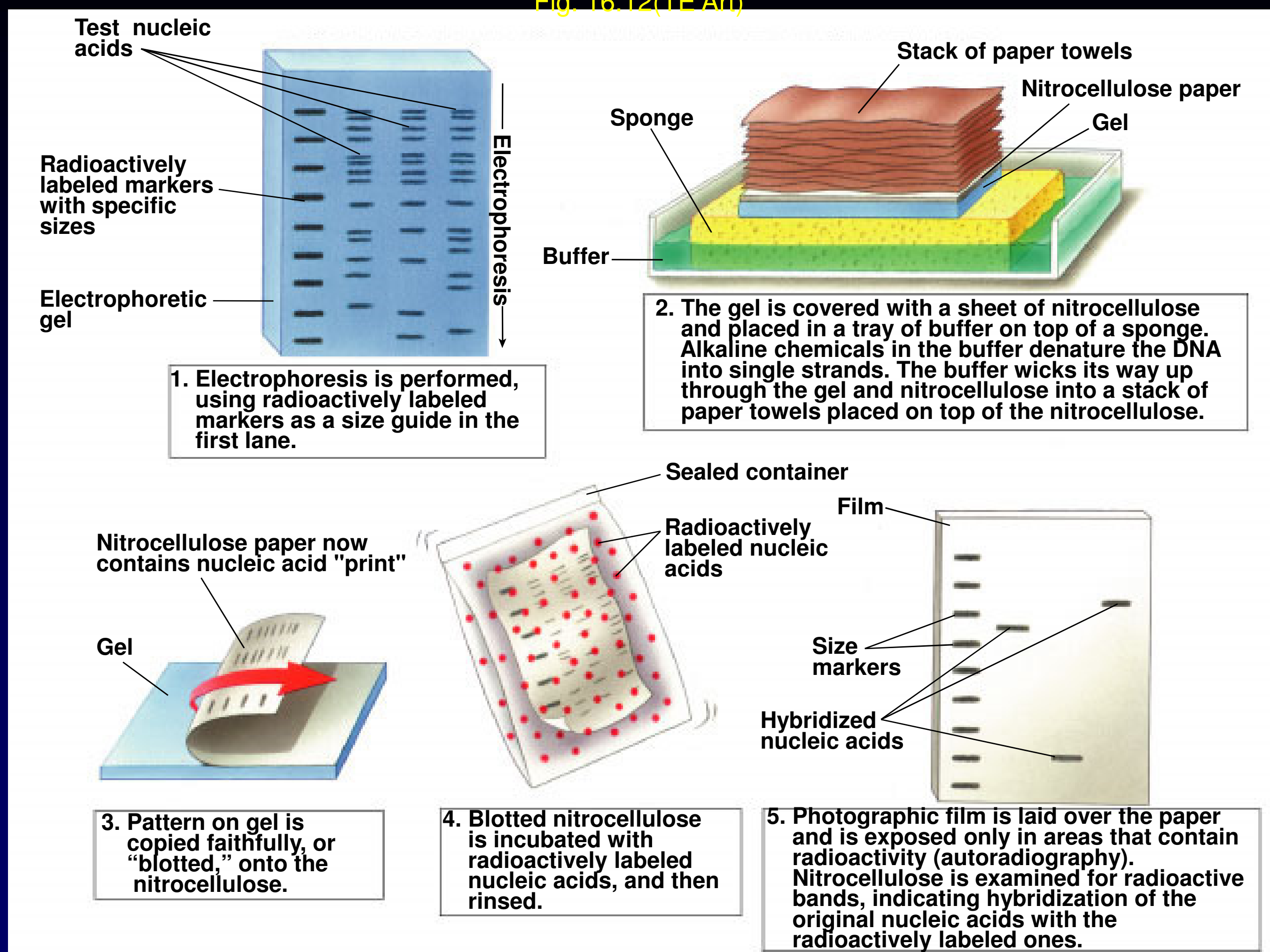
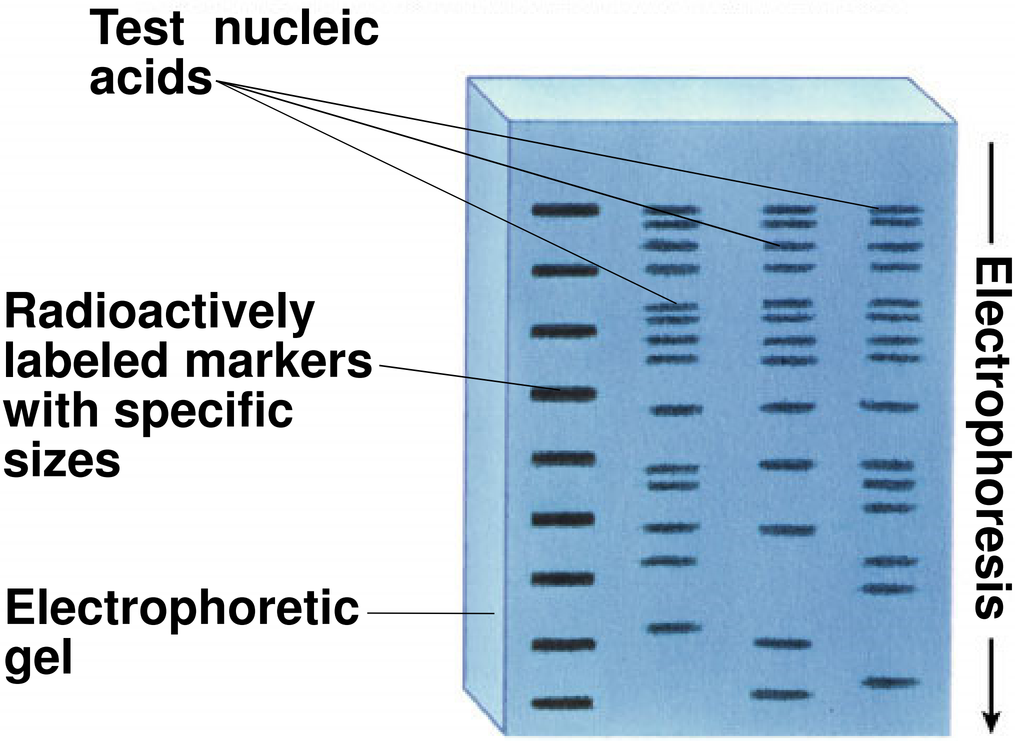
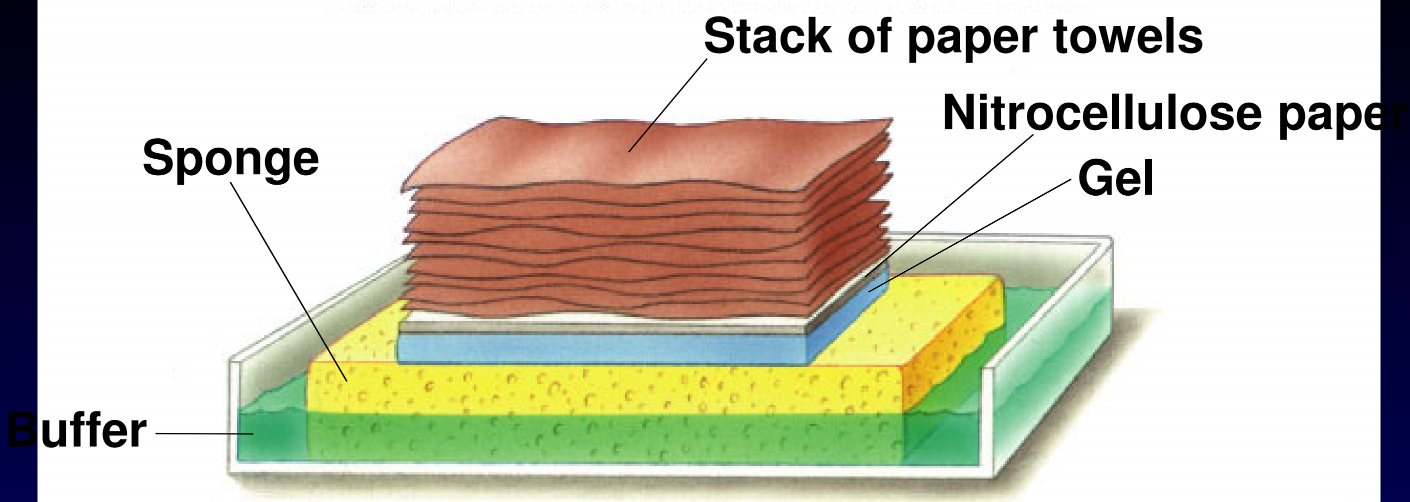


Fig. 16.12a(TE Art)

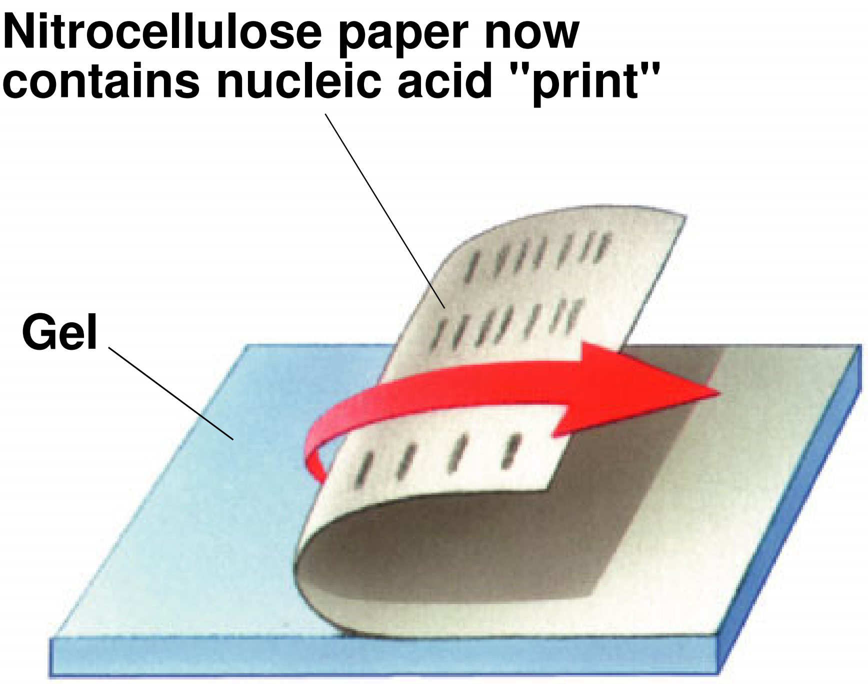


1. Electrophoresis is performed, using radioactively labeled markers as a size guide in the first lane.

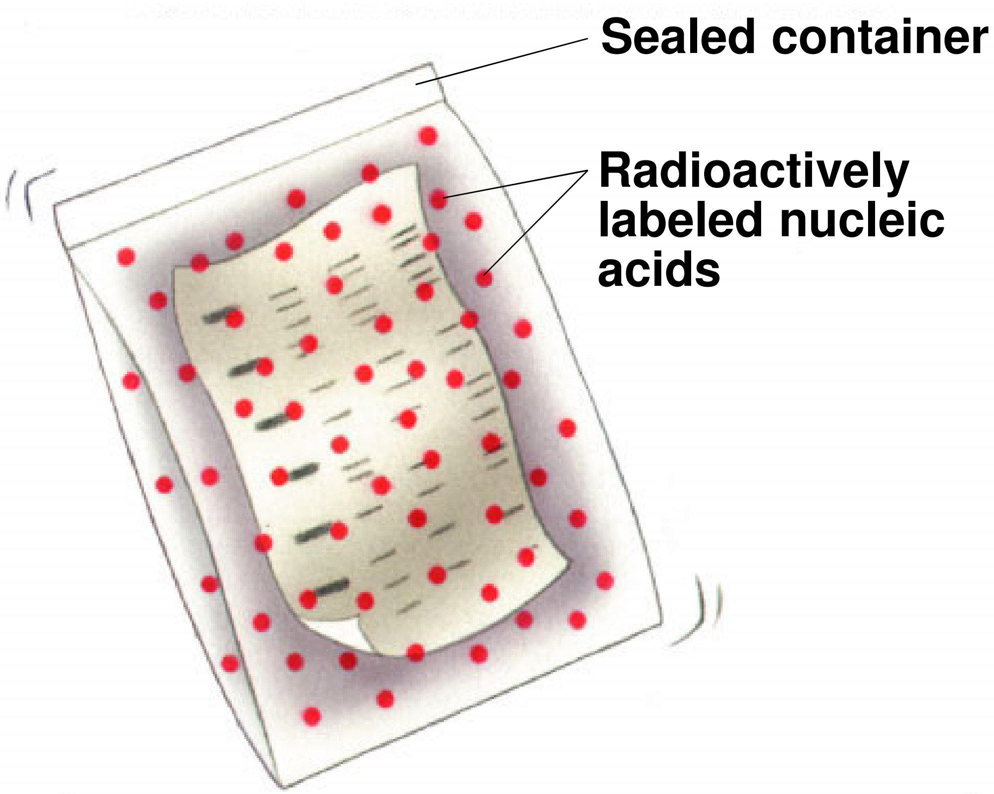
Fig. 16.12b(TE Art)



2. The gel is covered with a sheet of nitrocellulose and placed in a tray of buffer on top of a sponge. Alkaline chemicals in the buffer denature the DNA into single strands. The buffer wicks its way up through the gel and nitrocellulose into a stack of paper towels placed on top of the nitrocellulose.

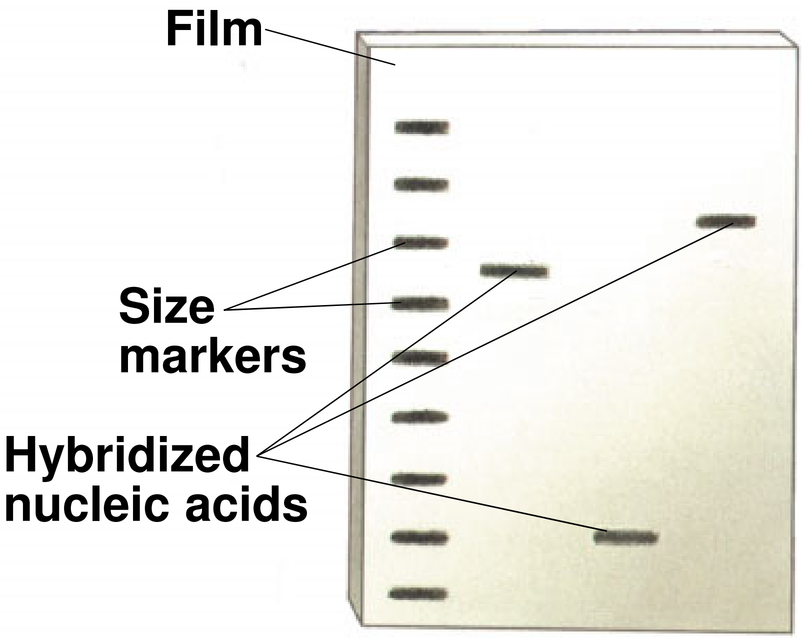


3. Pattern on gel is copied faithfully, or "blotted," onto the nitrocellulose.



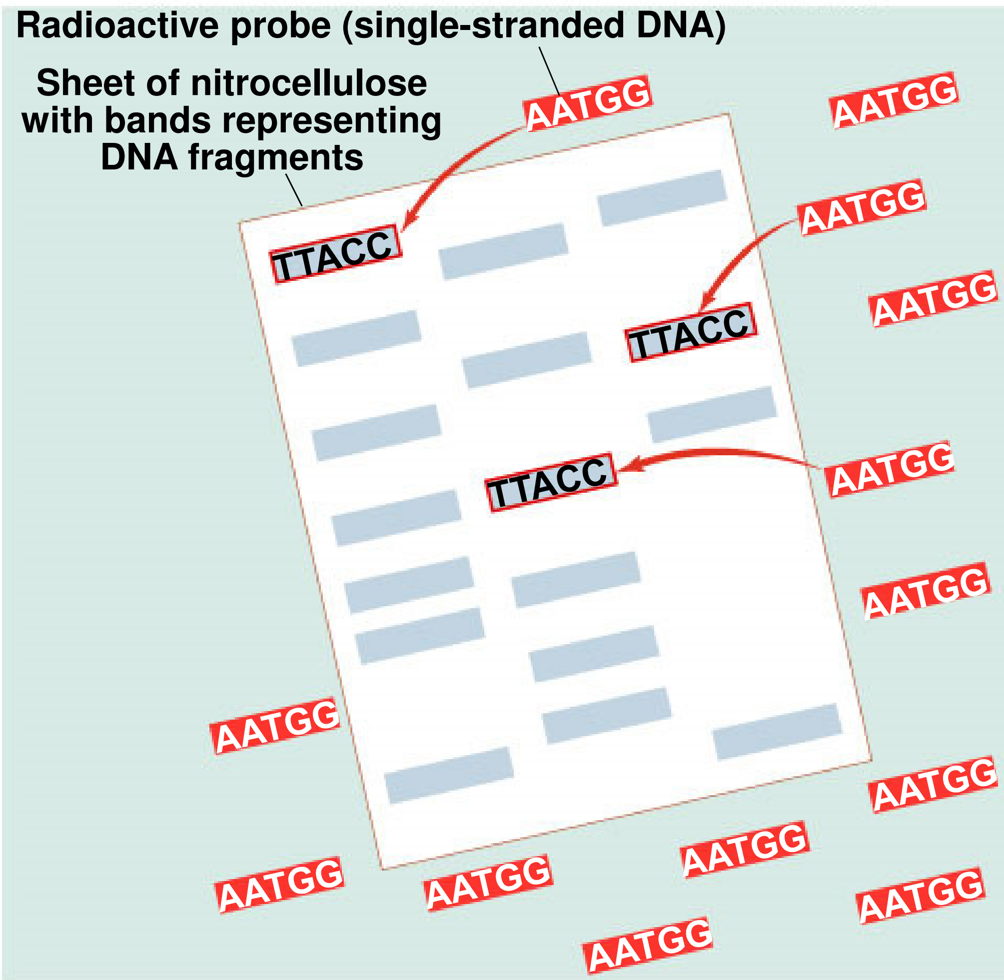
4. Blotted nitrocellulose is incubated with radioactively labeled nucleic acids, and then rinsed.

Fig. 16.12e(TE Art)



5. Photographic film is laid over the paper and is exposed only in areas that contain radioactivity (autoradiography). Nitrocellulose is examined for radioactive bands, indicating hybridization of the original nucleic acids with the radioactively labeled ones.

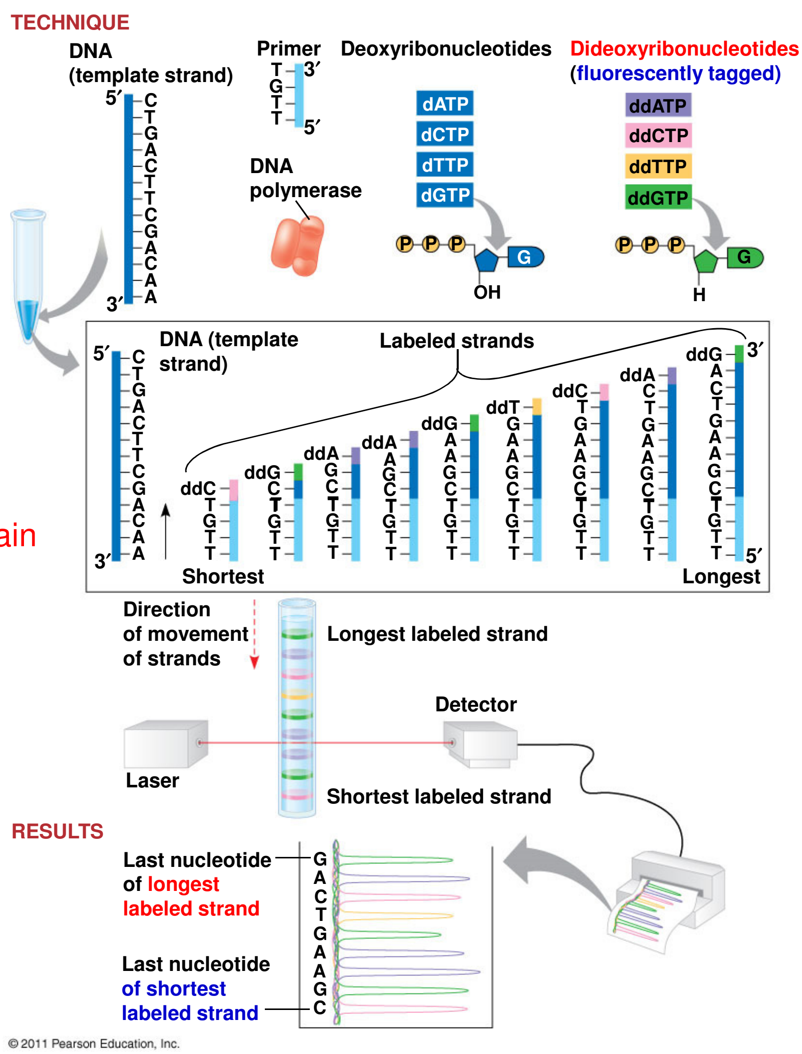
Fig. 16.13(TE Art)



DNA Sequencing

- Relatively short DNA fragments can be sequenced by the dideoxy chain termination method, the first automated method to be employed
- Modified nucleotides called dideoxyribonucleotides (ddNTP) attach to synthesized DNA strands of different lengths
- Each type of ddNTP is tagged with a distinct fluorescent label that identifies the nucleotide at the end of each DNA fragment
- The DNA sequence can be read from the resulting spectrogram

Figure 20.12



Dideoxy Chain Termination Method for Sequencing DNA

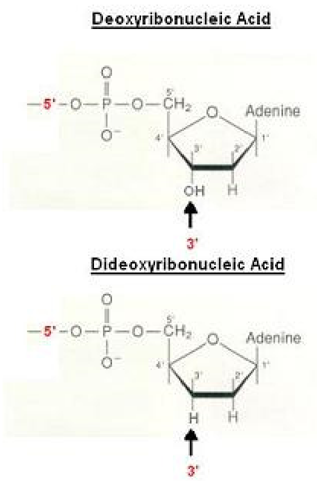


Figure 20.12a

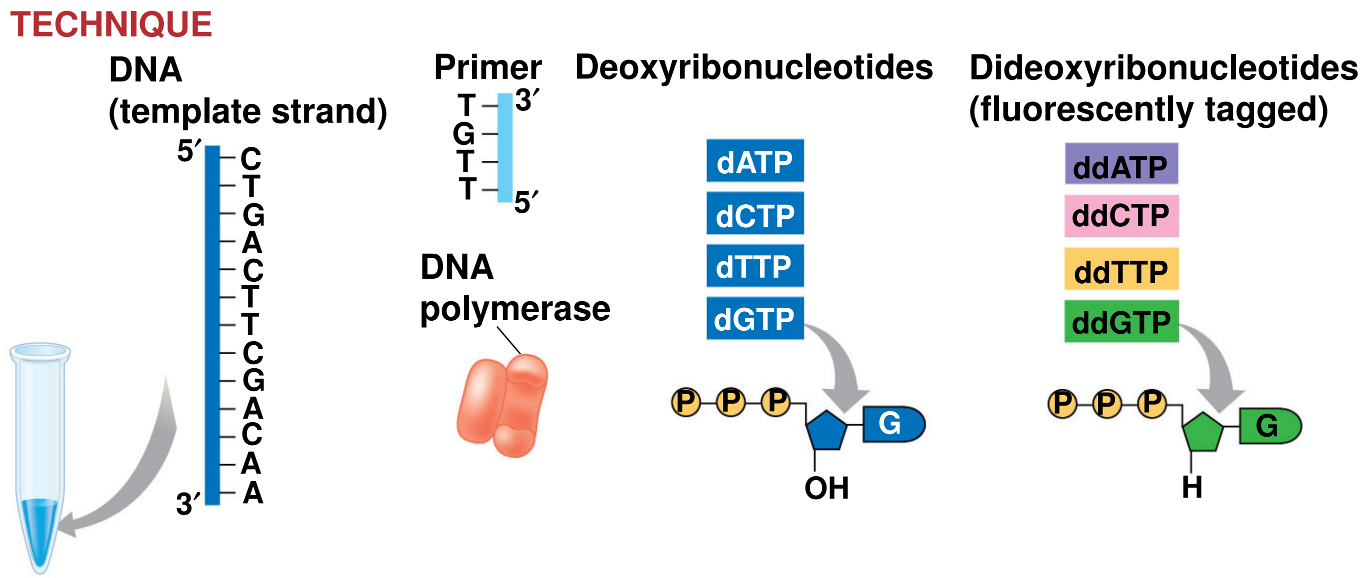


Figure 20.12b

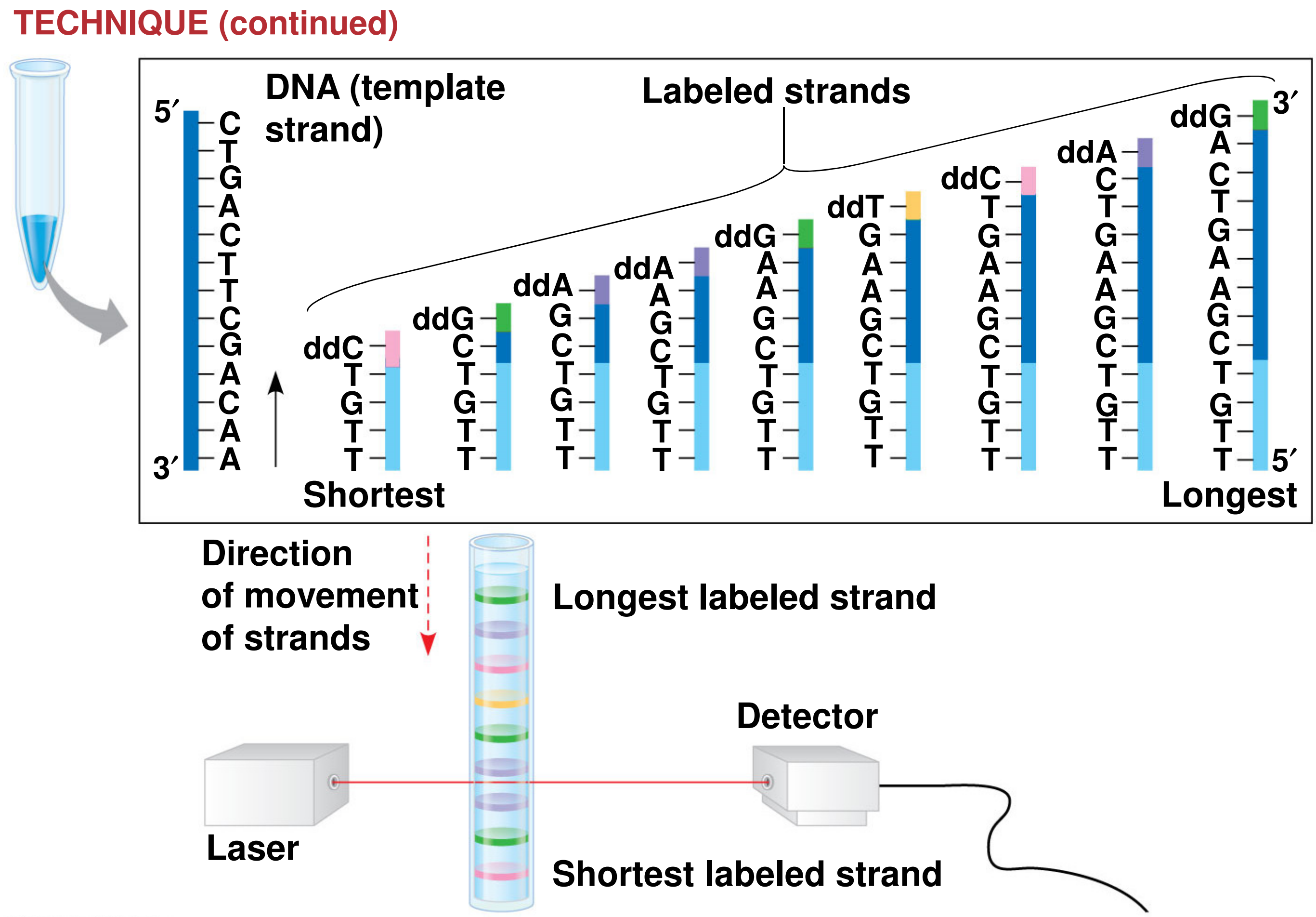
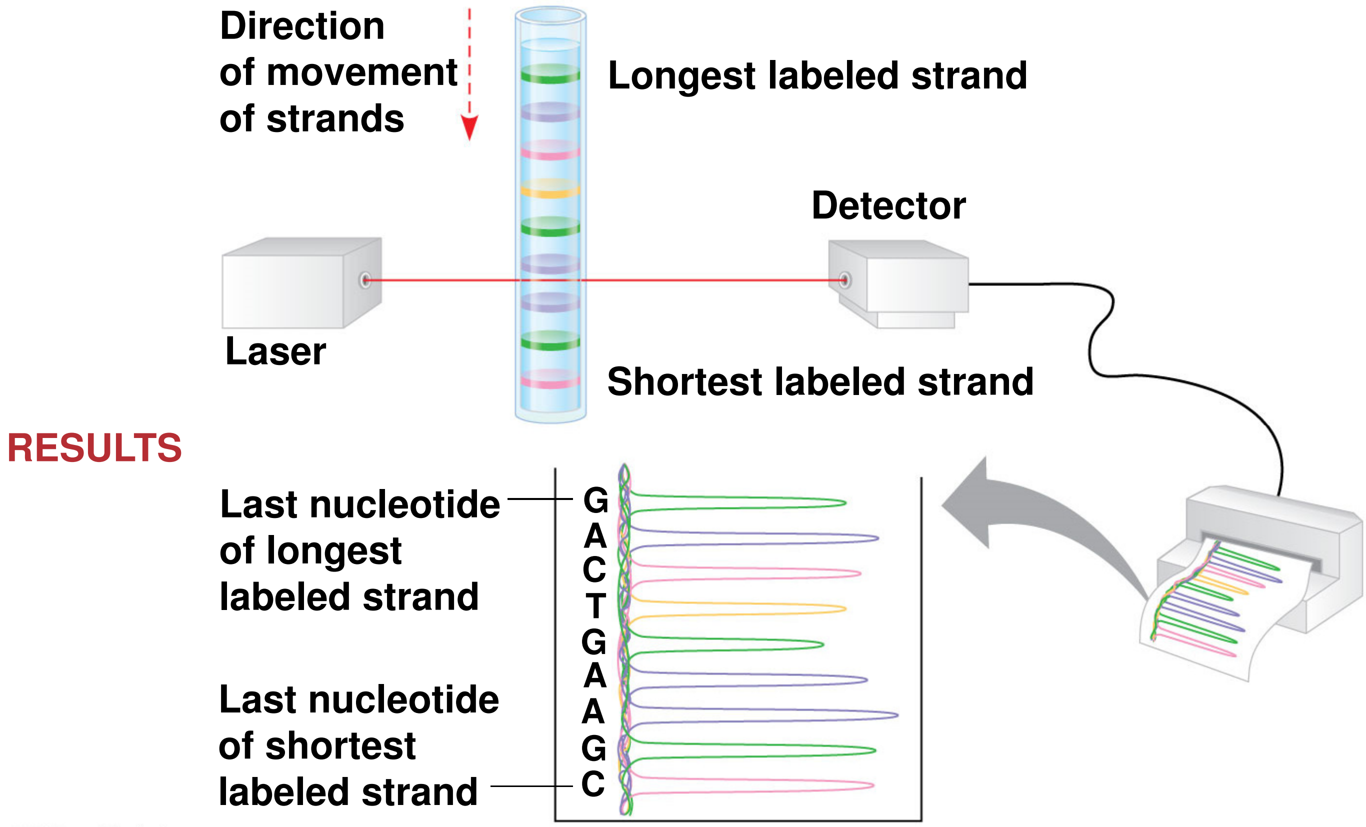
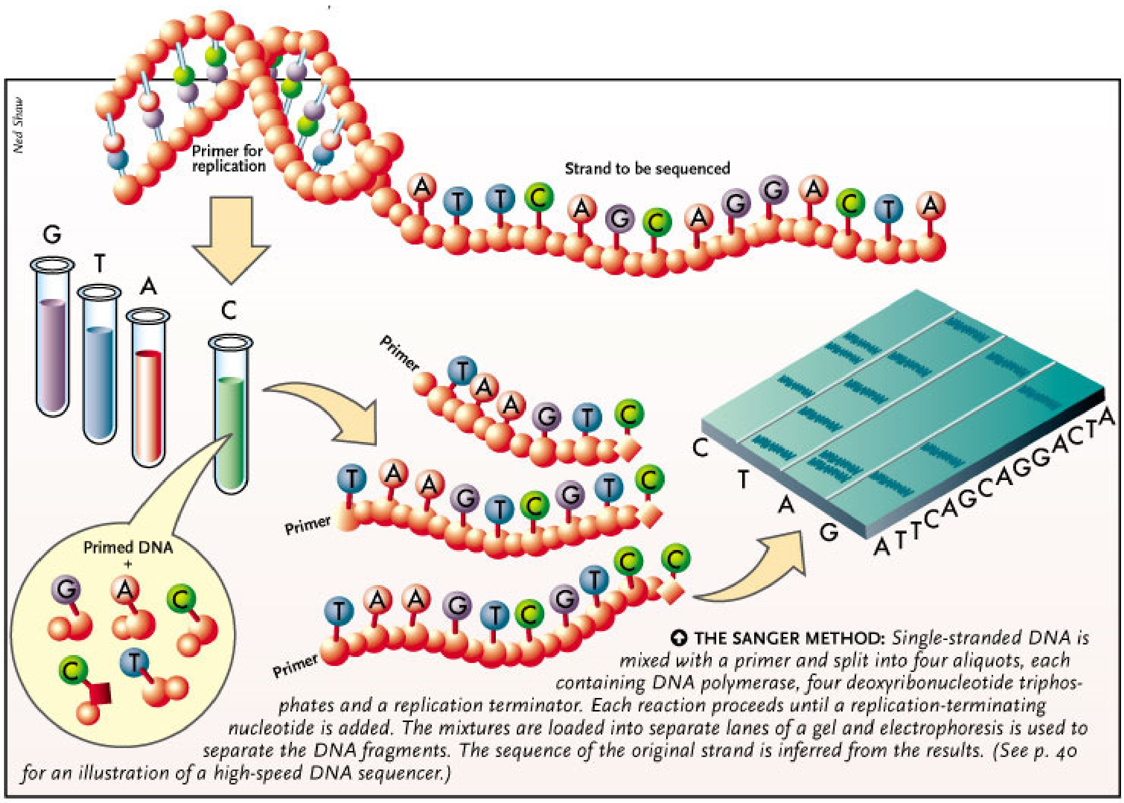


Figure 20.12c



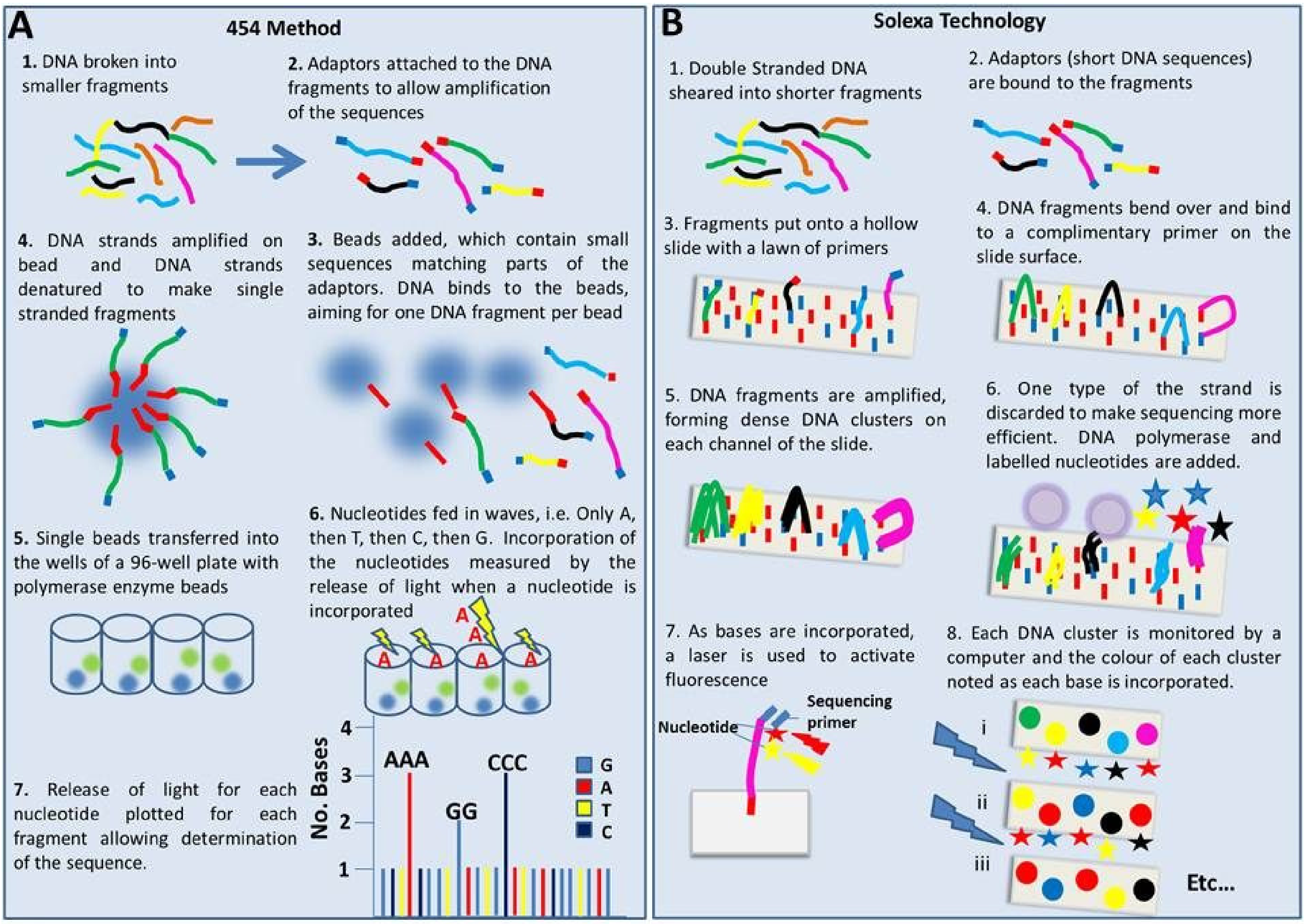
Sanger sequencing



❶ THE SANGER METHOD: *Single-stranded DNA is mixed with a primer and split into four aliquots, each containing DNA polymerase, four deoxyribonucleotide triphosphates and a replication terminator. Each reaction proceeds until a replication-terminating nucleotide is added. The mixtures are loaded into separate lanes of a gel and electrophoresis is used to separate the DNA fragments. The sequence of the original strand is inferred from the results. (See p. 40 for an illustration of a high-speed DNA sequencer.)*

http://www.the-scientist.com/?articles.view/articleNo/15939/title/DNA-Sequencing-Industry-Sets-its-Sights-on-the-Future/

Next generation sequencing



Studying the Expression of Single Genes

- Changes in the expression of a gene during embryonic development can be tested using
  - Northern blotting (probes hybridize with mRNAs)
  - Reverse transcriptase-polymerase chain reaction
- Identification of mRNA at a particular developmental stage suggests protein function at that stage
- **Reverse transcriptase-polymerase chain reaction (RT-PCR)** is quicker and more sensitive because it requires less mRNA than Northern blotting

Figure 20.13

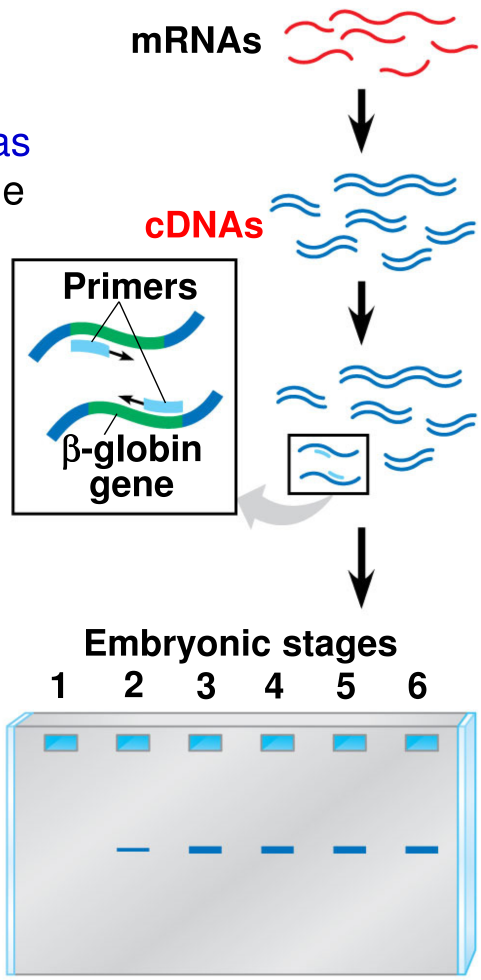
TECHNIQUE

1 cDNA synthesis

Reverse transcriptase is added to mRNA to make cDNA, which serves as a template for PCR amplification of the gene of interest

2 PCR amplification

3 Gel electrophoresis

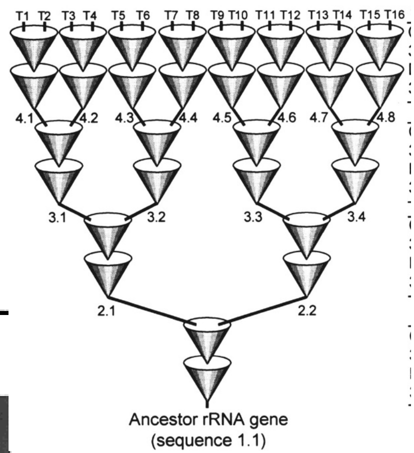


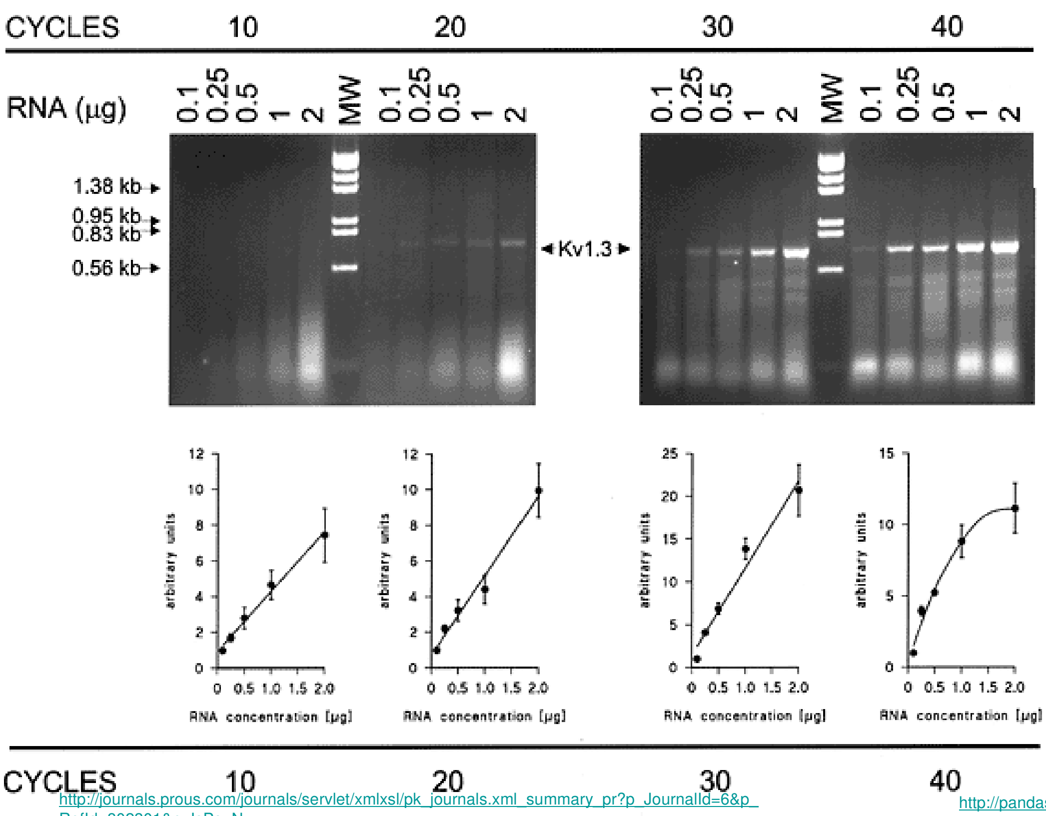
RESULTS

Which stage this gene express more?

Remember not to saturate the PCR product

Saturation of PCR



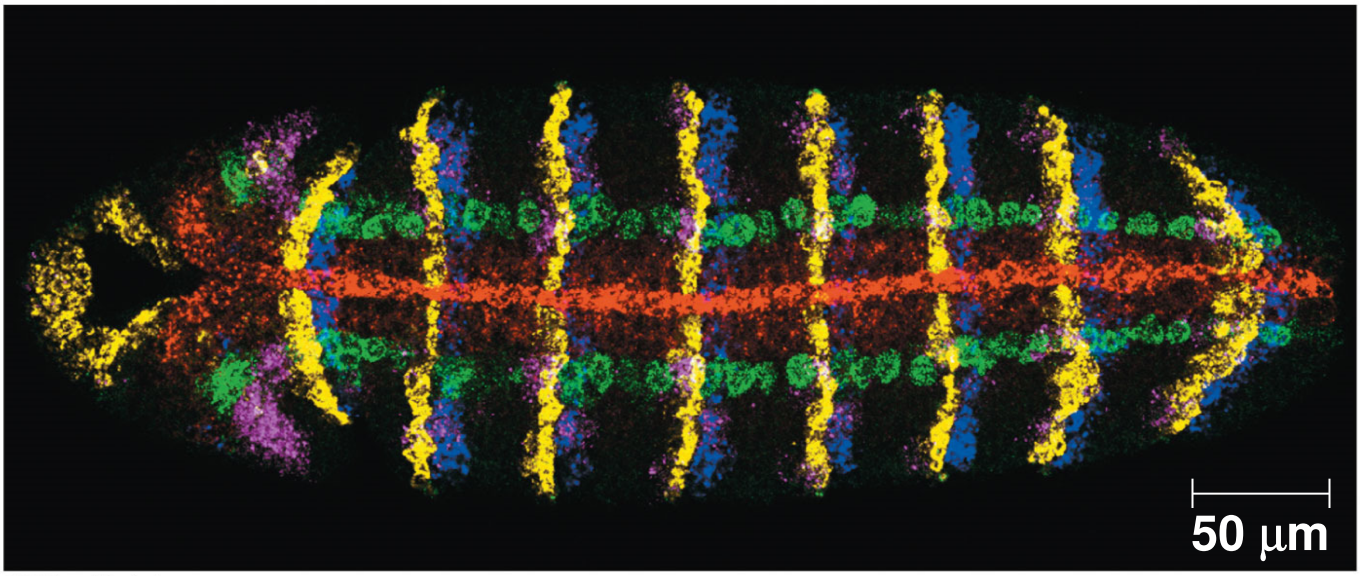


http://journals.prous.com/journals/servlet/xmlxsl/pk_journals.xml_summary_pr?p_JournalId=6&p_RefId=802301&p_IsPs=N

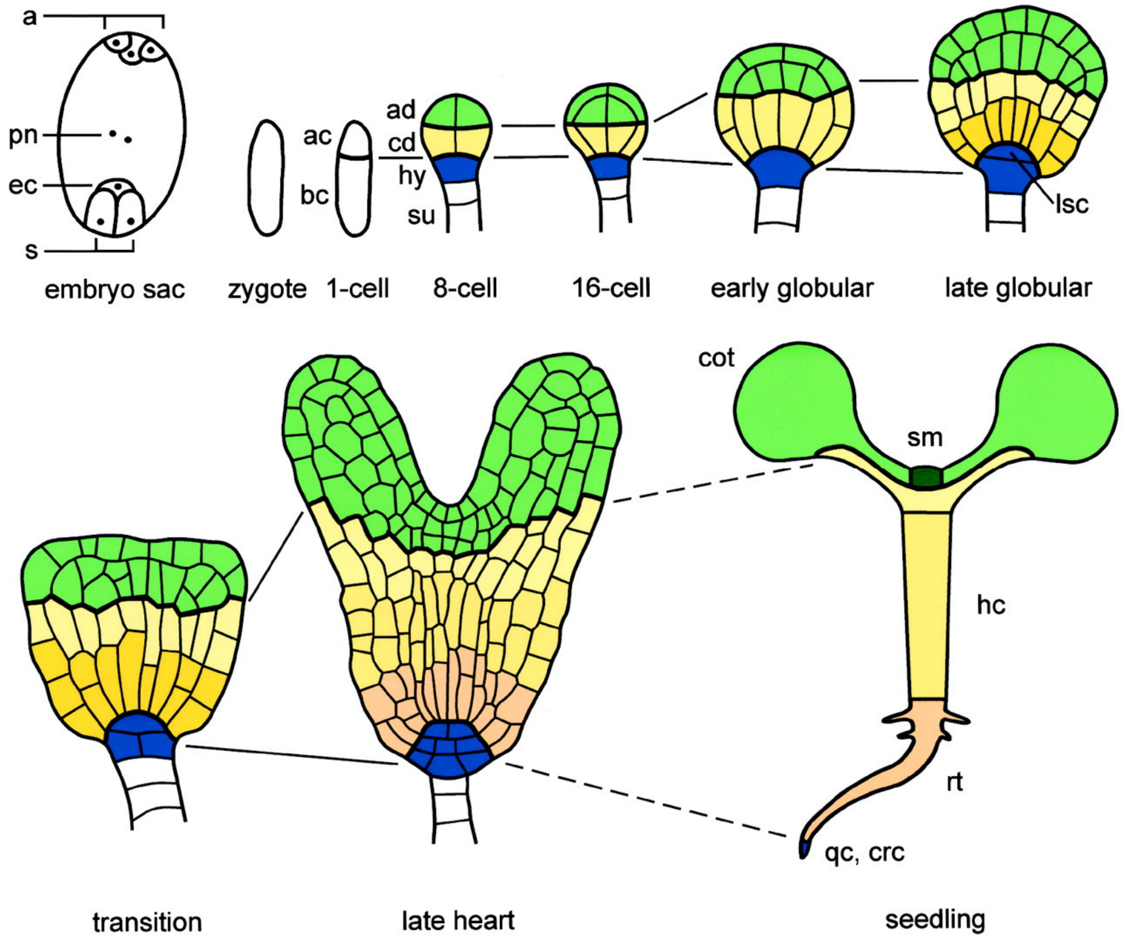
http://pandasthumb.org/archives/2004/07/icons-of-id-avi-1.html

Figure 20.14

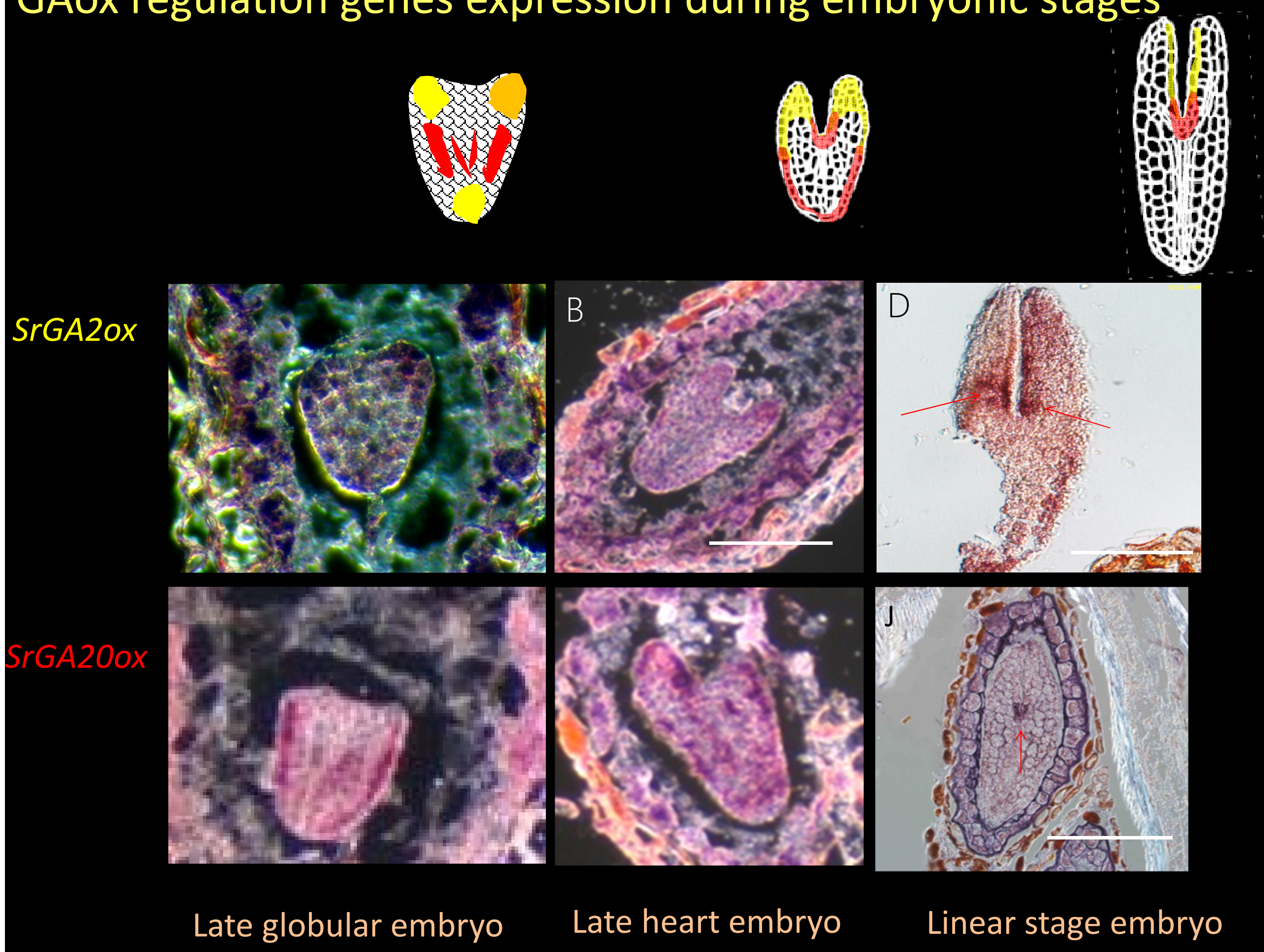
***In situ* hybridization** uses fluorescent (chemical) dyes attached to probes to identify the location of specific mRNAs in place in the intact organism

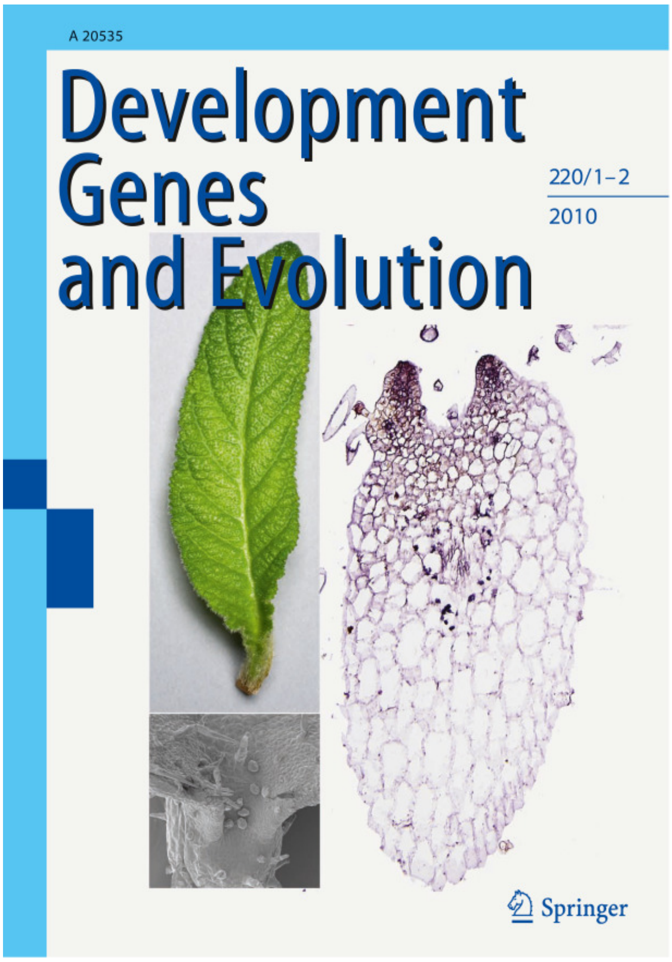


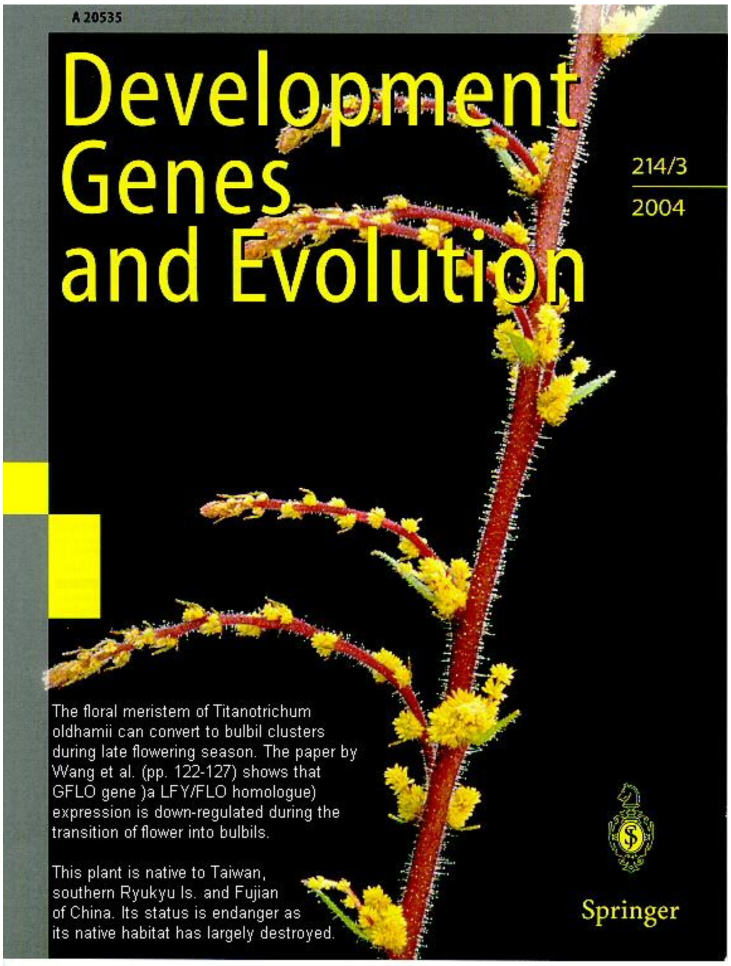
Shoot development in embryo



GAox regulation genes expression during embryonic stages







Studying the Expression of Interacting Groups of Genes

- Automation has allowed scientists to measure expression of thousands of genes at one time using DNA microarray assays
- **DNA microarray assays** compare patterns of gene expression in different tissues, at different times, or under different conditions

Figure 20.15

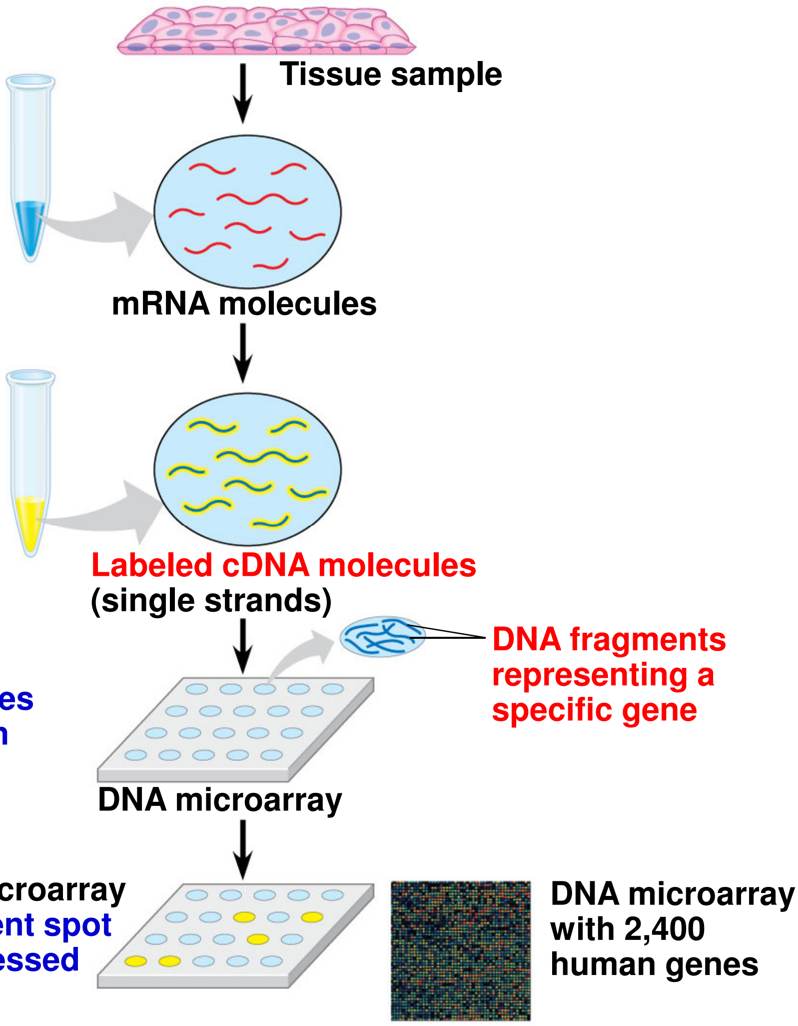
TECHNIQUE

1. Isolate mRNA.

2. Make cDNA by reverse transcription, using fluorescently labeled nucleotides.

3. Apply the cDNA mixture to a microarray, a different gene in each spot. The cDNA hybridizes with any complementary DNA on the microarray.

4. Rinse off excess cDNA; scan microarray for fluorescence. Each fluorescent spot (yellow) represents a gene expressed in the tissue sample.

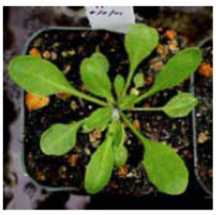


利用核酸微矩陣進行基因表現分析:雜和反應

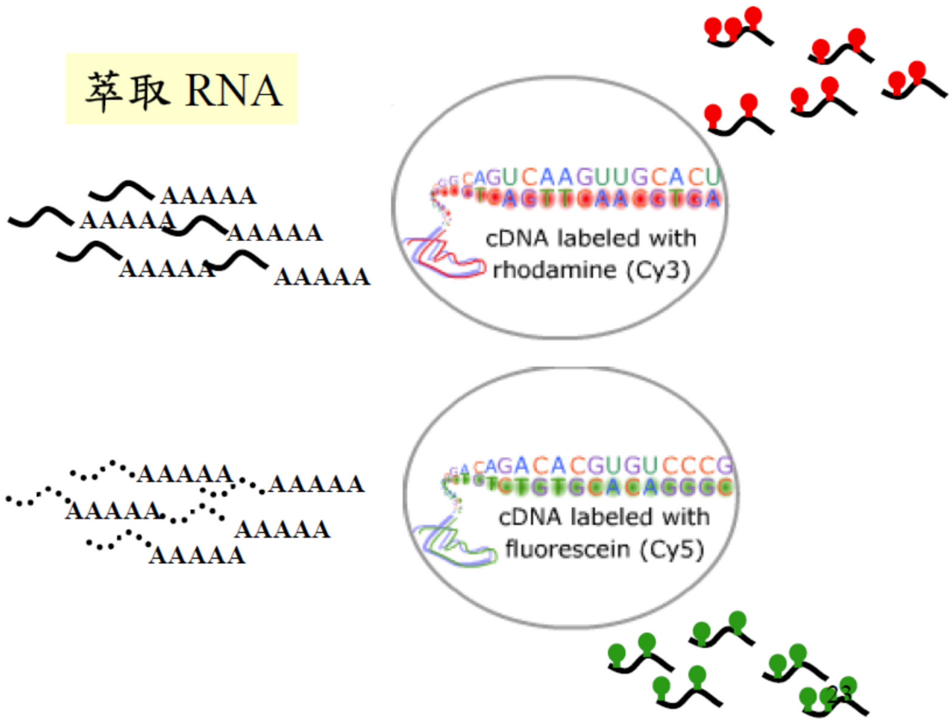
以螢光物質標定RNA

萃取 RNA

葉片



花

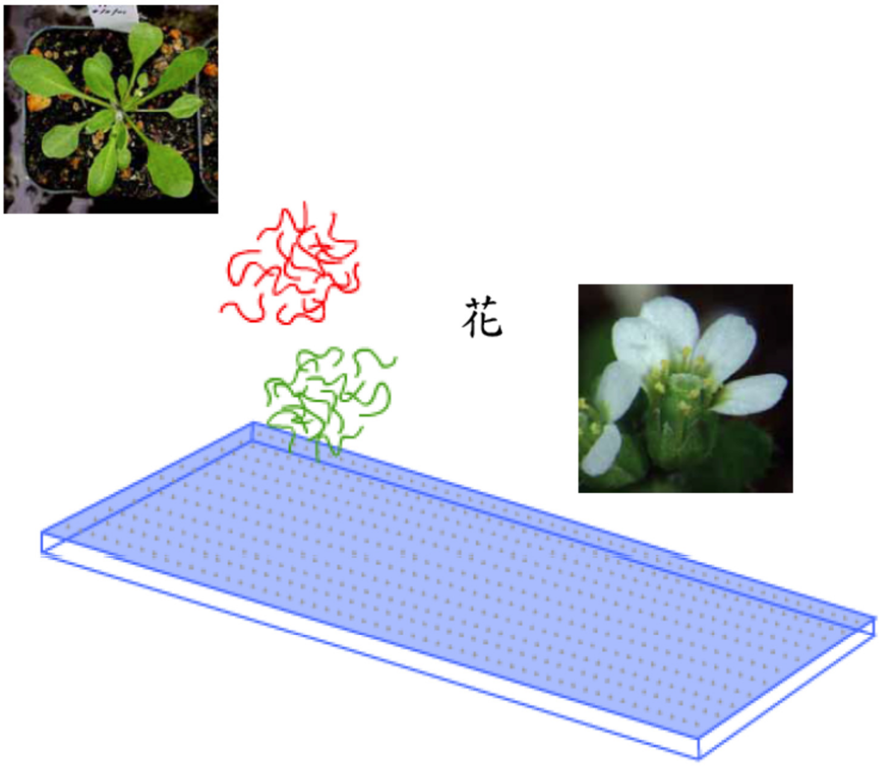


http://proj1.sinica.edu.tw/~hispj/program/doc/97/20090516Wu_Shu_Hsing.pdf

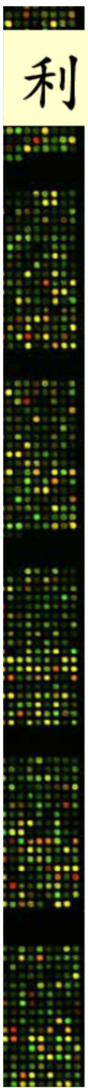
利用核酸微矩陣進行基因表現分析:雜和反應

葉片

花

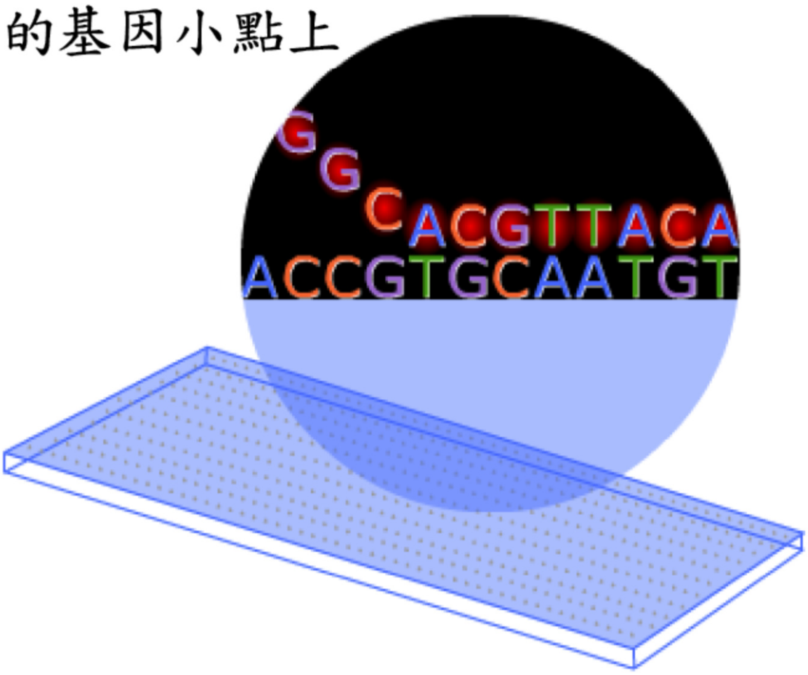


修改自 http://darwin.bio.uci.edu/~faculty/wagner/array2.html

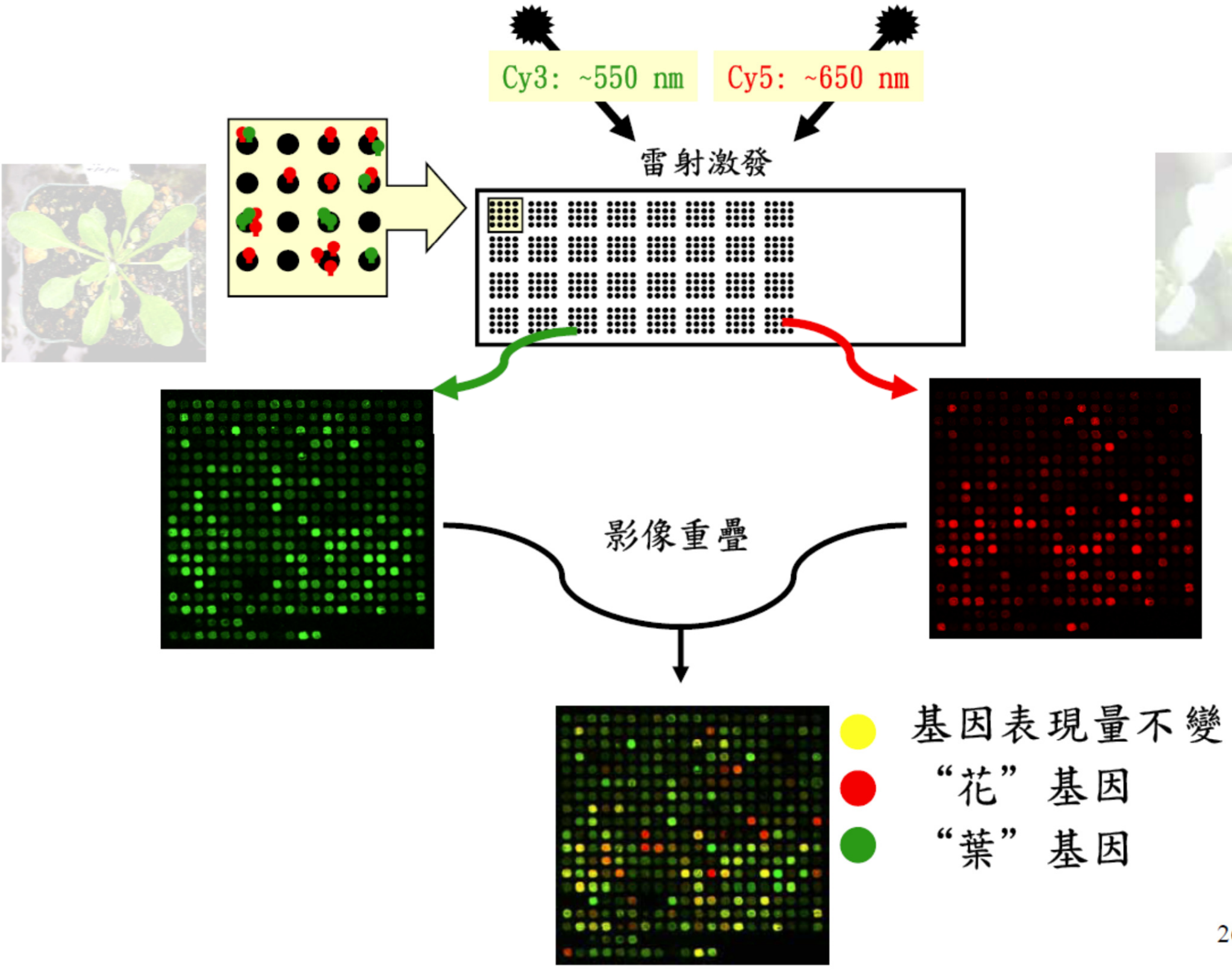


利用核酸微矩陣進行基因表現分析:雜和反應

螢光標記的 **RNA** 分子
被固定於相對應的基因小點上



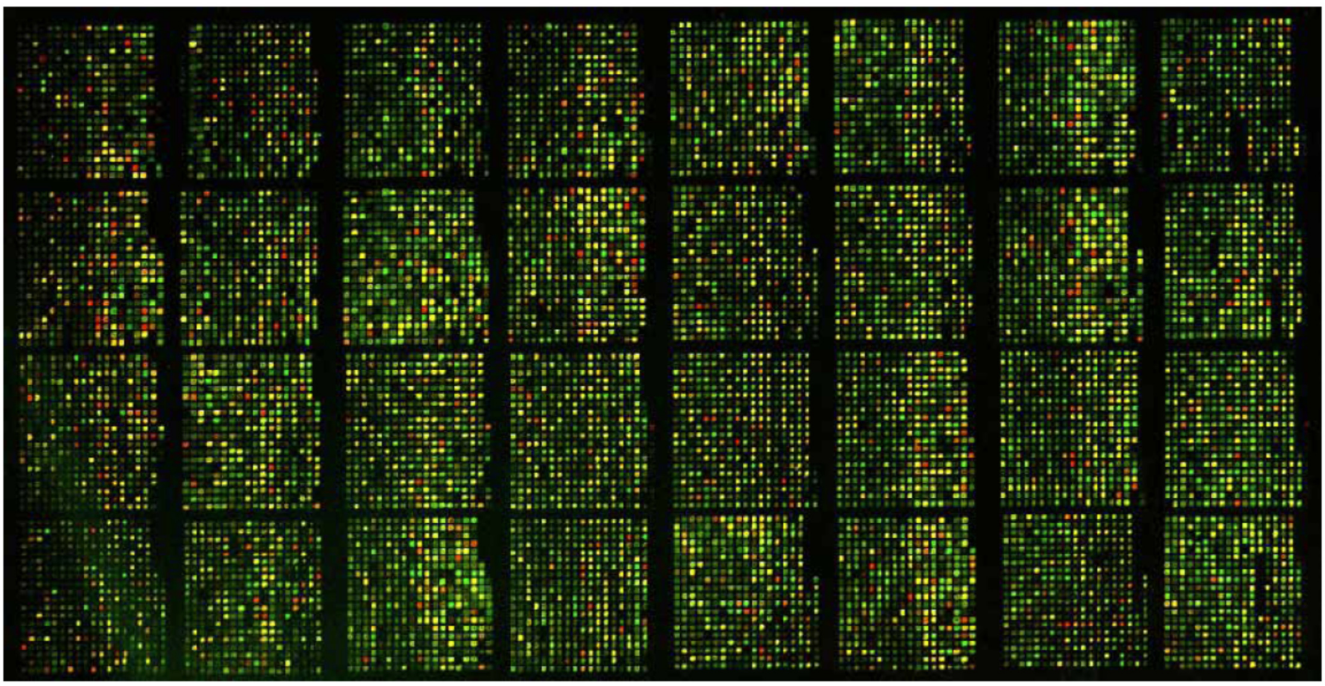
取材於 http://darwin.bio.uci.edu/~faculty/wagner/array2.html



26

http://proj1.sinica.edu.tw/~hispj/program/doc/97/20090516Wu_Shu_Hsing.pdf

植物有多少“花”基因? 有多少“葉片”基因?

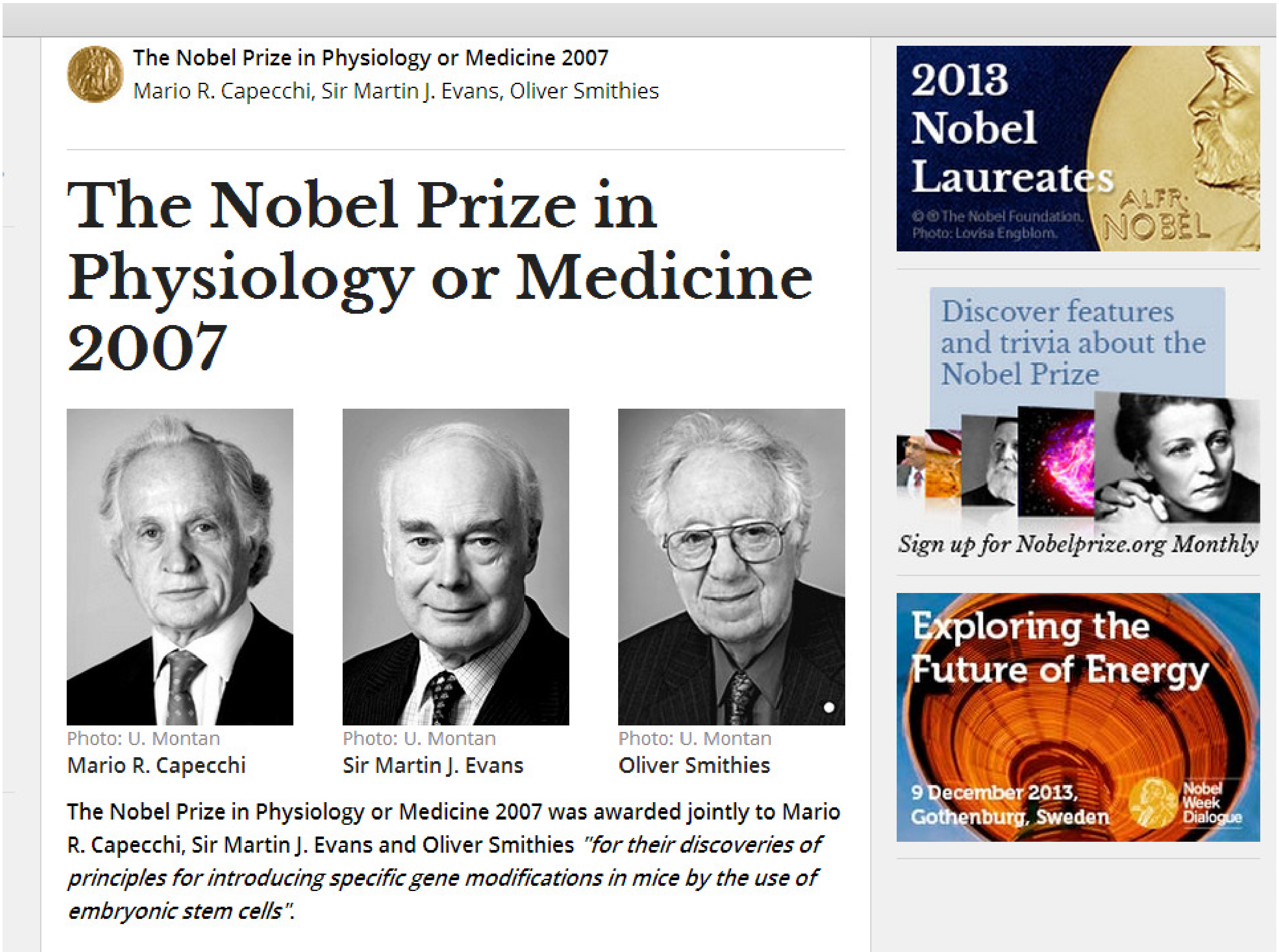


27

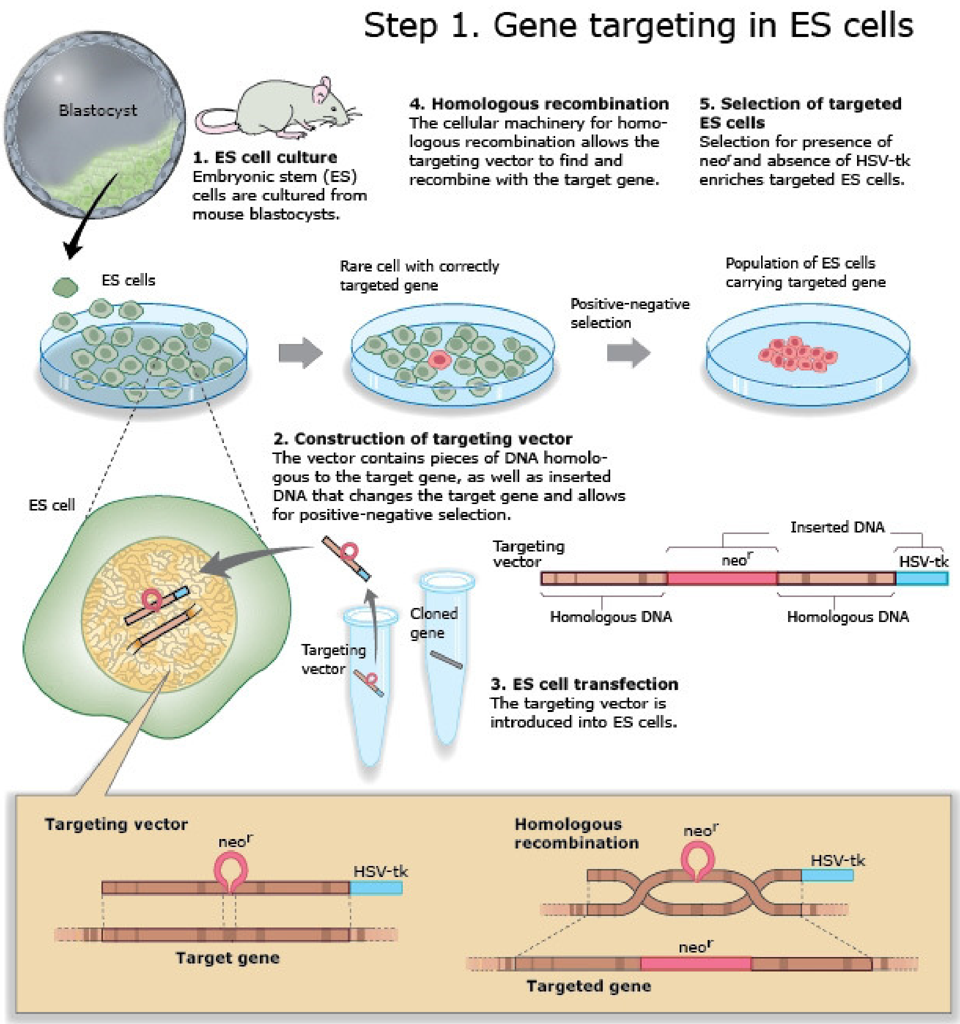
http://proj1.sinica.edu.tw/~hispj/program/doc/97/20090516Wu_Shu_Hsing.pdf

Determining Gene Function

- Using ***in vitro* mutagenesis**, mutations are introduced into a cloned gene, altering or destroying its function
- When the mutated gene is returned to the cell, the normal gene's function might be determined by examining the mutant's phenotype
- Gene expression can also be silenced using **RNA interference** (**RNAi**) (Synthetic double-stranded RNA molecules matching the sequence of a particular gene)



Homologous Recombination to introduce mutation



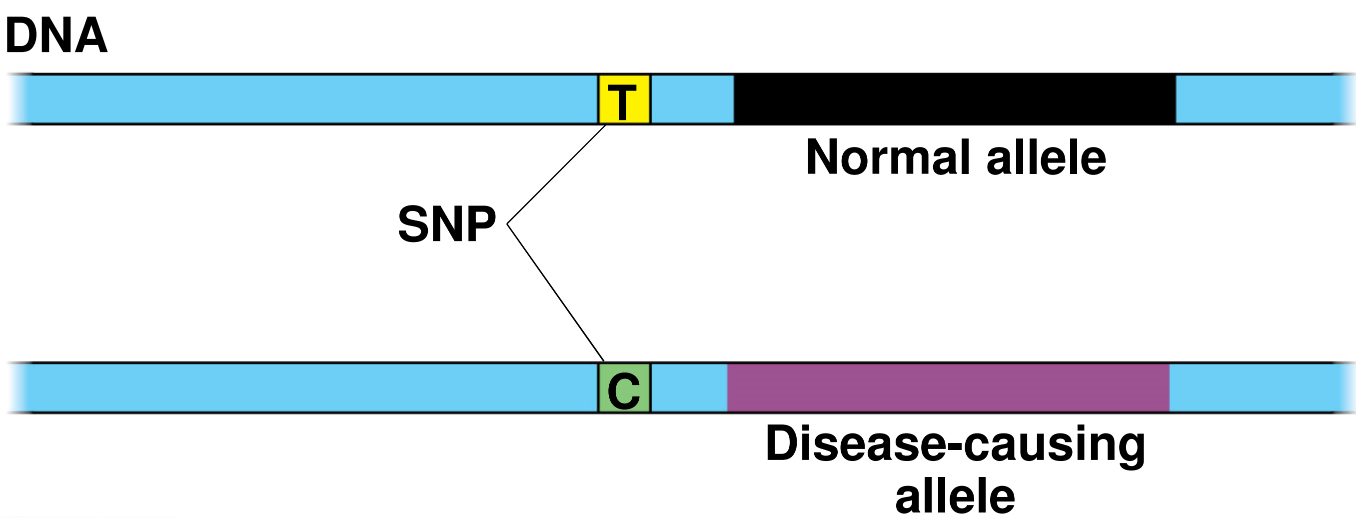
Homework

- Go to Nobel Prize website (below) and find an impressing winner's story to you. Summarize the story with your own words (no more than two A4 page)
- http://www.nobelprize.org

Genome-wide association studies

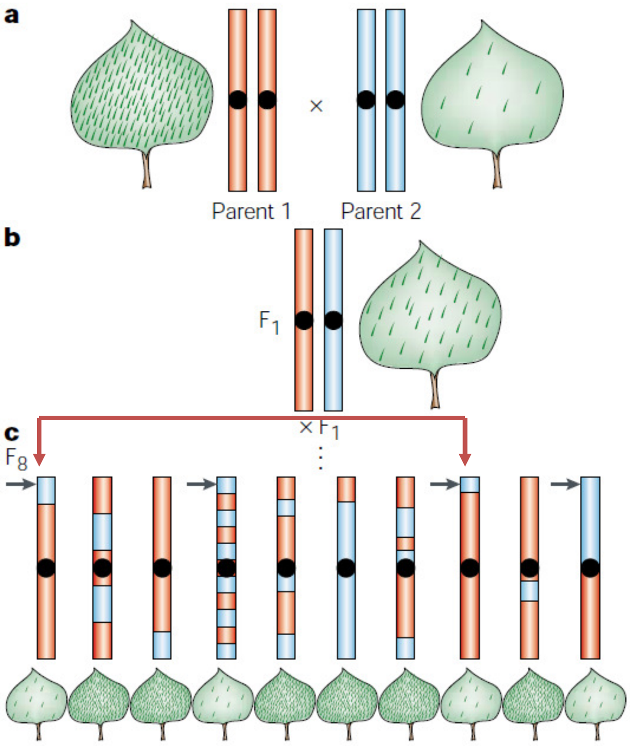
- In humans, researchers analyze the genomes of many people with a certain genetic condition to try to find nucleotide changes specific to the condition
- Genetic markers called **SNPs** (**single nucleotide polymorphisms**) occur on average every 100–300 base pairs
- SNPs can be detected by PCR, and any SNP shared by people affected with a disorder but not among unaffected people may pinpoint the location of the disease-causing gene

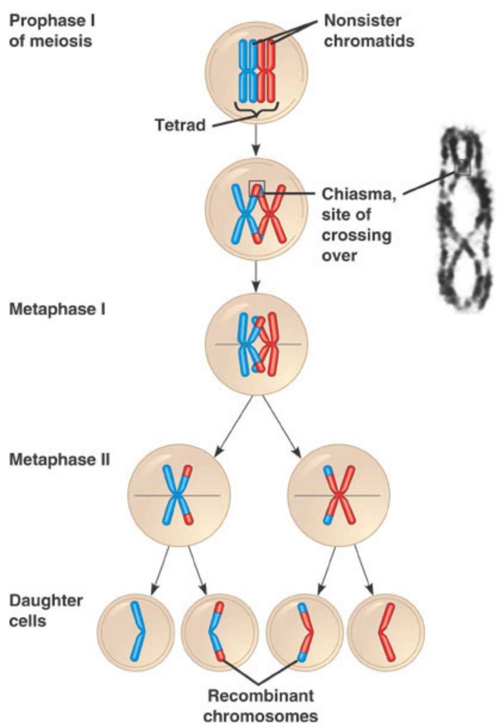
Figure 20.16



Approach: QTL on recombination lines

forward genetics: Mapping quantitative trait loci (QTL)

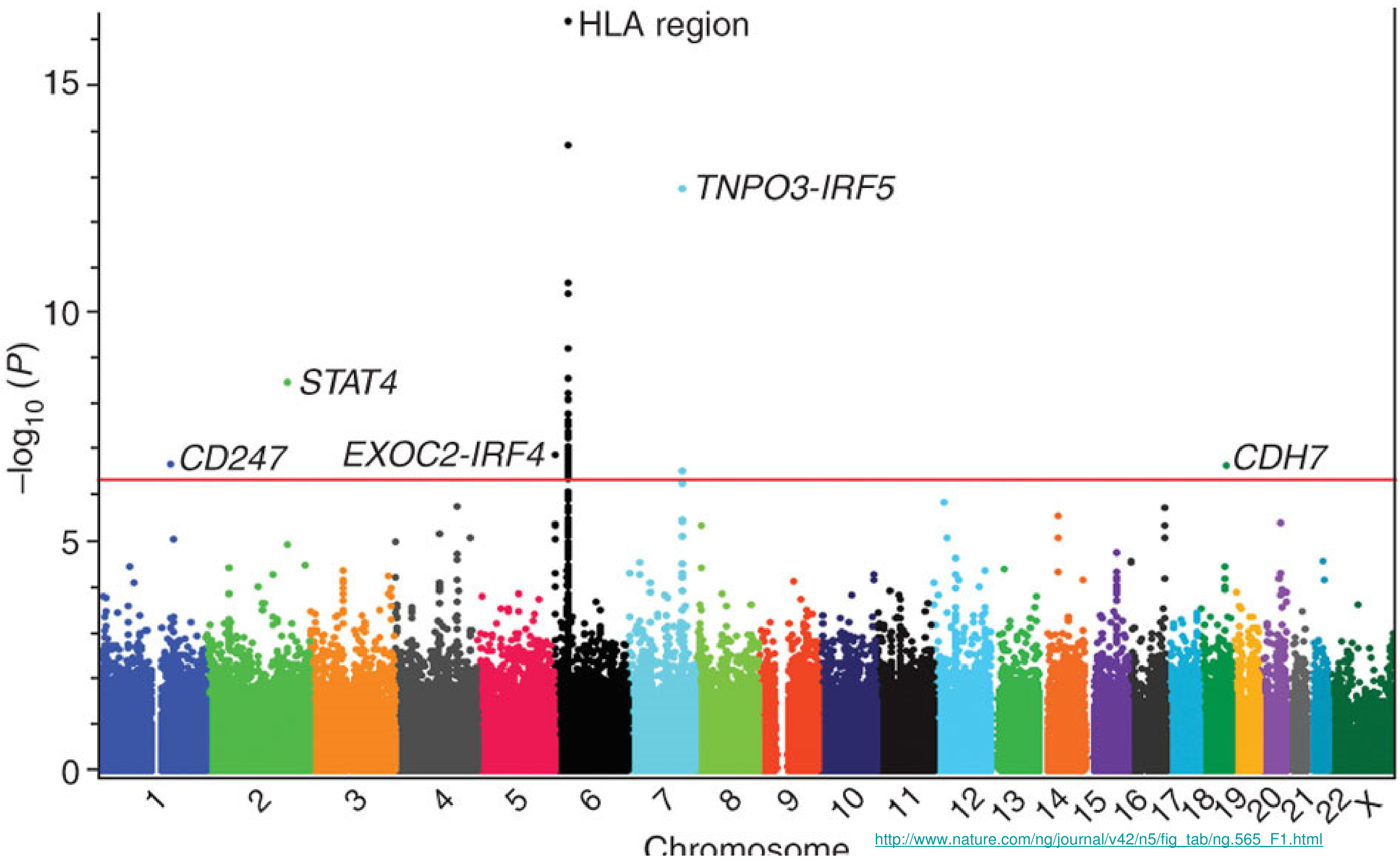




(Nature Review Genetics 2001 2:370-381)

Association mapping of the disease location

(due to low recombination)

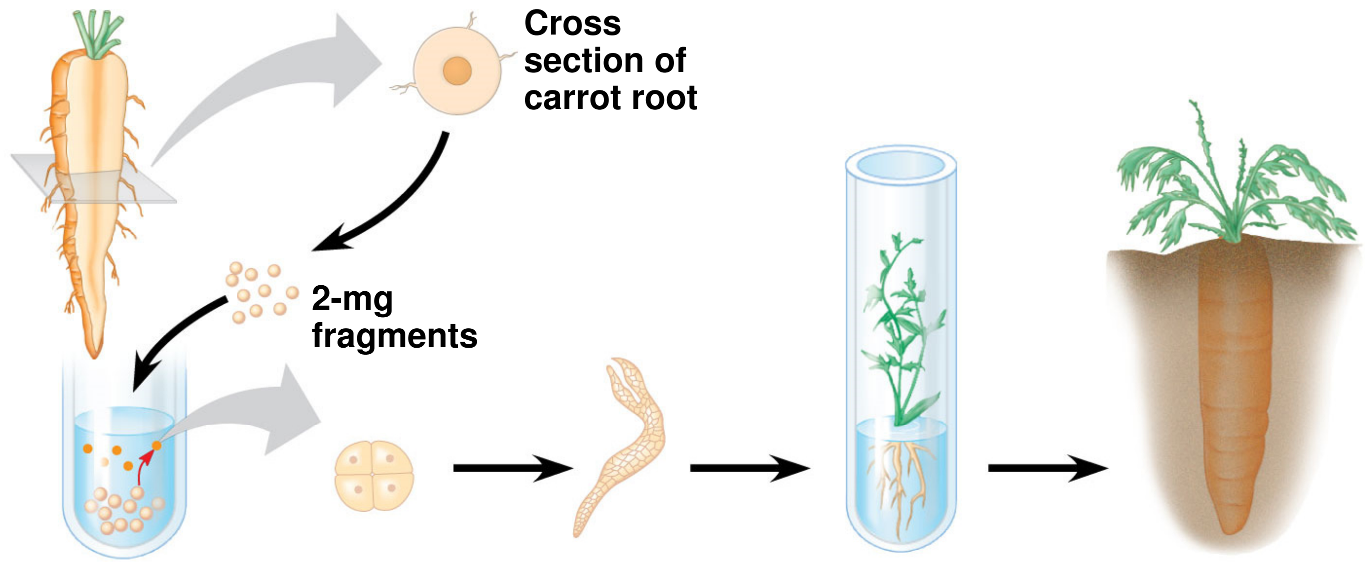


http://www.nature.com/ng/journal/v42/n5/fig_tab/ng.565_F1.html

Concept 20.3: Cloning organisms may lead to production of stem cells for research and other applications

- Organismal cloning produces one or more organisms genetically identical to the "parent" that donated the single cell
- A **totipotent** cell is one that can generate a complete new organism
- Plant cloning is used extensively in agriculture

Figure 20.17



My Sinningia

Cloning Animals: Nuclear Transplantation

- In nuclear transplantation, the nucleus of an unfertilized egg cell or zygote is replaced with the nucleus of a differentiated cell
- Experiments with frog embryos have shown that a transplanted nucleus can often support normal development of the egg
- However, the older the donor nucleus, the lower the percentage of normally developing tadpoles

Figure 20.18

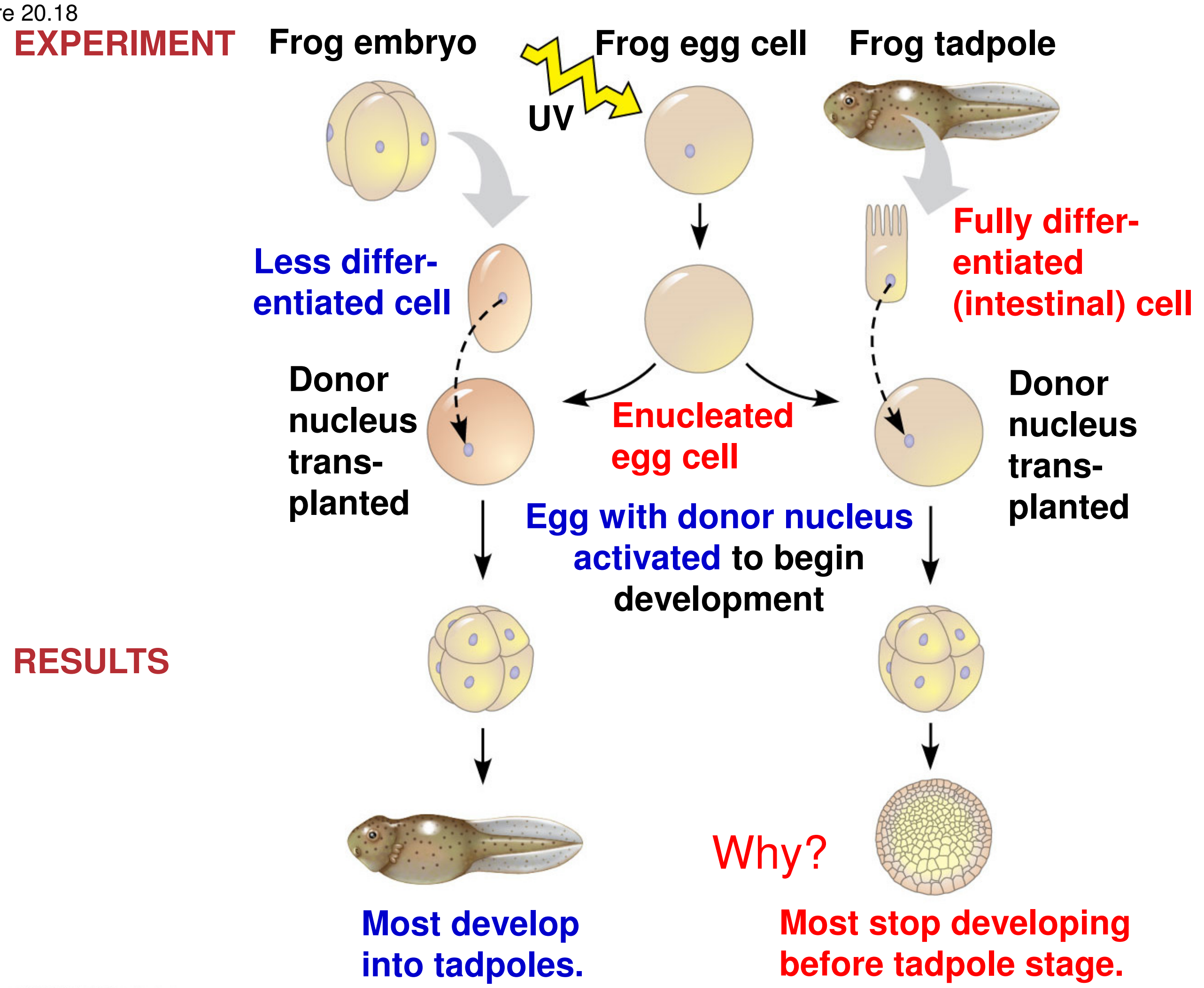
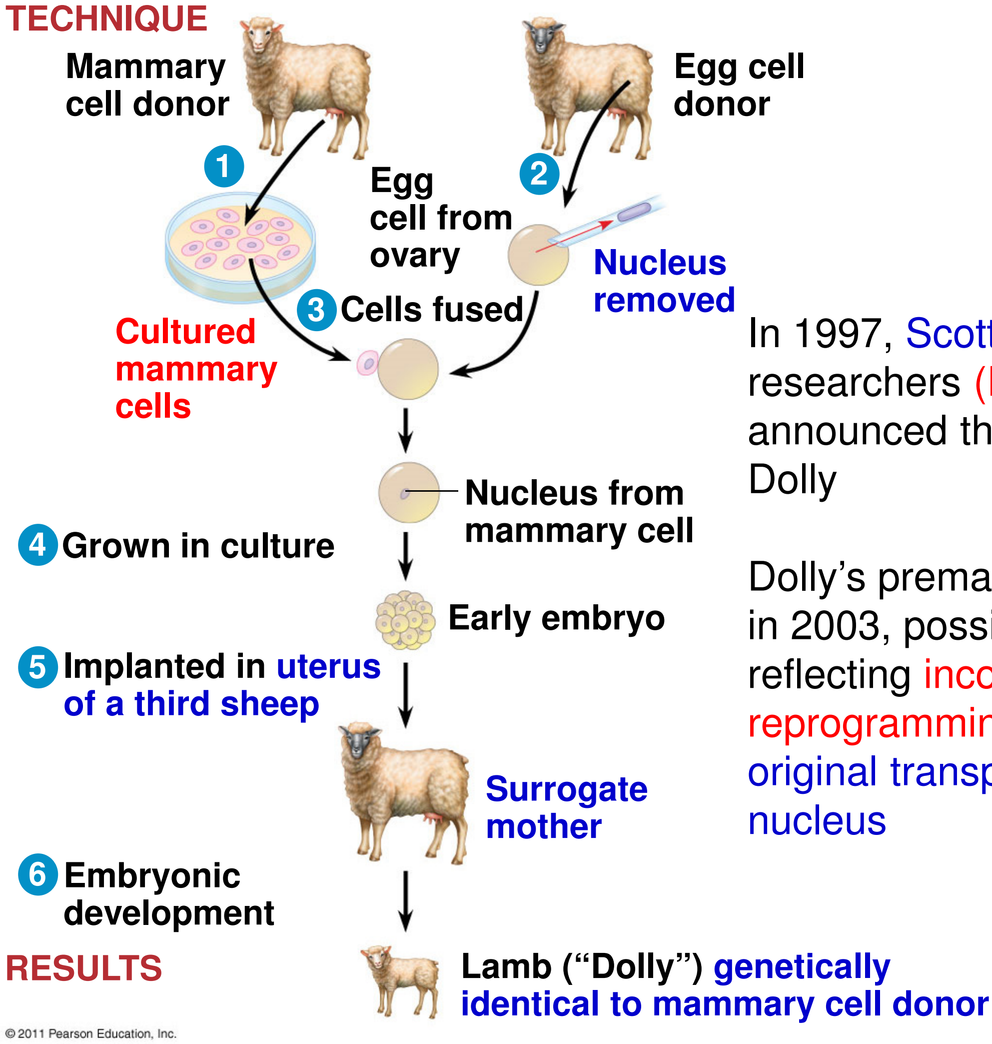


Figure 20.19



In 1997, Scottish researchers (Edinburgh) announced the birth of Dolly

Dolly's premature death in 2003, possibly reflecting incomplete reprogramming of the original transplanted nucleus

Figure 20.20

CC (for Carbon Copy) was the first cat cloned; however, CC differed somewhat from her female “parent” (left)

Why different skin color pattern? Random X chromosome inactivation

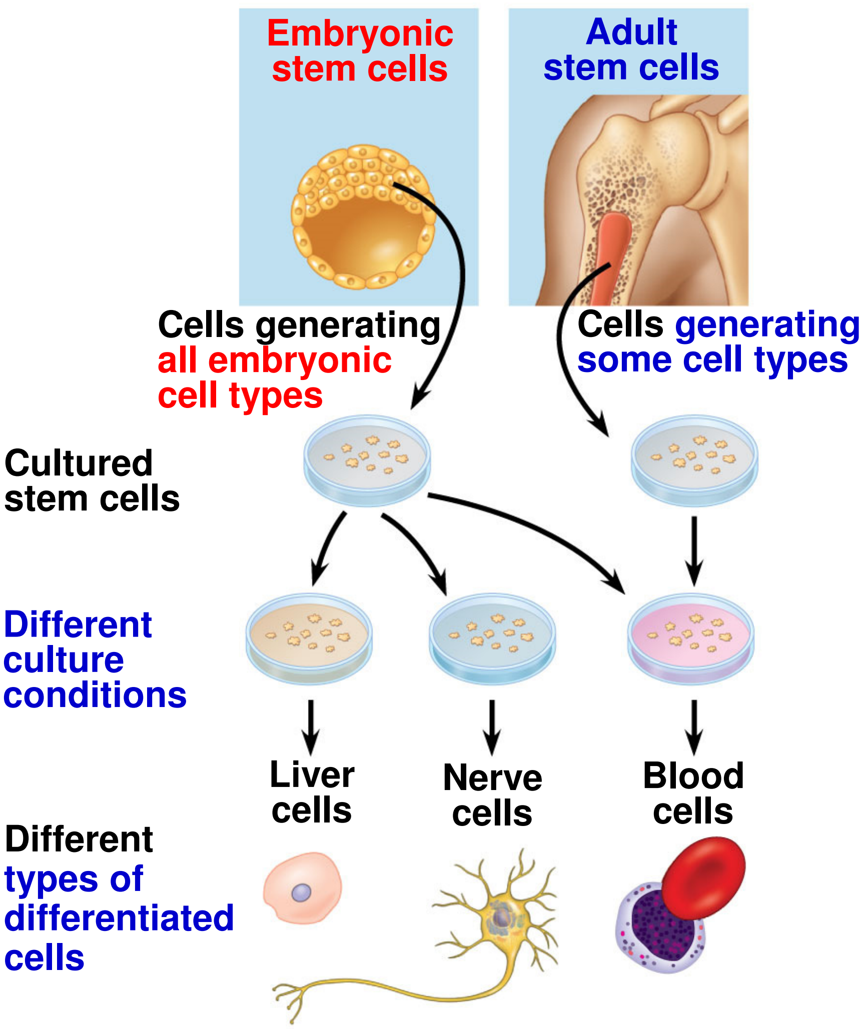
Problems Associated with Animal Cloning

- In most nuclear transplantation studies, only a small percentage of cloned embryos have developed normally to birth, and many cloned animals exhibit defects
- Many epigenetic changes, such as acetylation of histones or methylation of DNA, must be reversed in the nucleus from a donor animal in order for genes to be expressed or repressed appropriately for early stages of development

Stem Cells of Animals

- A **stem cell** is a relatively unspecialized cell that can reproduce itself indefinitely and differentiate into specialized cells of one or more types
- Stem cells isolated from early embryos at the blastocyst stage are called embryonic stem (ES) cells; these are able to differentiate into all cell types
- The adult body also has stem cells, which replace nonreproducing specialized cells

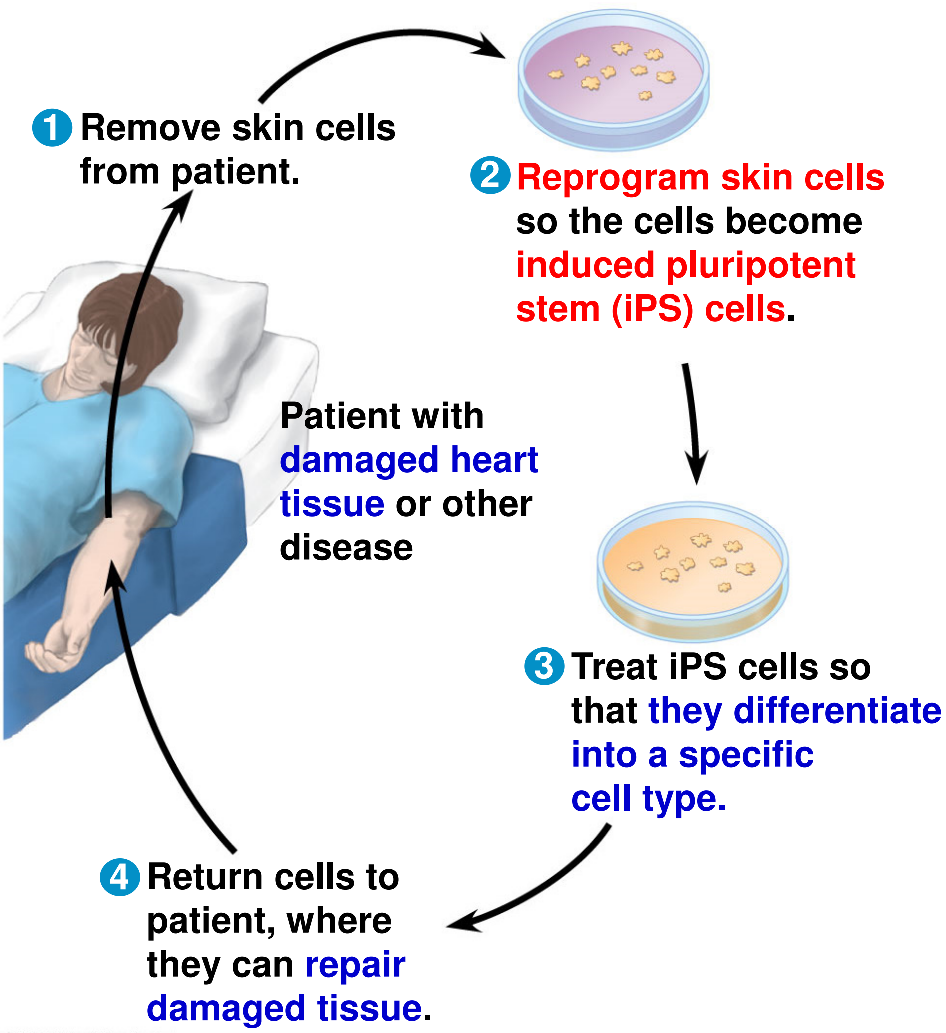
Figure 20.21



Induce Stem Cells

- Researchers can transform skin cells into ES cells by using viruses to introduce stem cell master regulatory genes
- These transformed cells are called iPS cells (induced pluripotent cells)
- These cells can be used to treat some diseases and to replace nonfunctional tissues

Figure 20.22



Concept 20.4: The practical applications of DNA technology affect our lives in many ways

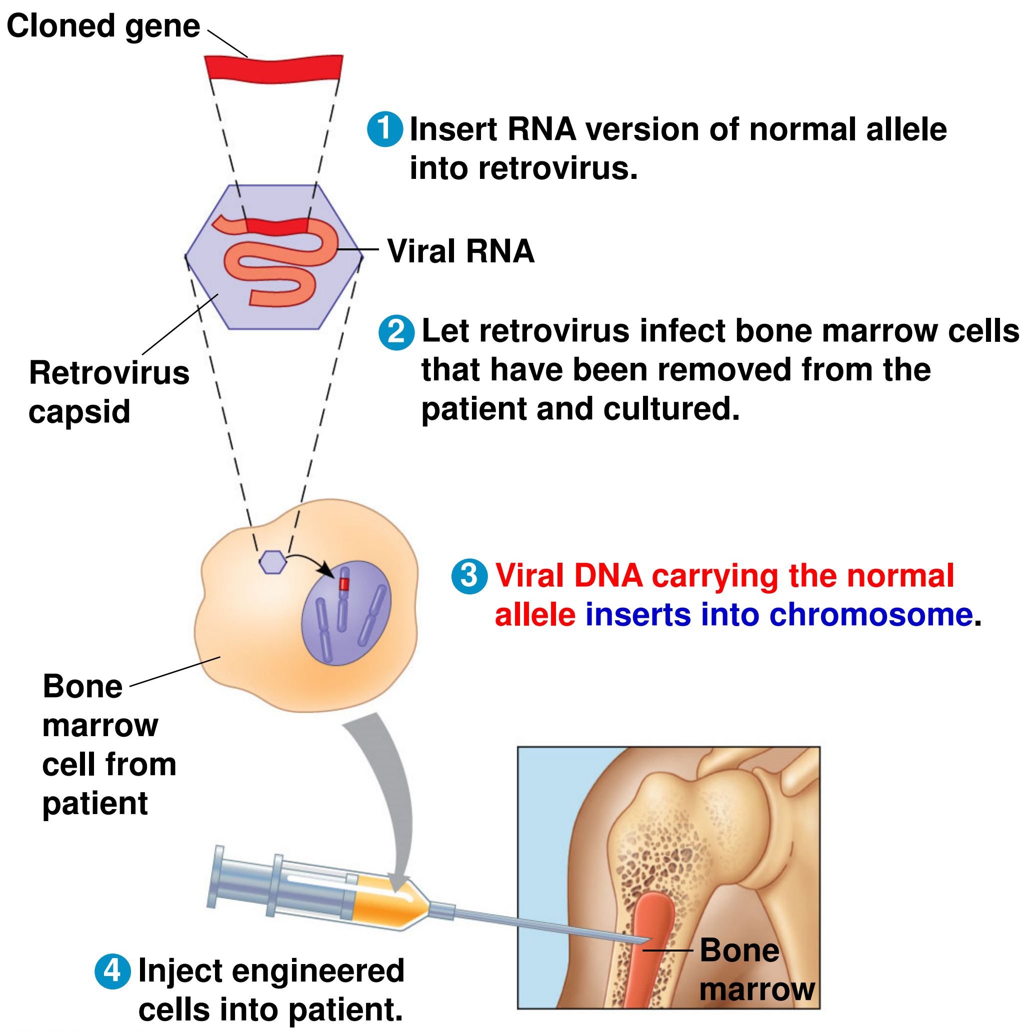
- Many fields benefit from DNA technology and genetic engineering

Diagnosis and Treatment of Diseases

Human Gene Therapy

- Scientists can diagnose many human genetic disorders using PCR and sequence-specific primers, then sequencing the amplified product to look for the disease-causing mutation
- SNPs may also be correlated with increased risks for conditions such as heart disease or certain types of cancer
- **Gene therapy** is the alteration of an afflicted individual's genes
- Gene therapy holds great potential for treating disorders traceable to a single defective gene

Figure 20.23



Pharmaceutical Products:
Synthesis of Small Molecules for Use as Drugs

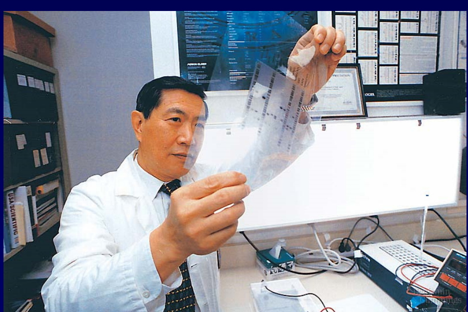
- The drug imatinib (a tyrosine-kinase inhibitor) is a small molecule that inhibits overexpression of a specific leukemia-causing receptor
- Pharmaceutical products that are proteins can be synthesized on a large scale
- This is useful for the production of insulin, human growth hormones, and vaccines

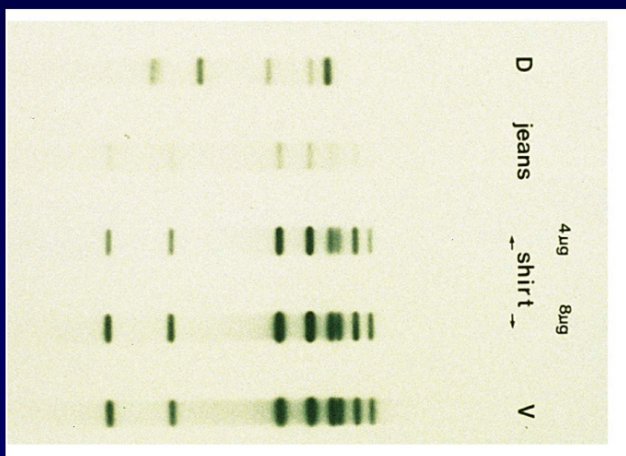
Figure 20.24

Transgenic Goats as “pharm” factory animals: carries antithrombin gene for a human blood protein: avoid formation of blood clot

Criminal detecting

- DNA fingerprinting can help solve crimes





Defendant’s blood

Blood from defendant’s clothes

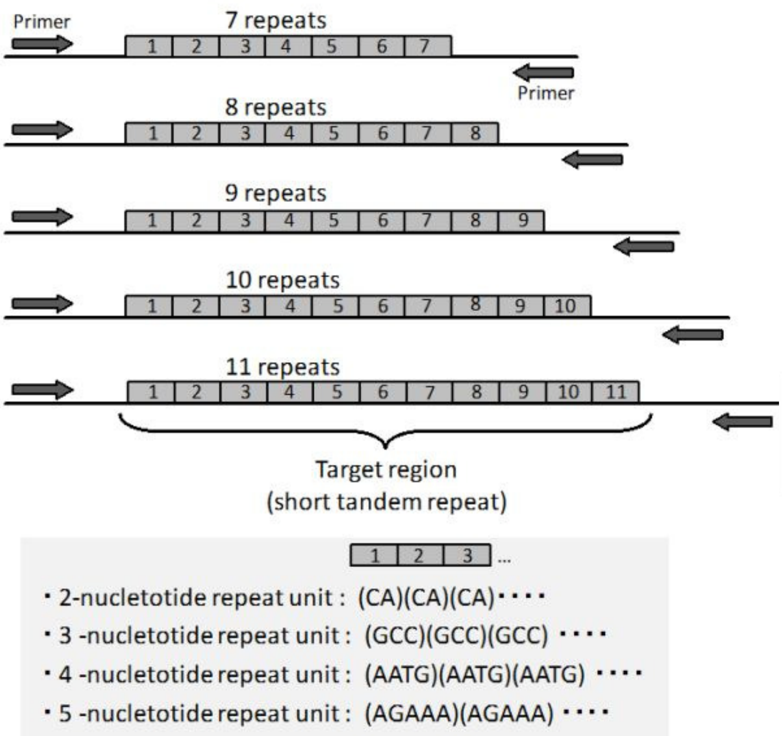
Victim’s blood

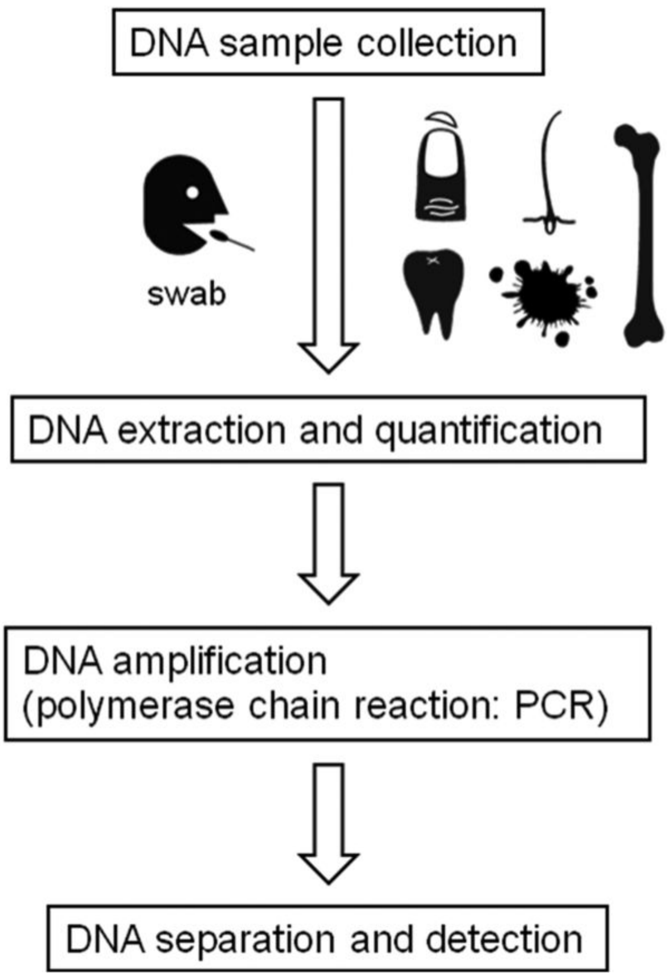
Figure 12.15A, B Adopt from Campbell biology concept 6e (2005)

Forensic Evidence and Genetic Profiles

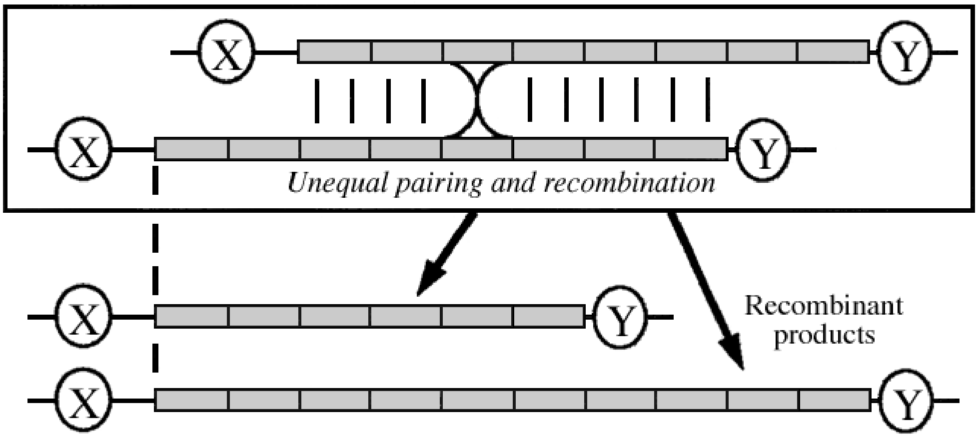
- An individual's unique DNA sequence, or **genetic profile**, can be obtained by analysis of tissue or body fluids
- The use of genetic markers called **short tandem repeats (STRs)**, which are variations in the number of repeats of specific DNA sequences
- PCR and gel electrophoresis are used to amplify and then identify STRs of different lengths
- The probability that two people who are not identical twins have the same STR markers is exceptionally small

short tandem repeats (STRs)





Origin of tandem repeats by unequal pairing and crossing over

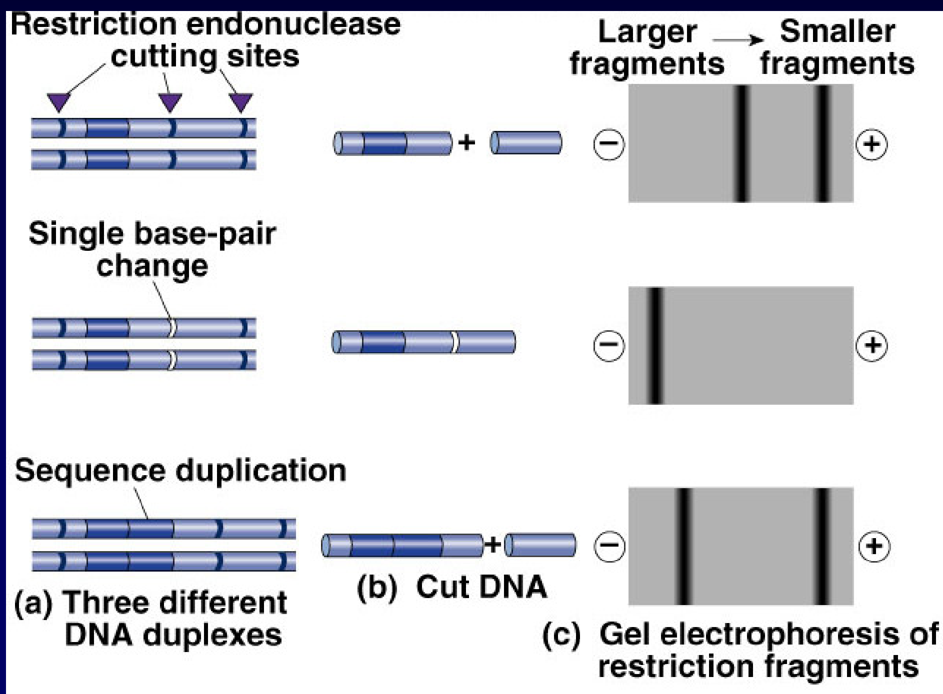


Length variation can be generated at tandem repeat loci by unequal pairing and crossing over. This Figure illustrates the general principle behind the generation of DNA variation at tandem repeat loci such as minisatellites and microsatellites. Individual repeat units are represented by boxes. The flanking sites "X" and "Y" allow detection of length variation at the locus, and correspond to nearest flanking restriction sites in the case of minisatellites or targets for PCR primers in the case of microsatellites.

http://www.informatics.jax.org/silver/images/figure8-4.gif

Working With Gene Clones

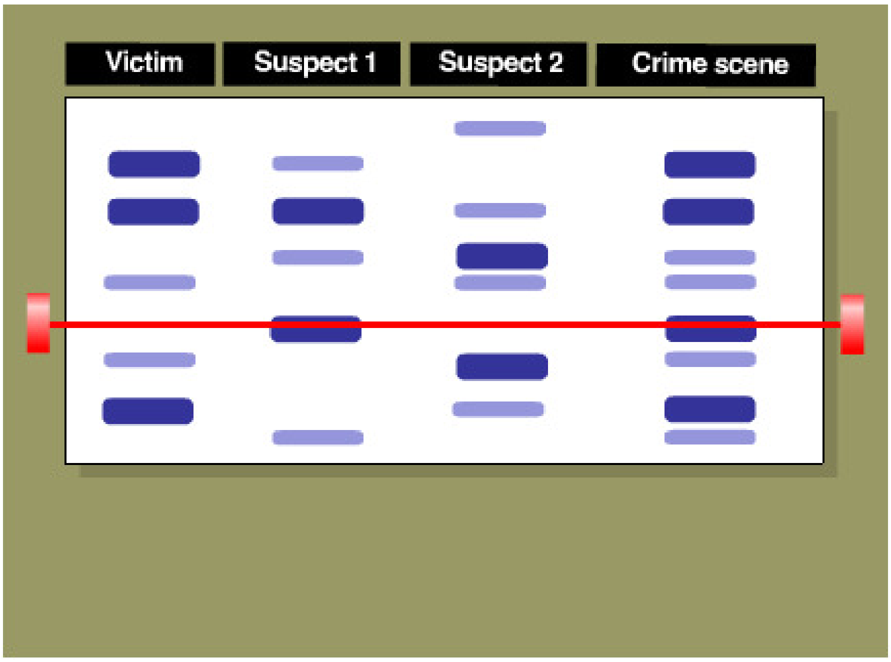
- Restriction fragment length polymorphisms (RFLP's) can be used to identify a particular individual.



12F Connection: DNA Fingerprinting

Murder. A body lies on the sidewalk near an alley. It looks like the victim fought off her attacker, leaving blood and tissue under her fingernails. There is also a pool of blood on the sidewalk next to the victim. Two suspects have been picked up just a block away with fresh scratches on them. Could one

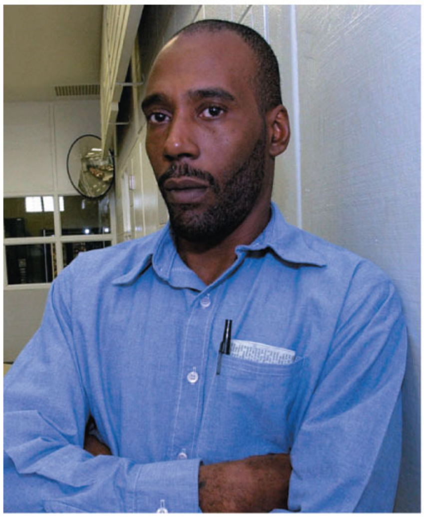
12F Connection: DNA Fingerprinting



Here are the results. Let's compare the DNA fingerprint of each suspect to the blood samples we found at the crime scene to see if there are matches. You should also compare these results to the DNA fingerprint of the victim to make sure the crime scene sample isn't just from the victim herself.

Figure 20.25

(a) This photo shows Washington just before his release in 2001, after 17 years in prison.



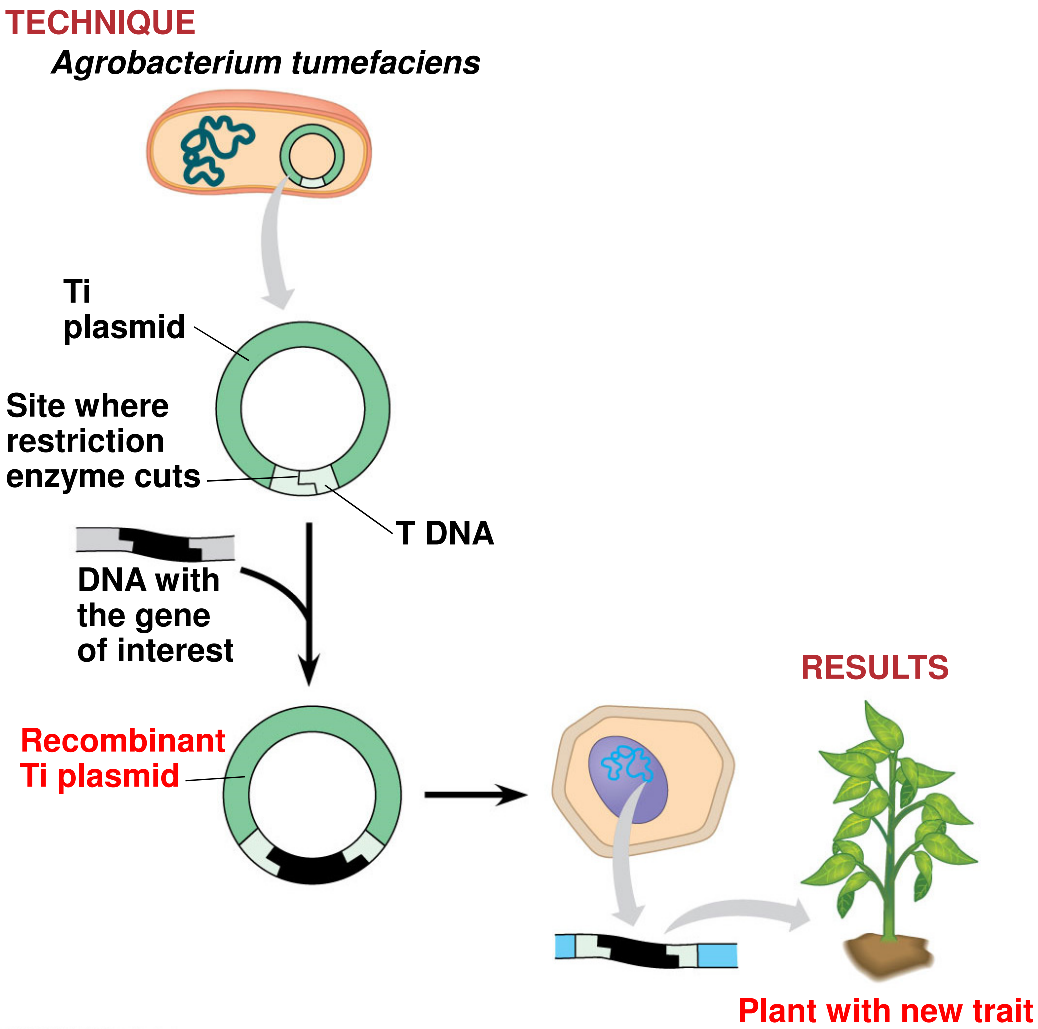
Source of sample	STR marker 1	STR marker 2	STR marker 3
Semen on victim	17,19	13,16	12,12
Earl Washington	16,18	14,15	11,12
Kenneth Tinsley	17,19	13,16	12,12

(b) These and other STR data exonerated Washington and led Tinsley to plead guilty to the murder.

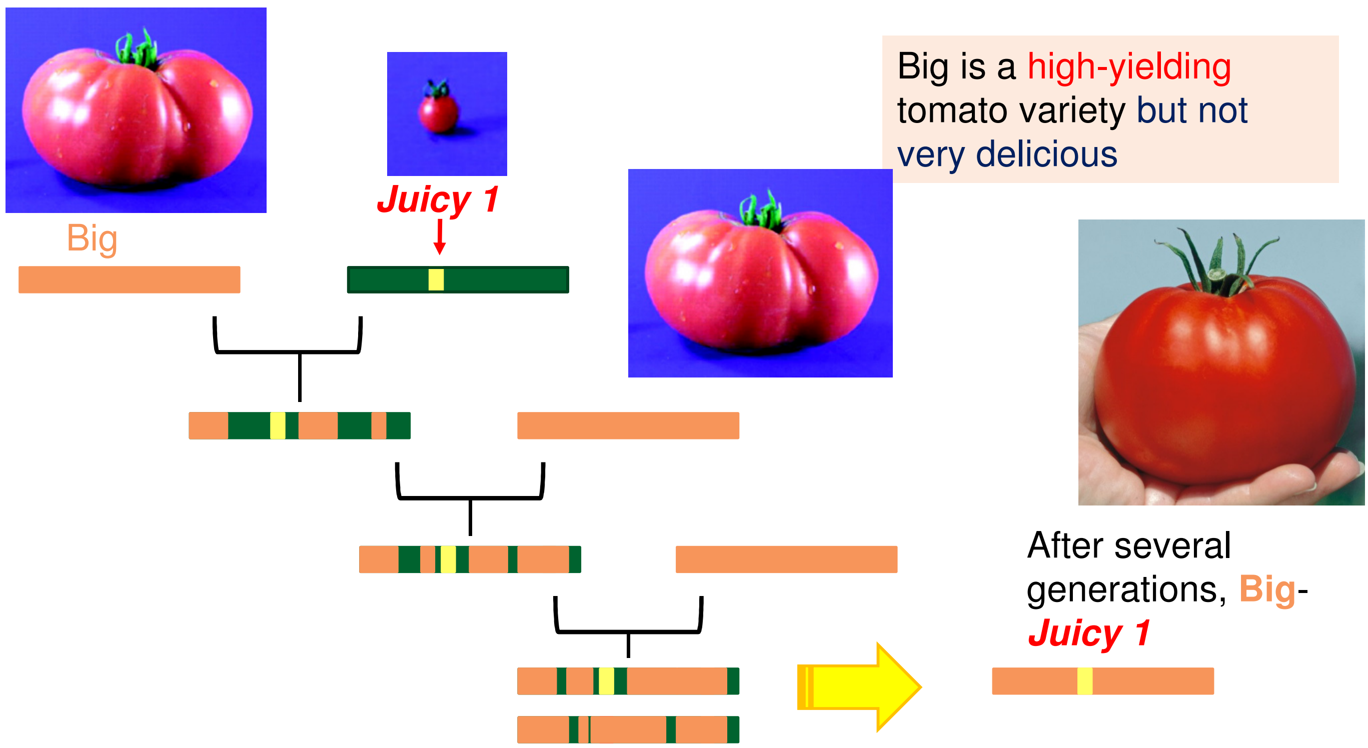
Agricultural Applications

- The **Ti plasmid** is the most commonly used vector for introducing new genes into plant cells
- Genetic engineering in plants has been used to transfer many useful genes including those for herbicide resistance, increased resistance to pests, increased resistance to salinity, and improved nutritional value of crops
- Most public concern about possible hazards centers on **genetically modified (GM) organisms** used as food
- Some are concerned about the creation of "super weeds" from the transfer of genes from GM crops to their wild relatives (male sterility genes needed)

Figure 20.26



Production of Big–*Juicy 1*:
Cross Big with *Juicy1* donor



Concept 38.3: Humans modify crops by breeding and genetic engineering

- Humans have intervened in the reproduction and genetic makeup of plants for thousands of years
- Hybridization雜交育種 is common in nature and has been used by breeders to introduce new genes
- Maize, a product of artificial selection 五千年在墨西哥的人擇育種, is a staple in many developing countries

Figure 38.16

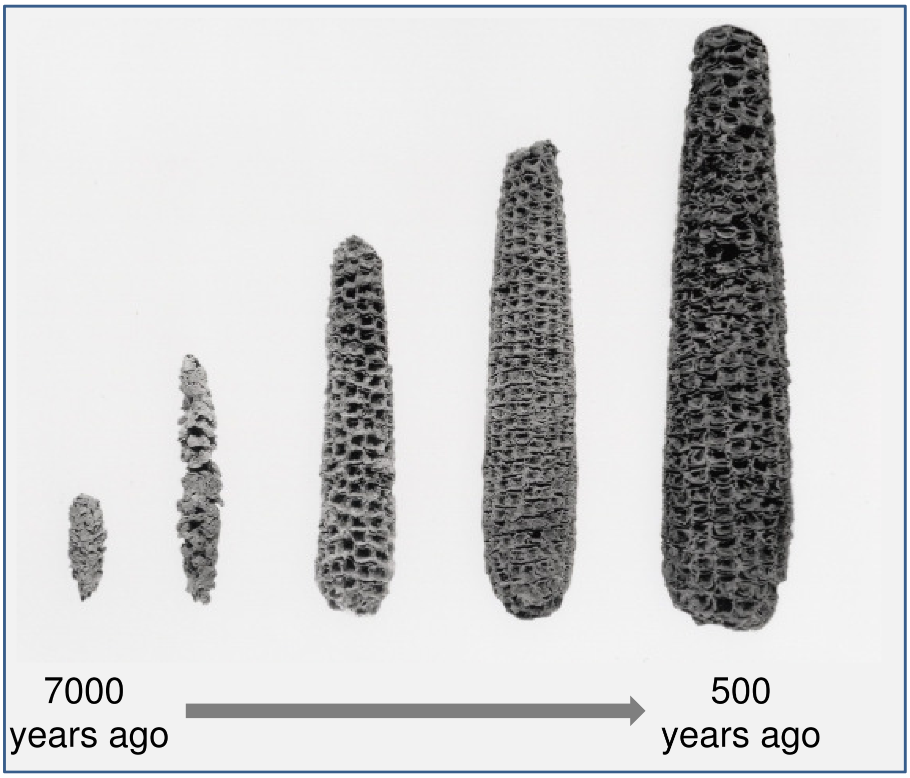
Plant Breeding

Maize domestication

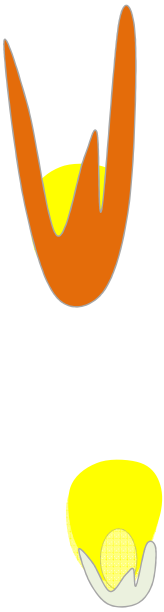
http://hila.webcentre.ca/research/teosinte/

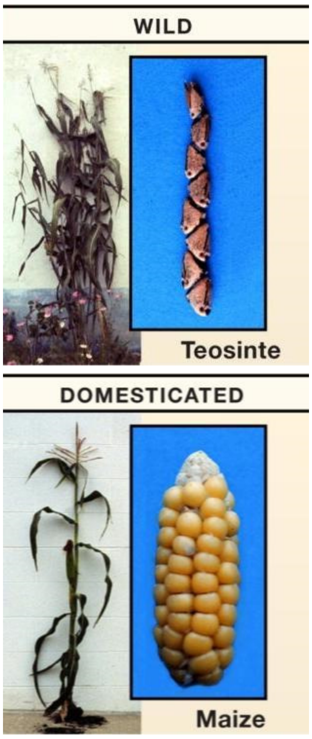
During maize domestication cob size increased

Cobs from archeological sites in the Valley of Tehuacan, Mexico



The hard casings around many grains were eliminated

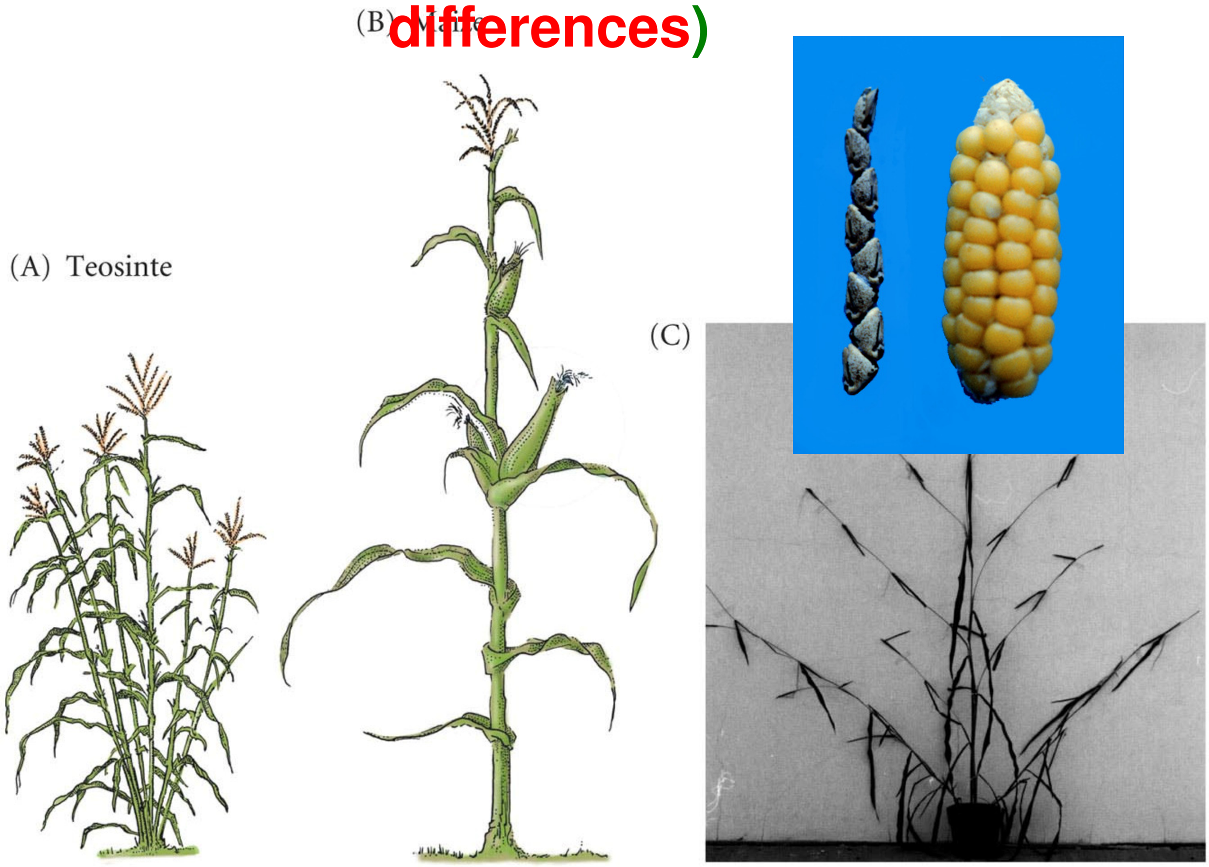




Teosinte, the wild relative of maize, has hard coverings over each grain. Humans selected against these during maize domestication.

Photo by Hugh Iltis; Reprinted from Doebley, J.F., Gaut, B.S., and Smith, B.D. (2006). The Molecular Genetics of Crop Domestication. Cell 127: 1309-1321, with permission from Elsevier.

The *tb1* gene (TCP genes) express in lateral meristem in creating inflorescence (spatial differences)

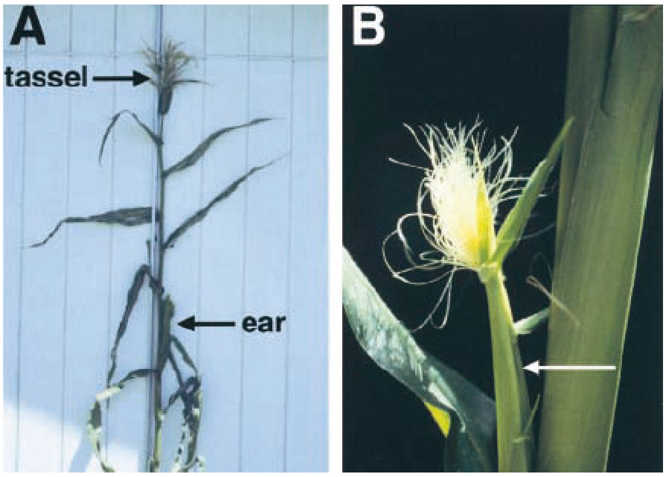


EVOLUTION, Figure 20.12

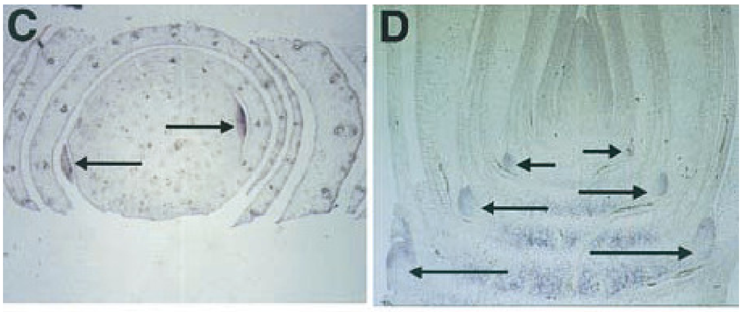
tb1 mutant

- **TB1 express in axillary meristem of maize shoot apex –** suggests inhibitions of lateral branches

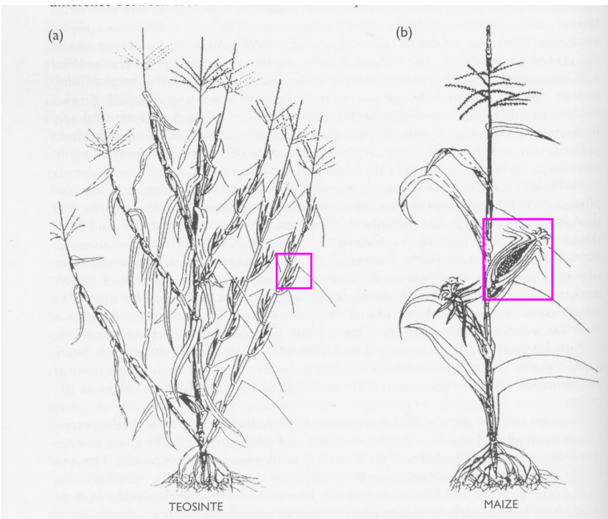
Maize



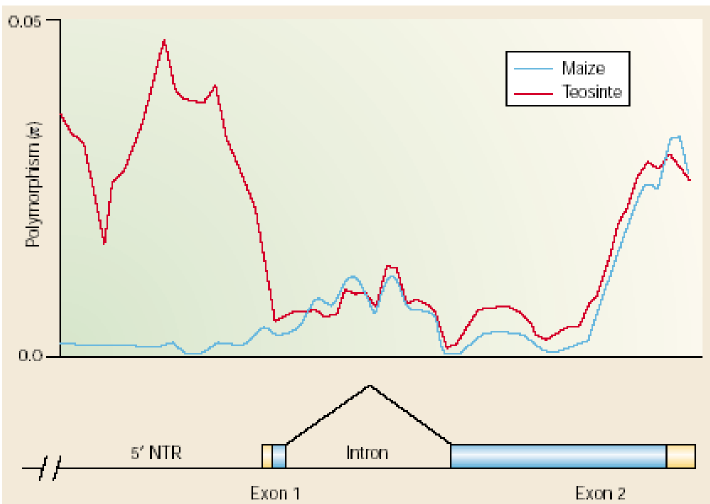
TB1 expression in maize shoot apex (axillary meristem)



Hubbard et al. 2002



從玉米的五千年人擇結果我們學到；基因調控區域的變異可能比基因轉錄區的變化來得更重要

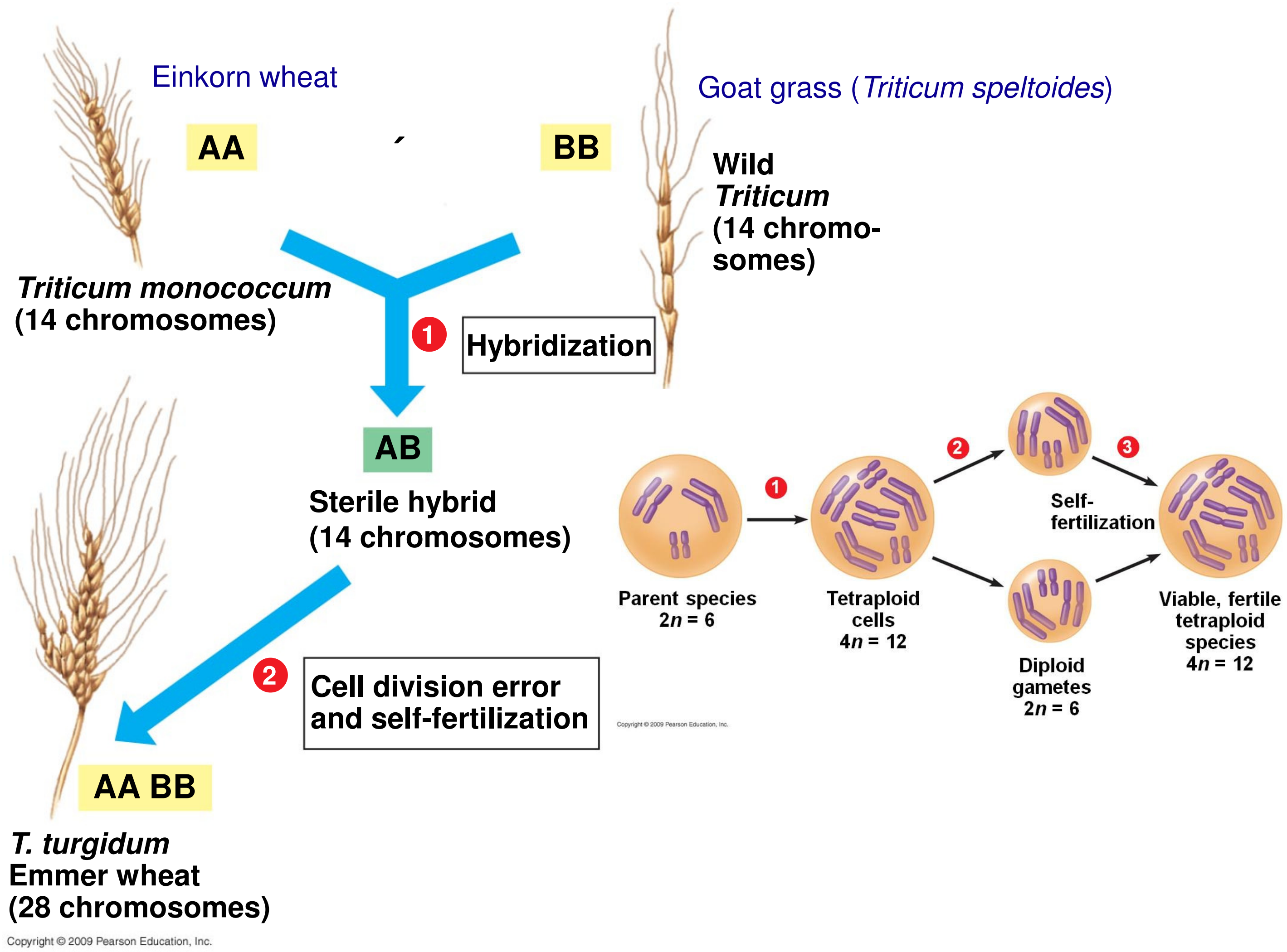


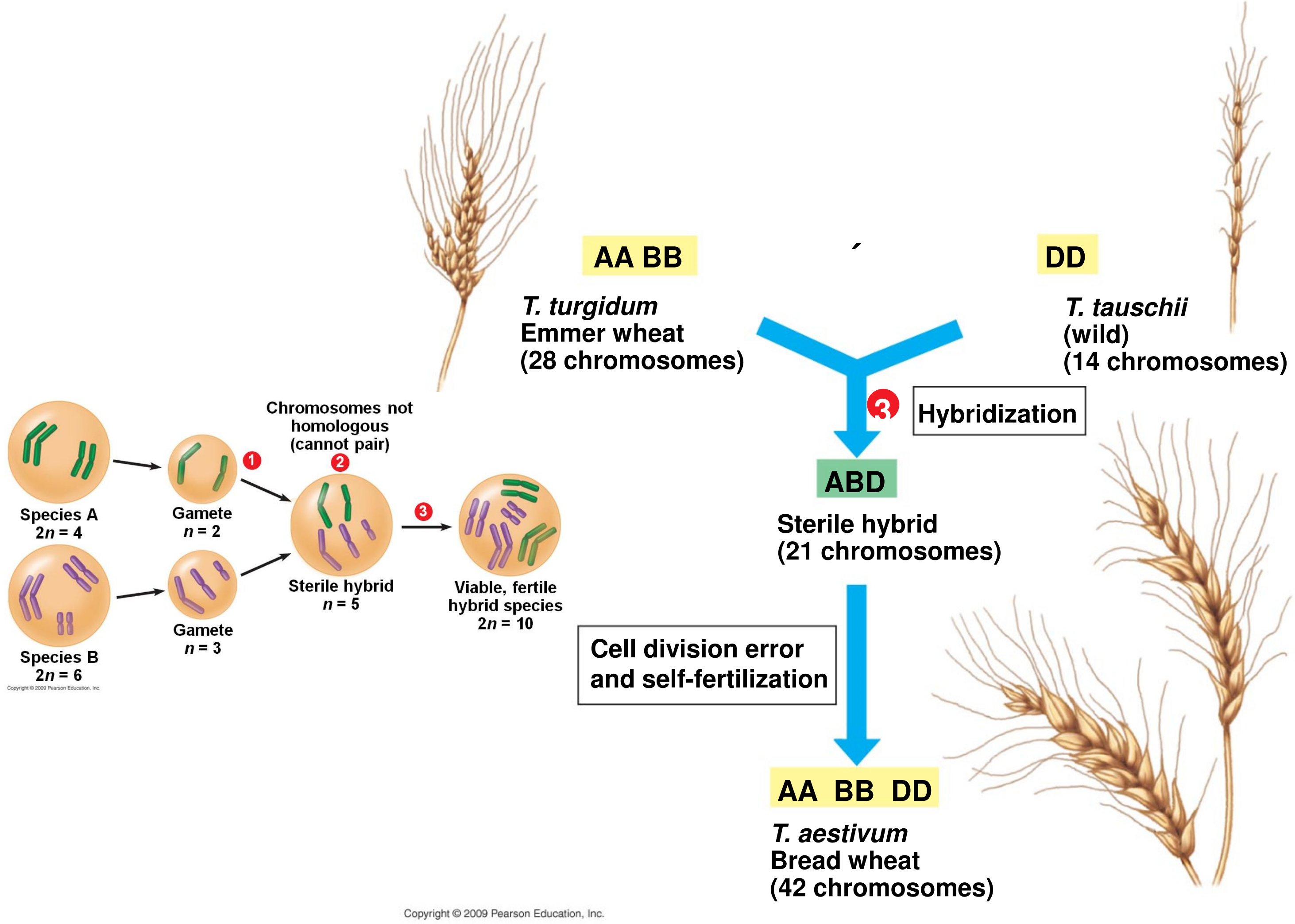
cis-regulatory region in charge of gene regulation

Wang, RL et al. Nature,1999

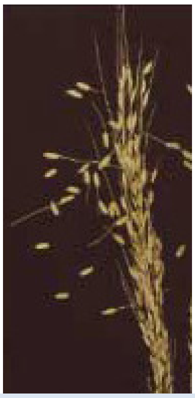
Plant Breeding

- Mutations can arise spontaneously or can be induced by breeders
- Plants with beneficial mutations are used in breeding experiments
- Desirable traits can be introduced from different species or genera
- The grain triticale黑小麥 is derived from a successful cross between wheat and rye黑麥

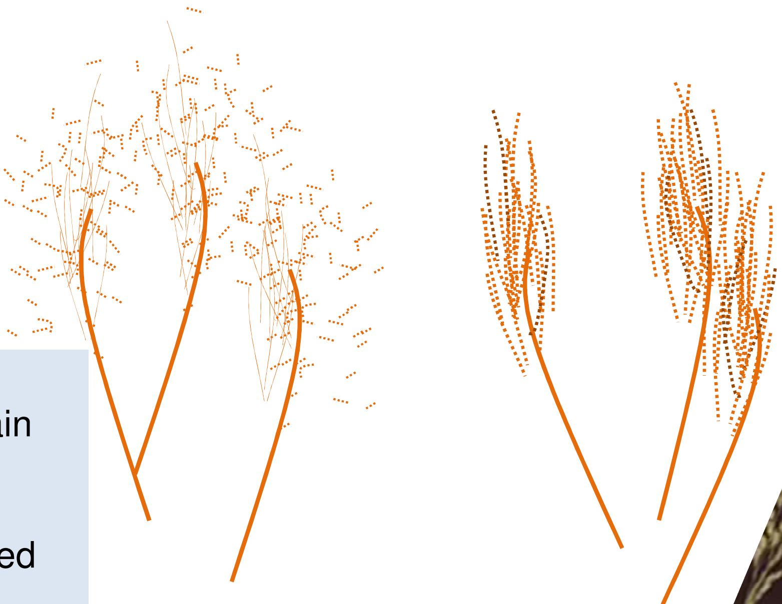




Seeds that don't break off were selected



Wild
Shattering grain
"Brittle rachis"
Advantage – maximizes seed dispersal



Domesticated
Non-shattering grain
"Tough rachis"
Advantage – facilitates harvesting

From Konishi, S., Izawa, T., Lin, S.Y., Ebana, K., Fukuta, Y., Sasaki, T., and Yano, M. (2006). An SNP caused loss of seed shattering during rice domestication. Science 312: 1392-1396. Reprinted with permission from AAAS.

《拾穗》（Des glaneuses） **Jean-François Millet, 1857**

Phenotypes of Some Crops and Their Progenitors

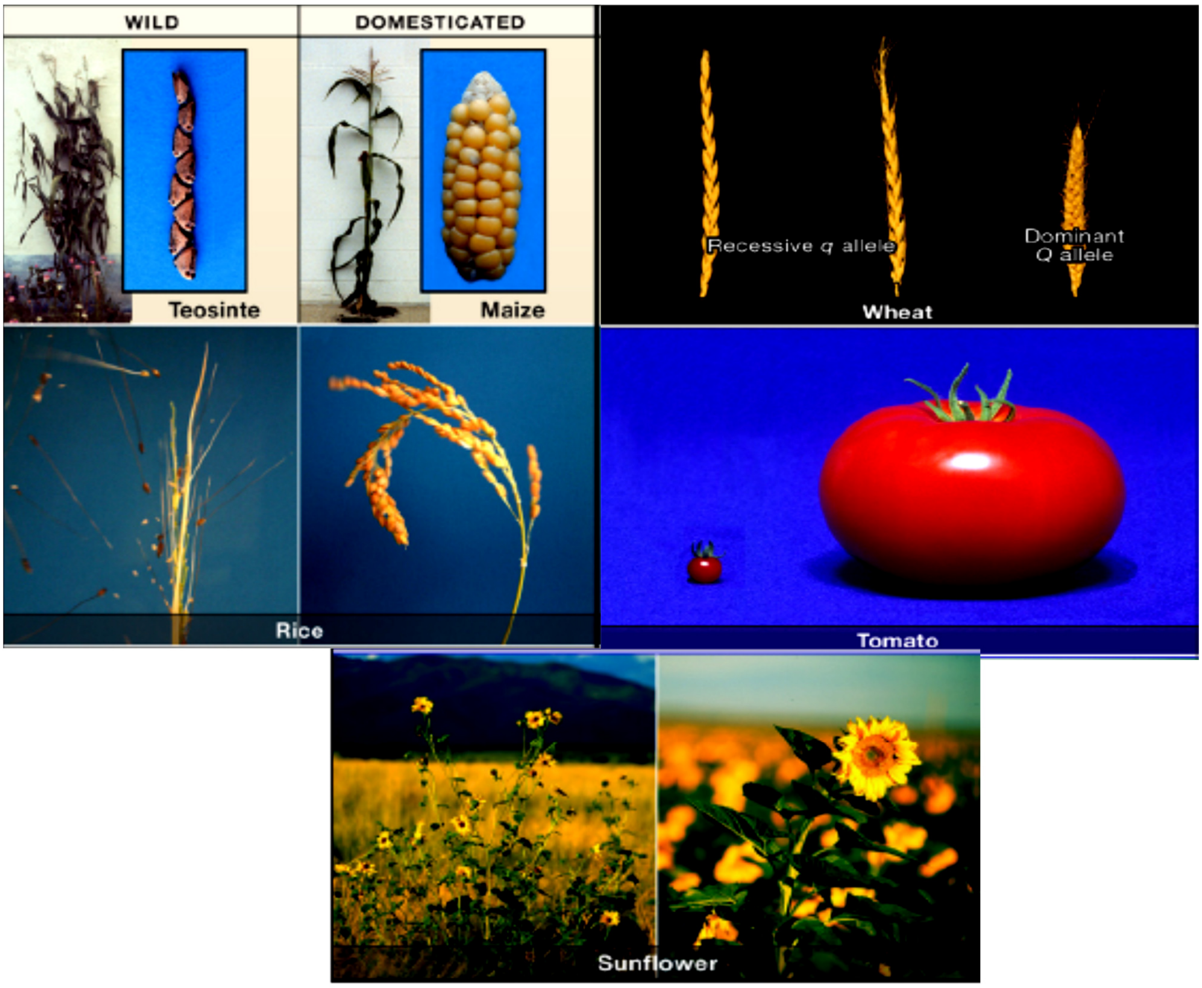
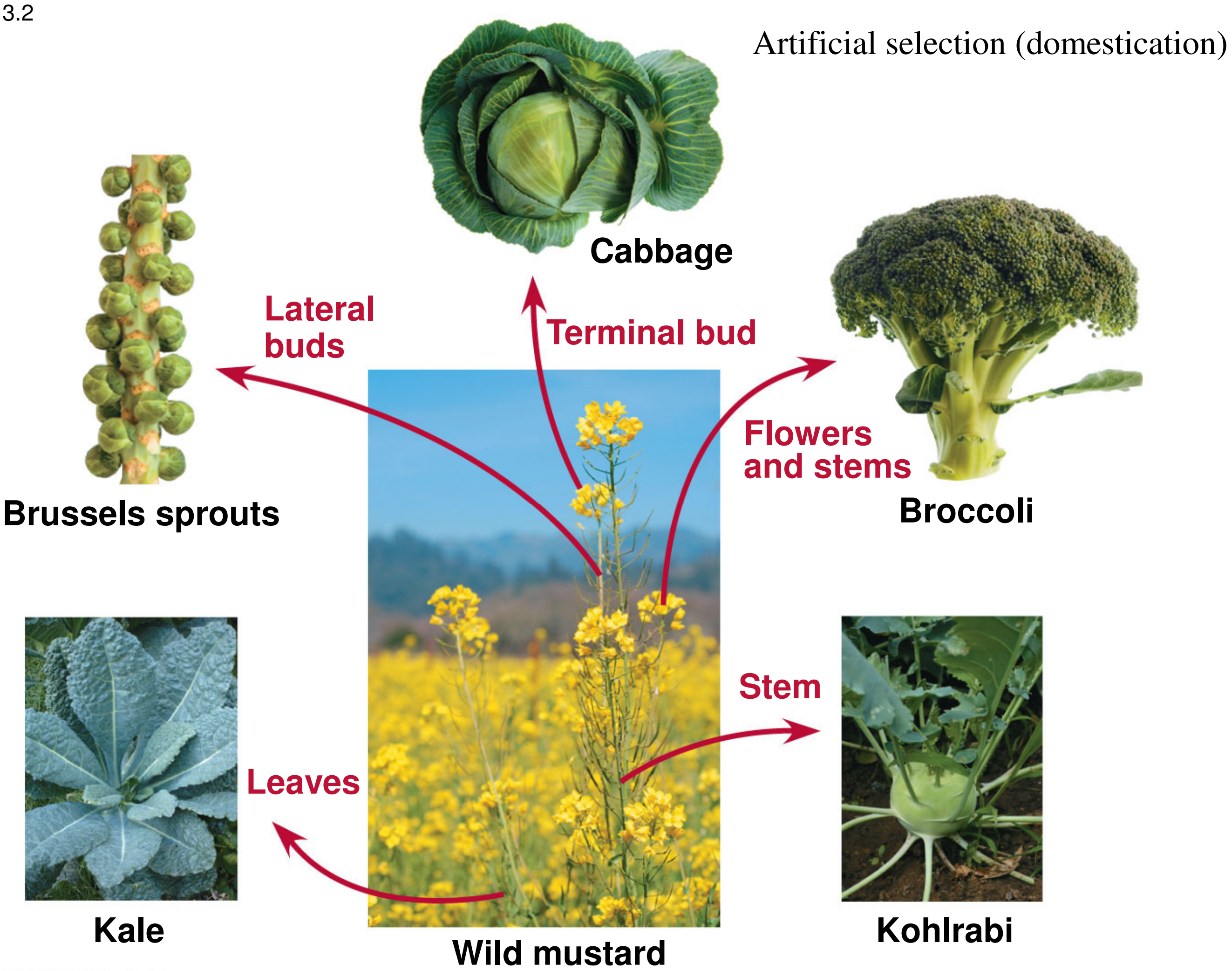


Figure 13.2



Plant Biotechnology and Genetic Engineering

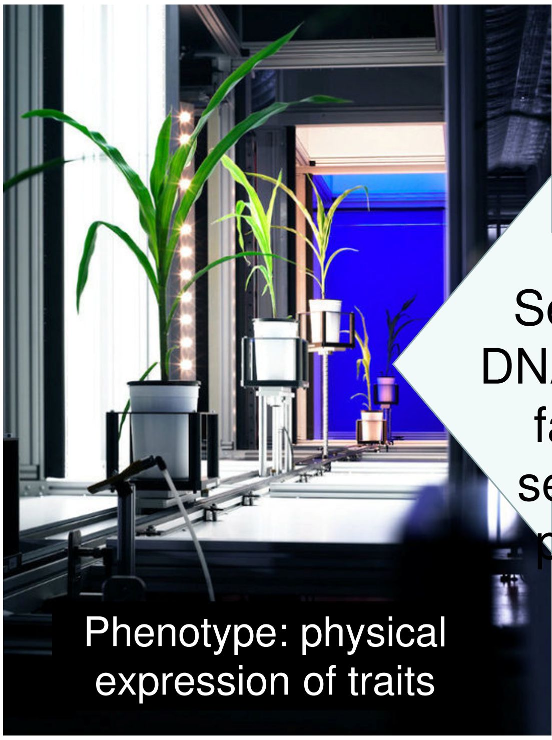
- Plant biotechnology has two meanings
  - In a general sense, it refers to innovations in the use of plants to make useful products
  - In a specific sense, it refers to use of GM organisms in agriculture and industry
- Modern plant biotechnology is not limited to transfer of genes between closely related species or varieties of the same species

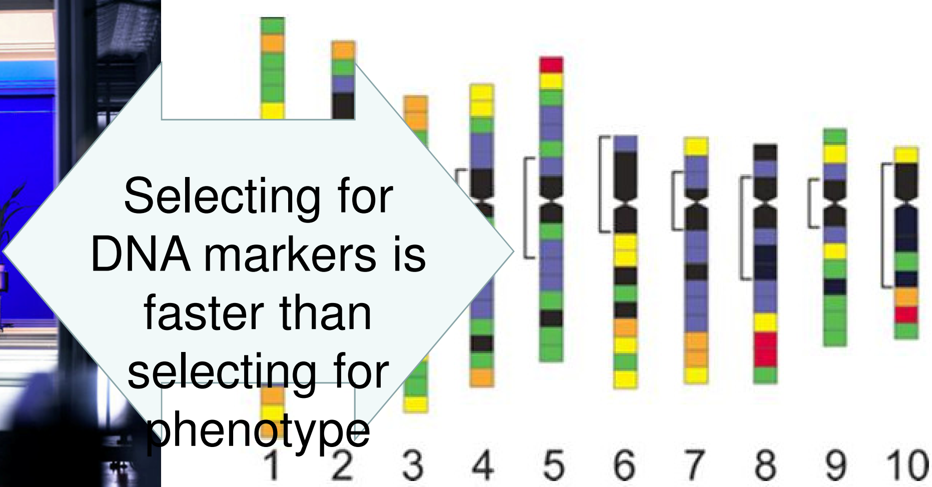
Advances in genetic technologies contribute to improved plants

- Marker assisted selection
- Genome-wide association studies
- Recombinant DNA technology and transgenic plants
- Cisgenics and intragenics
- Transgrafting
- Precision genome editing

Photo credit: IRRI

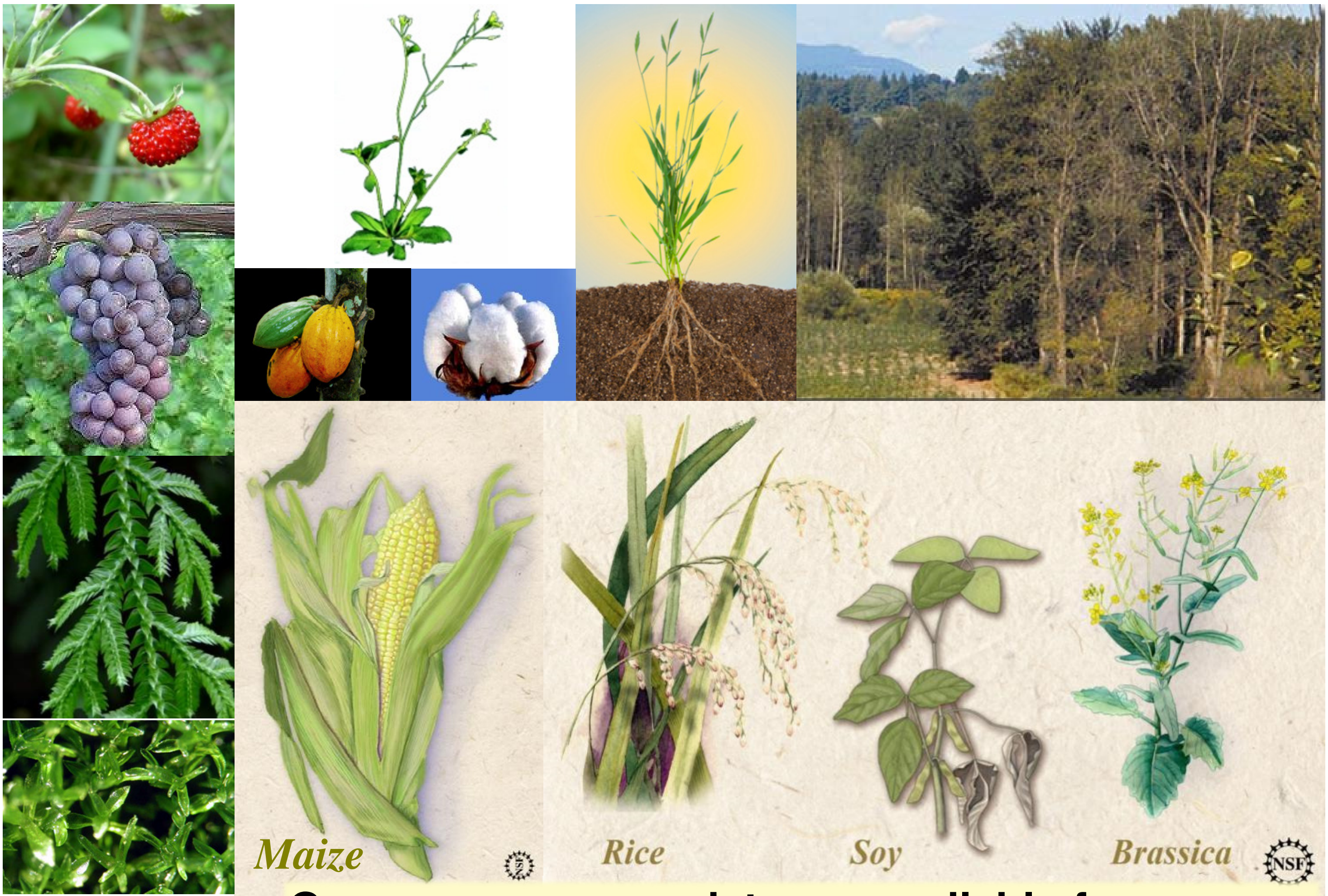
Marker assisted selection (MAS)





Genotype: sequence of all the genes in a genome

Photo credit LemnaTec; Anderson, L.K., Lai, A., Stack, S.M., Rizzon, C. and Gaut, B.S. (2006). Uneven distribution of expressed sequence tag loci on maize pachytene chromosomes. Genome Research. 16: 115-122.



Genome sequence data are available for many important plants

http://www.onekp.com/project.html

The 1KP Project

Links

- Home
- What is the 1KP Project?
- Why Sequence 1000 plants?
- Transcriptomes not Genomes
- Essential Plant Phylogeny
- Media
- Contact Us

What is the 1KP Project?

A new initiative launched in November 2008 will acquire gene sequence information for 1000 plant species. Our mandate includes everything from algae to land or aquatic plants, with a particular focus on plants that make valuable bioproducts. The project is led from Alberta by Gane Ka-Shu Wong and Michael Deyholos, and the sequencing will be done at BGI-Shenzhen. An international multidisciplinary consortium has been formed to participate in this research. All of our sequence data will be released to the public upon publication, specifically through GenBank and other open access websites. This project will begin what we hope is a longer term effort by the research community to study the vast biodiversity that to date has barely been touched by genomics. Not only will this lead to great science, but also, we believe it will lead to commercialization opportunities.

The 1KP Project

Links

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[Why Sequence 1000 plants?]

[Transcriptomes not Genomes]

[Essential Plant Phylogeny]

[Media]

[Contact Us]

The 1000 plants (oneKP or 1KP) initiative is a public-private partnership generating large scale gene sequence information for 1000 different species of plants. Major supporters include Alberta's Department of Advanced Education and Technology (AET), Silicon Valley based Musea Ventures, Beijing Genomics Institute in Shenzhen, University of Alberta, and Alberta's Informatics Circle of Research Excellence (iCORE).

Subproject Catagories

Grouped by Phylogeny

Angiosperms

Non Flowering

Green Algae

Grouped by Application

Agricultural

Biochemical

Medicinal

Extremophytes

View List of 1000 Plants

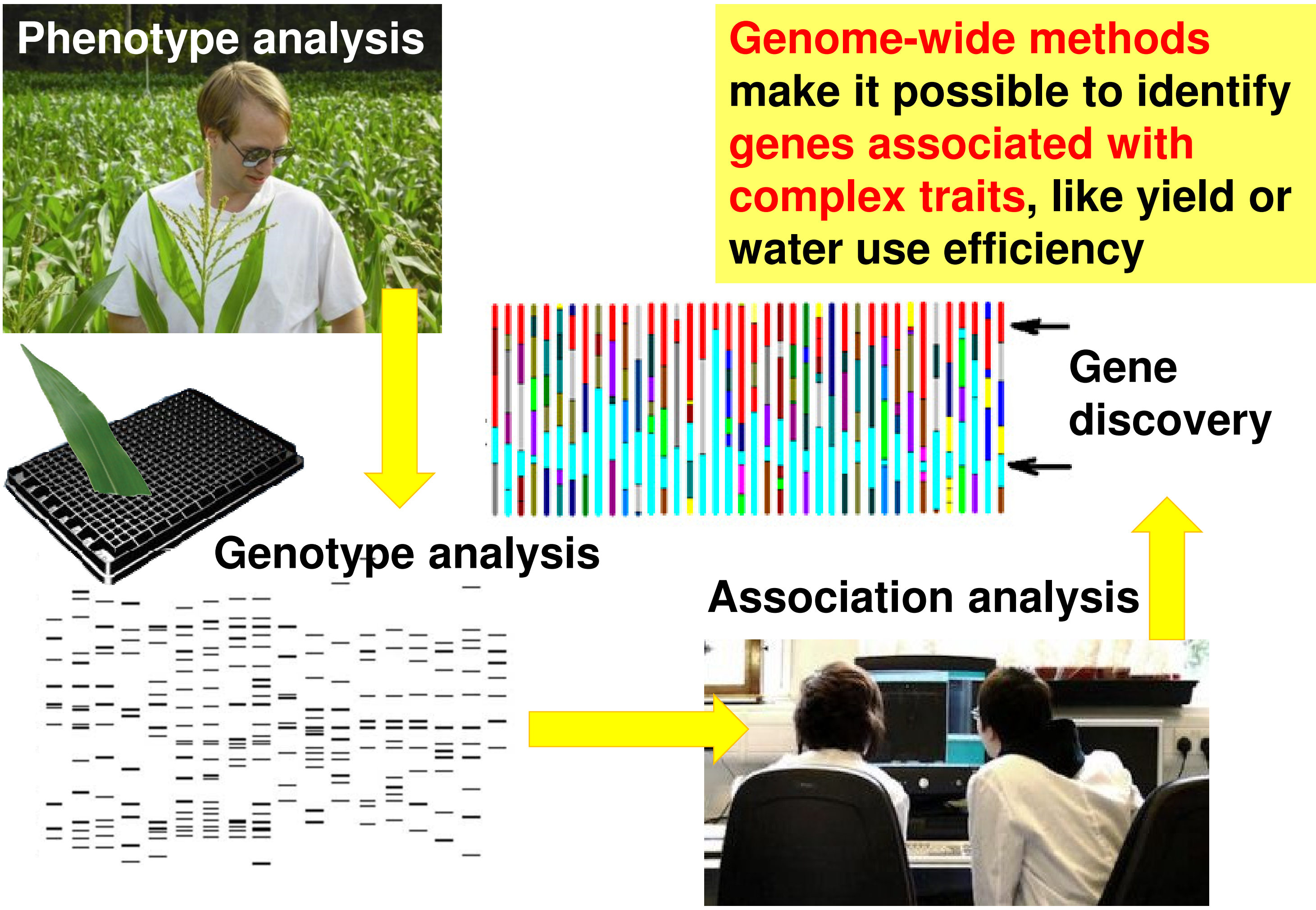
中藥植物中開啟的代謝基因-王俊能

1kP Sample List Viewer

www.onekp.com/samples/list.php

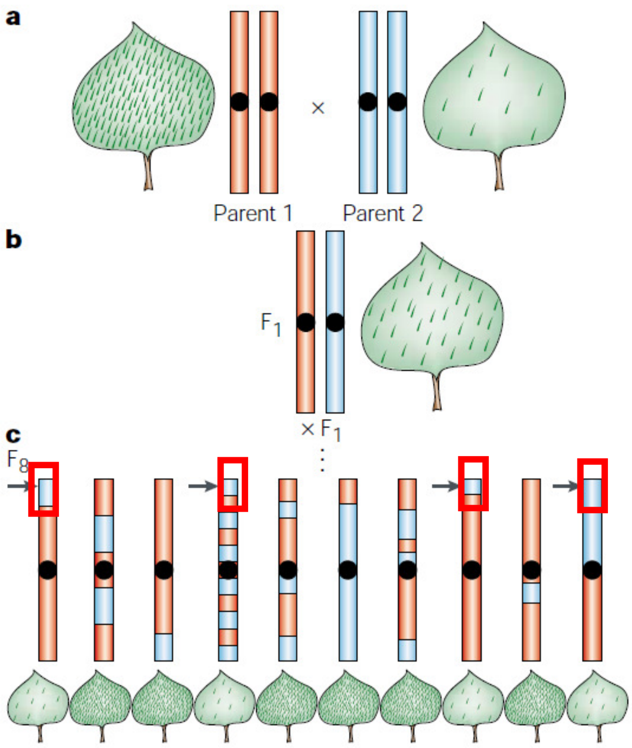
wang 1 個，共 33 個

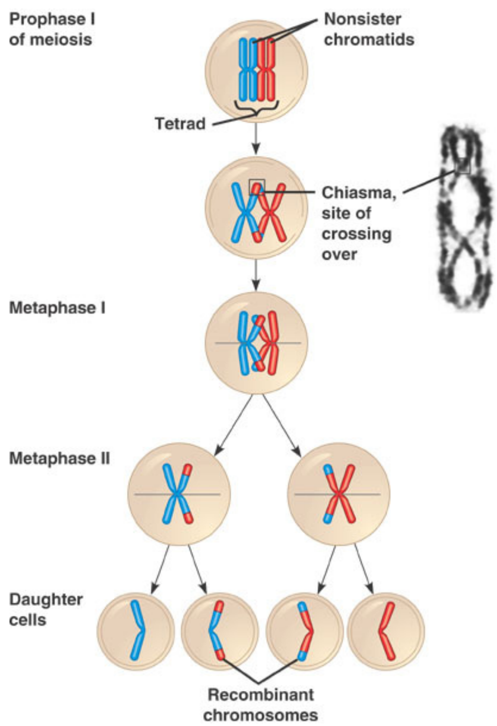
ZSSR	Core Eudicots/Rosids	Fabaceae	Xanthicercis zambesiaca	leaf	sequenced			
ATQZ	Core Eudicots/Rosids	Fabaceae	Acacia pycnantha		sequenced	DJ532A	A. Lowe	BGI
MGBF	Core Eudicots/Rosids	Fabaceae	Acacia pycnantha		sequenced	DJ489A	A. Lowe	BGI
MYMP	Core Eudicots/Rosids	Fabaceae	Astragalus propinquus	leaves	sequenced	Wang 2141 (TAI)	Chun-Neng Wang	Chun-Neng Wang
VHZV	Core Eudicots/Rosids	Fabaceae	Gleditsia sinensis	leaves	sequenced	Wang 2148 (TAI)	Chun-Neng Wang	Chun-Neng Wang
ZCDJ	Core Eudicots/Rosids	Fabaceae	Acacia argyrophylla		sequenced	HC423A	A. Lowe	BGI
OHAE	Core Eudicots/Rosids	Polygalaceae	Polygala lutea	leaf buds and flowers	sequenced		J. Leebens-Mack	J. Leebens-Mack
OQHZ	Core Eudicots/Rosids	Quillajaceae	Quillaja saponaria	leaves	sequenced	Chase 33146	M. Chase	BGI
CWZU	Core Eudicots/Rosids	Betulaceae	Betula pendula	young leaves	sequenced	DWS NY 1471/95	D. W. Stevenson	BGI
LWDA	Core Eudicots/Rosids	Betulaceae	Alnus serrulata	young leaves, young inflorescence	sequenced	Soltis and Miles 2964	D. Soltis	D. Soltis
LNER	Core Eudicots/Rosids	Casuarinacae	Casuarina equisetifolia	leaves	sequenced	Soltis and Miles 2773	D. Soltis	BGI
SVVG	Core Eudicots/Rosids	Fagaceae	Fagus sylvatica		sequenced		J. Leebens-Mack	J. Leebens-Mack
HENI	Core Eudicots/Rosids	Fagaceae	Quercus shumardii	very young leaves, some staminate flowers	sequenced	Soltis and Miles 2780	D. Soltis	BGI
UZWG	Core Eudicots/Rosids	Fagaceae	Castanea pumila	young leaves and flowers	sequenced	Soltis and Miles 2977	D. Soltis	D. Soltis
NHUA	Core Eudicots/Rosids	Fagaceae	Castanea crenata		sequenced		J. Leebens-Mack	J. Leebens-Mack
DXOW	Core Eudicots/Rosids	Juglandaceae	Juglans nigra	leaves	sequenced	Soltis and Miles 2798	D. Soltis	BGI
VWIP	Core Eudicots/Rosids	Juglandaceae	Carya glabra		sequenced		J. Leebens-Mack	J. Leebens-Mack
INSP	Core Eudicots/Rosids	Myricaceae	Myrica cerifera	leaves	sequenced	Soltis and Miles 2761	D. Soltis	BGI
TJLC	Core Eudicots/Rosids	Nothofagaceae	Nothofagus obliqua	leaves	sequenced	Chase 33143	M. Chase	BGI
NFXV	Core Eudicots/Rosids	Calophyllaceae	Mumea americana	young leaves	sequenced	Soltis & Miles 3003	D. Soltis	D. Soltis
ZBVT	Core Eudicots/Rosids	Chrysobalanaceae	Chrysobalanus icaco	young leaves	sequenced	Soltis and Miles 2940	D. Soltis	D. Soltis
HBUQ	Core Eudicots/Rosids	Chrysobalanaceae	Licania michauxii	young leaves	sequenced	Soltis & Miles 2990	D. Soltis	D. Soltis
FWCQ	Core Eudicots/Rosids	Clusiaceae	Garcinia oblongiflolia	young leaves	sequenced	T. Chen et. al. 2010090804	Tao Chen	BGI
OSIP	Core Eudicots/Rosids	Clusiaceae	Garcinia livingstonei	leaves	sequenced	Chase 34490 K	M. Chase	BGI



Approach: Association analysis on recombinant inbred lines

forward genetics: Mapping quantitative trait loci (QTL)





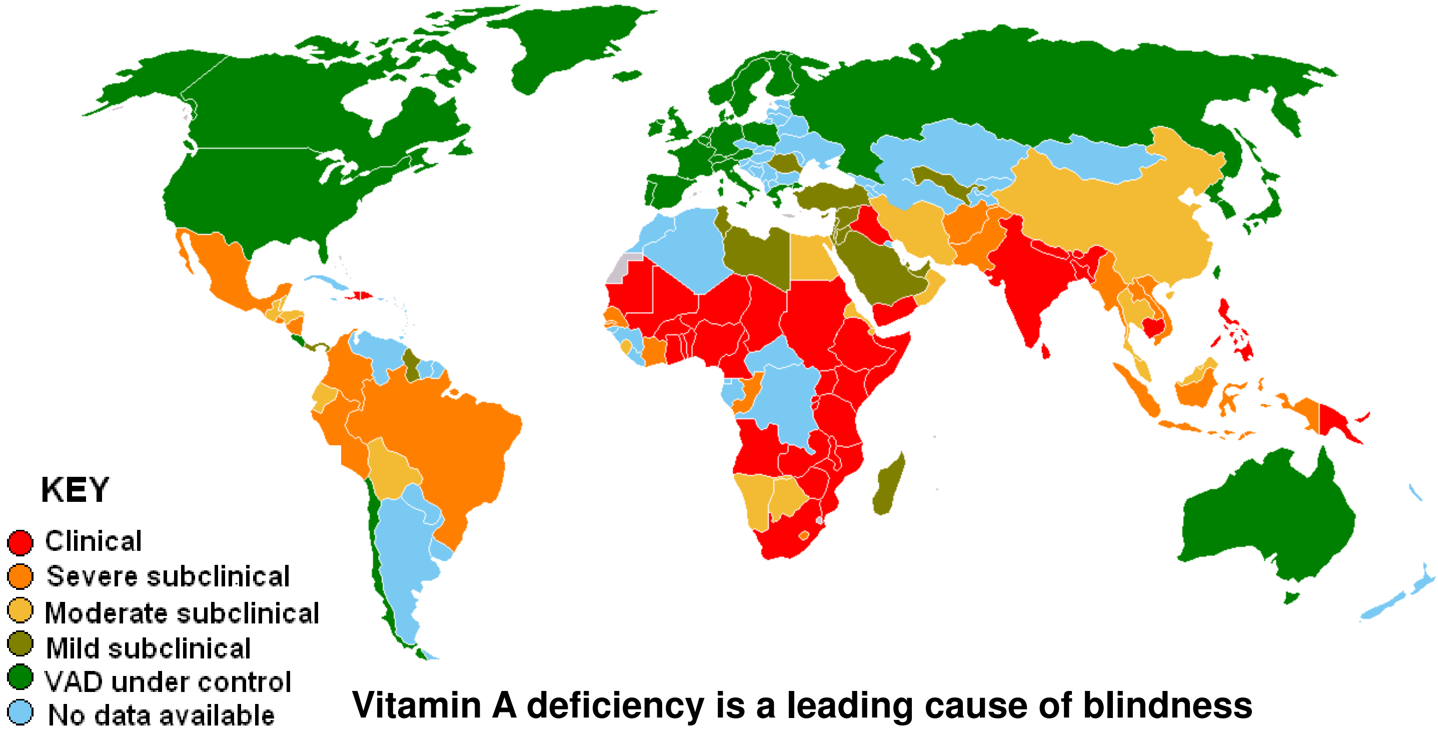
(Nature Review Genetics 2001 2:370-381)

Reducing World Hunger and Malnutrition

- Transgenic crops have been developed that
  - Produce proteins to defend them against insect pests
  - Tolerate herbicides
  - Resist specific diseases
- Nutritional quality of plants is being improved
  - For example, "Golden Rice" is a transgenic variety being developed to address vitamin A deficiencies among the world's poor

- Nutritional quality of plants is being improved
  - For example, "Golden Rice" is a transgenic variety being developed to address vitamin A deficiencies among the world's poor

Breeding plants for β-carotene (pro-vitamin A) enrichment

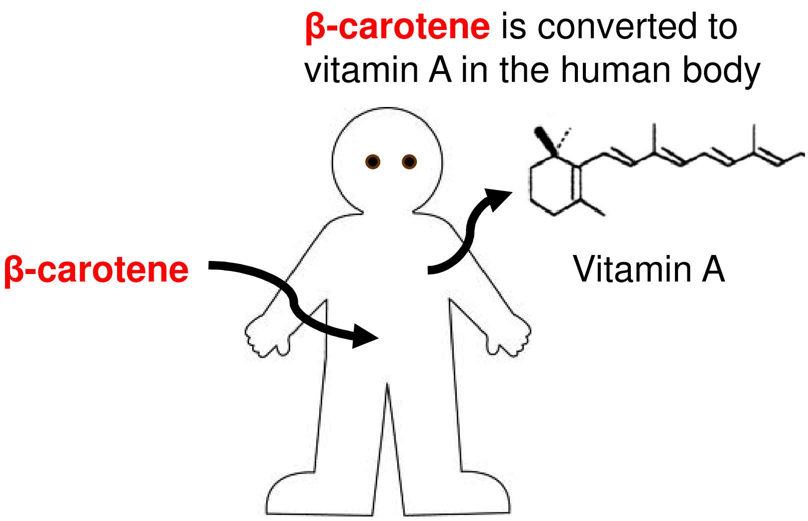


Vitamin A deficiency is a leading cause of blindness

Image sources: Petaholmes based on WHO data;

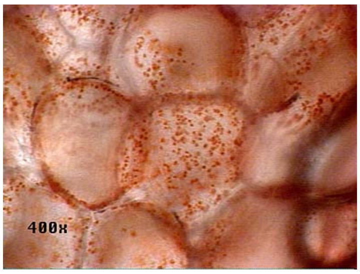
Enhanced β-carotene content in food can prevent vitamin A deficiency

- Many staple foods are poor sources of β-carotene so many people do not get adequate vitamin A in their diet



Synthesis, storage and breakdown all affect β-carotene content

To increase beta-carotene levels in plants, you need **more synthesis, more storage** or **less catabolism**



Chromoplasts – organelles that store carotenoids – colors of petals and else

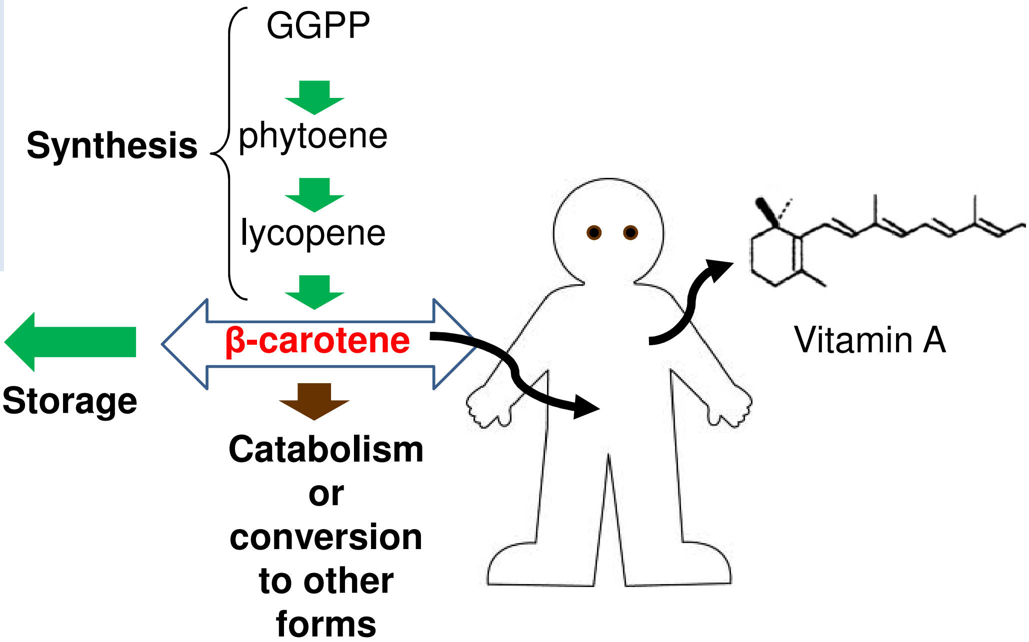
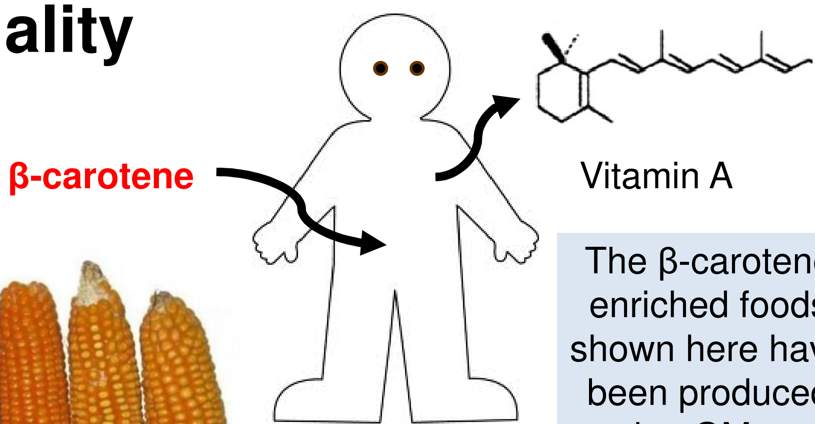
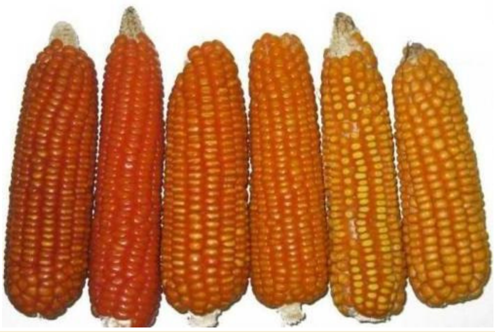


Photo credit: University of Wisconsin

β-carotene makes the rice look golden

There is no inherently right or wrong way to enhance plant nutritional quality





The β-carotene enriched foods shown here have been produced using GM and non-GM approaches

Photo credit: Golden rice humanitarian board

Figure 38.17

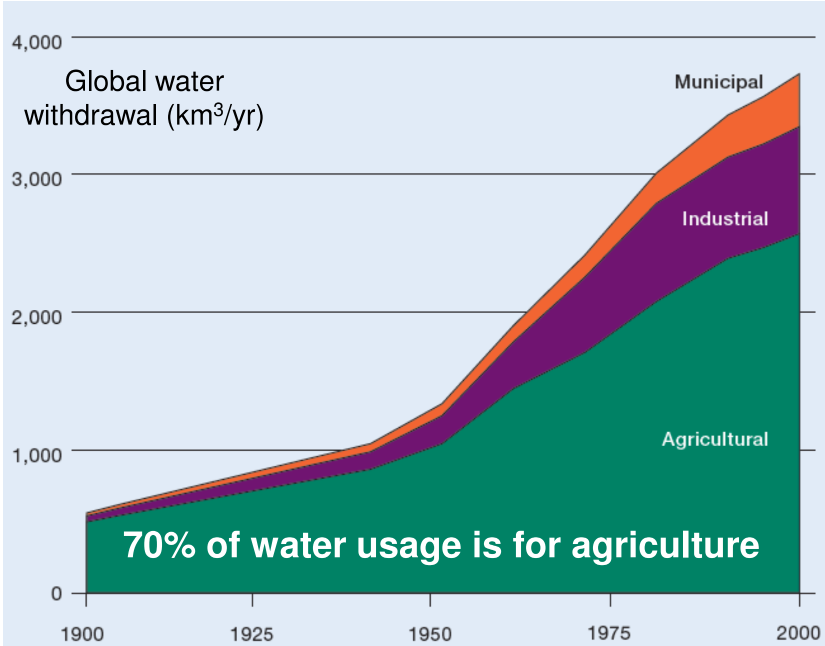
β-carotene, protein, iron enriched. Cyanide氰化物removed, carbohydrate unbalanced high.

Cassava 大戟科\木薯，又稱樹薯 roots harvested in Thailand

In the next 50 years, we will have to produce as much food as we have yet produced in human history

Photo credit: © UNICEF/NYHQ1998-0891/Giacomo Pirozzi

Food production for one person for one day requires 3000 liters of water



Comprehensive Assessment of Water Management in Agriculture. 2007. Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture. London: Earthscan, and Colombo: International Water Management Institute.

Maize is a staple crop in Africa but very sensitive to drought damage

Less than 10% of crop land in sub-Saharan Africa is irrigated, making agriculture production highly susceptible to drought

Irrigation as percentage of cultivated area

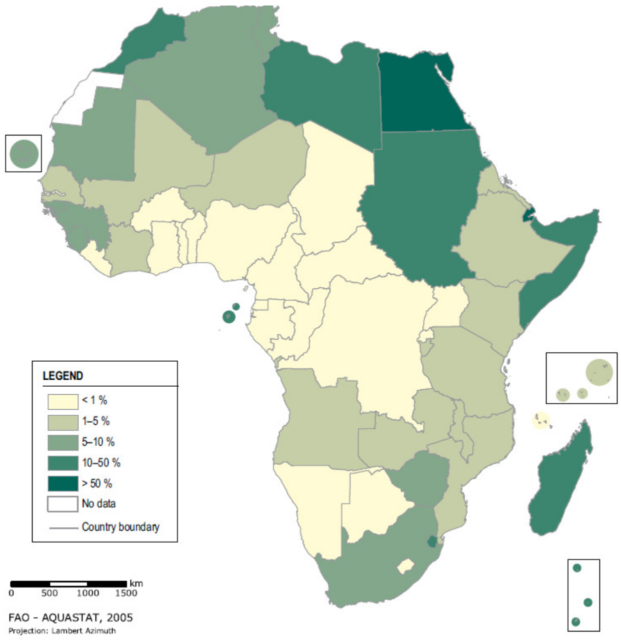


Photo credit: Anne Wangalachi/CIMMYT Map Source – FAO Aquastat 2005

Teaching Tools in Plant Biology™ ideas to grow on
AN INNOVATION FROM *THE PLANT CELL*
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Water Efficient Maize for Africa (WEMA) was developed through a public-private partnership

Water-efficient maize optimized for growth in sub-Saharan Africa (WEMA) has been developed through a combination of breeding and GM methods

WEMA is being developed as a public-private partnership that includes international and regional plant breeding institutes, philanthropic groups and Monsanto

Photo credits: Anne Wangalachi/CIMMYT

Reducing Fossil Fuel Dependency

- **Biofuels** are made by the fermentation and distillation of plant materials such as cellulose
- Biofuels can be produced by rapidly growing crops such as switchgrass and poplar
- Biofuels would reduce the net emission of CO_2, a greenhouse gas
- The environmental implications of biofuels are controversial

Issues of Human Health

- One concern is that genetic engineering may transfer allergens from a gene source to a plant used for food
- Some GMOs have health benefits
  - For example, maize that produces the *Bt* toxin has 90% less of a cancer-causing toxin than non-*Bt* corn
  - *Bt* maize has less insect damage and lower infection by *Fusarium* 鐮胞菌 fungus (香蕉黃葉病） that produces the cancer-causing toxin