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 6: Inheritance

- Let's review previous homeworks and group discussion results

homework

- Identify topic sentences among these paragraphs in this section
- Based on SQ3R, propose a question and an answer to summarize this section
- Practice marking tips and upload your marking figure

A Case Study in Scientific Inquiry: Investigating Mimicry in Snake Populations

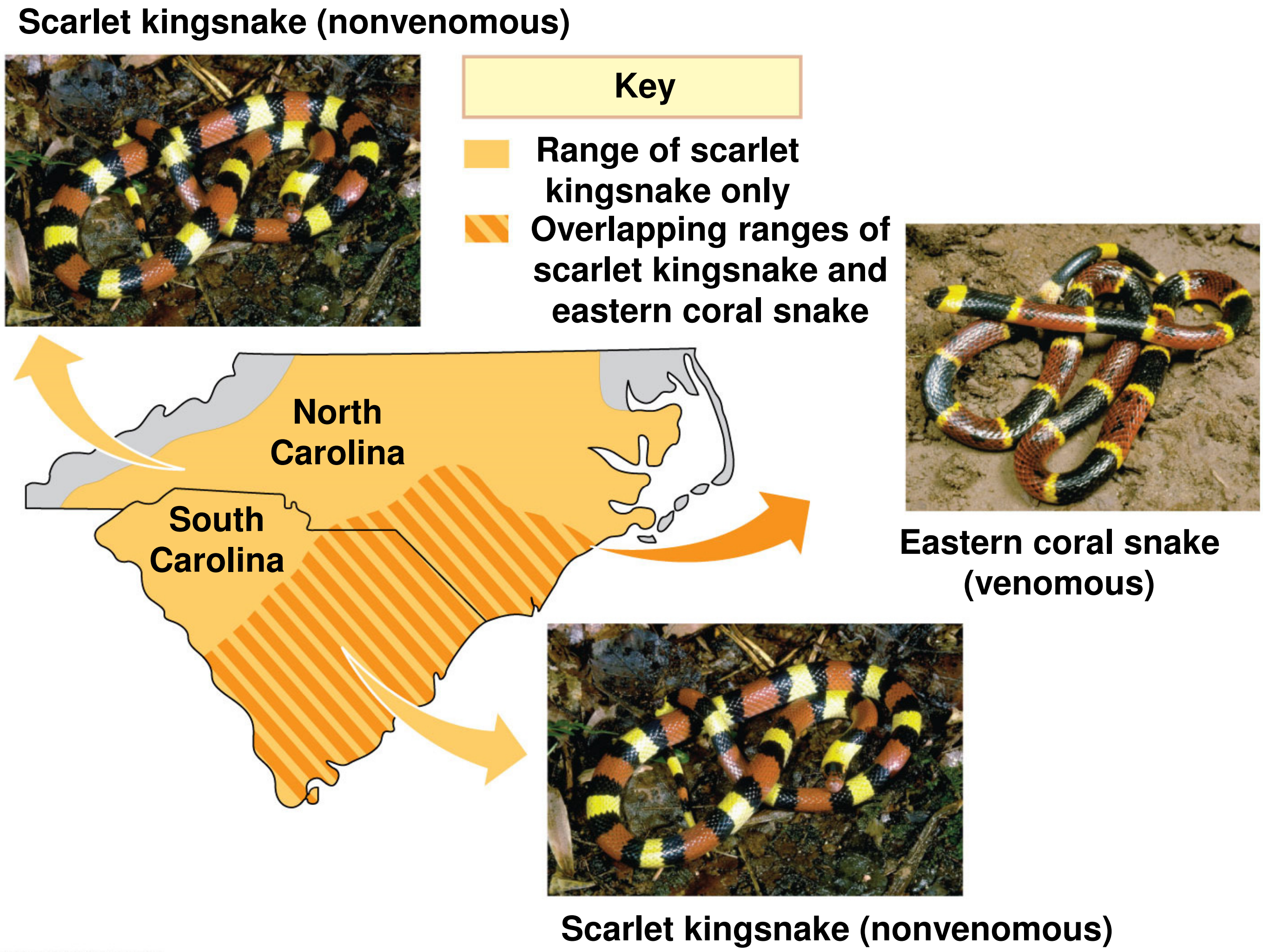
Now that we have highlighted the key features of scientific inquiry—making observations and forming and testing hypotheses—you should be able to recognize these features in a case study of actual scientific research.

The story begins with a set of observations and inductive generalizations. Many poisonous animals are brightly colored, often with distinctive patterns that stand out against the background. This is called *warning coloration* because it apparently signals "dangerous species" to potential predators. But there are also mimics. These imposters look like poisonous species but are actually harmless. A question that follows from these observations is: What is the function of such mimicry? A reasonable hypothesis is that the "deception" is an evolutionary adaptation that reduces the harmless animal's risk of being eaten because predators mistake it for the poisonous species. This hypothesis was first formulated by British scientist Henry Bates in 1862.

A Case Study in Scientific Inquiry: Investigating Mimicry in Snake Populations

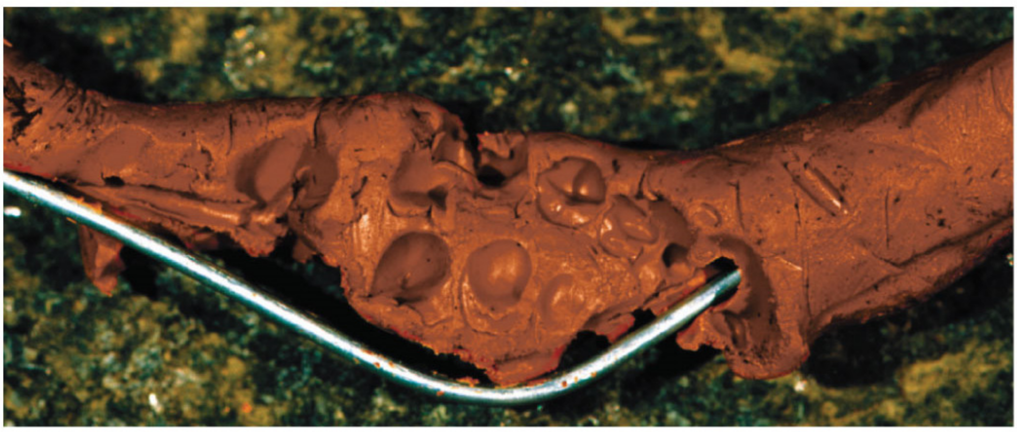
- Many poisonous species are brightly colored, which warns potential predators
- Mimics are harmless species that closely resemble poisonous species
- Henry Bates hypothesized that this mimicry evolved in harmless species as an evolutionary adaptation that reduces their chances of being eaten

Figure 1.25



Figu

(a) Artificial kingsnake



(b) Brown artificial snake that has been attacked

What is the function of mimicry?

A Case Study in Scientific Inquiry: Investigating Mimicry in Snake Populations

Now that we have highlighted the key features of scientific inquiry—making observations and forming and testing hypotheses—you should be able to recognize these features in a case study of actual scientific research.

The story begins with a set of observations and inductive generalizations. Many poisonous animals are brightly colored, often with distinctive patterns that stand out against the background. This is called *warning coloration* because it apparently signals "dangerous species" to potential predators. But there are also mimics. These imposters look like poisonous species but are actually harmless. A question that follows from these observations is: What is the function of such mimicry? A reasonable hypothesis is that the "deception" is an evolutionary adaptation that reduces the harmless animal's risk of being eaten because predators mistake it for the poisonous species. This hypothesis was first formulated by British scientist Henry Bates in 1862.

As obvious as this hypothesis may seem, it has been relatively difficult to test, especially with field experiments. But

Answer:
a harmless animal reduce its risk of being eaten

1 問答題

Identify the topic sentence and concluding sentence from texts below:
"The story begins with a set of observations and inductive generalizations. Many poisonous animals are brightly colored, often with distinctive patterns that stand out against the background. This is called warning coloration because it apparently signals "dangerous species" to potential predators. But there are also mimics. Thes imposters look like poisonous species but are actually harmless. A question that follows from these observations is: What is the function of such mimicry? A reasonable hypothesis is that the "deception" is an evolutionary adaptation that reduces the harmless animal's risk of being eaten because predators mistake it for the poisonous species. This hypothesis was first formulated by British scientist Henry Bates in 1862."

譚芳

topic sentence：The story about animal mimicry begins with a set of observations and inductive generalizations.
concluding sentence:The hypothesis was first formulated by British scientist Henry Bates in 1862.

张宇

Many poisonous animals are brightly colored.
The warning coloration is an evolutionary adaptation.

Topic and Concluding usually are not just facts

邓茹

Topic sentence:Brightly color is called warning coloration.
Concluding sentence:Warning coloration apparently signals "dangerous species" to potential predators and reduces the harmless animal's risk of being eaten.

王洁琦

Topic sentence

Many poisonous animals are brightly colored, often with distinctive patterns that stand out against the background.

Concluding sentence

A reasonable hypothesis is that the "deception" is an evolutionary adaptation that reduces the harmless animal's risk of being eaten because predators mistake it for the poisonous species.

The Molecular Basis of Inheritance

▲ **Figure 16.1** How was the structure of DNA determined?

KEY CONCEPTS

16.1 DNA is the genetic material

16.2 Many proteins work together in DNA replication and repair

16.3 A chromosome consists of a DNA molecule packed together with proteins

OVERVIEW

Life's Operating Instructions

In April 1953, James Watson and Francis Crick shook the scientific world with an elegant double-helical model for the structure of deoxyribonucleic acid, or DNA. **Figure 16.1** shows Watson (left) and Crick admiring their DNA model, which they built from tin and wire. Over the past 60 years or so, their model has evolved from a novel proposition to an icon of modern biology. Mendel's heritable factors and Morgan's genes on chromosomes are, in fact, composed of DNA. Chemically speaking, your genetic endowment is the DNA

Sample reading materials

The Search for the Genetic Material: *Scientific Inquiry*

Once T. H. Morgan's group showed that genes exist as parts of chromosomes (described in Chapter 15), the two chemical components of chromosomes—DNA and protein—became the candidates for the genetic material. Until the 1940s, the case for proteins seemed stronger, especially since biochemists had identified them as a class of macromolecules with great heterogeneity and specificity of function, essential requirements for the hereditary material. Moreover, little was known about nucleic acids, whose physical and chemical properties seemed far too uniform to account for the multitude of specific inherited traits exhibited by every organism. This view gradually changed as experiments with microorganisms yielded unexpected results. As with the work of Mendel and Morgan, a key factor in determining the identity of the genetic material was the choice of appropriate experimental organisms. The role of DNA in heredity was first worked out while studying bacteria and the viruses that infect them, which are far simpler than pea plants, fruit flies, or humans. In this section, we will trace the search for the genetic material in some detail as a case study in scientific inquiry.

Read sample reading (Ch 14. The molecular basis of inheritance, Campbell biology)
Transform key concepts/key words you found in the section called "the search for the genetic material" into 3-5 questions and answers. This allow you to practice SQ3R.

全班人數：119　作答人數：10　■ 已作答　■ 未作答

未分組名單

李雪梅　李娜　郭恒　郑晓帆　赵家乐　王芙美　张静　龙雪　侯前　邓茹　爽　高凤芝　格根　成功　趙雅君
周佳欣　烏蘭　张敏娜　韩再强　宋欣泽　白杰　何小龍　程琛　永　刘佳　荣安　王璐瑶　刘冬美　朱敏　宋有利
姚重阳　新月　李娜　杜孟欣　汪昕珑　俞卓然　许可　石晓　张敏　赵晓倩　王浩宇　辛旭　杨爱慧　郝瑞花
秦雅　孔伶瑞　曹婕　王萌　弛　朱育楼　瑞培　郭雨晴　苗　竇數　王洁琦　于圣英　楊闖　国情文　碧桐
刘雅娜　高娜　卢凯文　雅迪　何琦奇　董鉴霄　范胜男　竇鵬飛　森　胡靖　刘晶　賈慧芳　刘春 艳　陳潔
潘建安　吴小南　肖南西　李凤妍　張 曉　王笑冰　敖敦格日勒　辛亮　武欣艳　娜力格尔　光因　毕南南　王玮
劉 詩龍　袁鑫宇　李豆　邢麗華　贾翠红　王小能　張夢圓　汪瑜　WangYu

已分組名單

光阴的故事 (　孙彤彤　蘇 諾爾　侯娜　劉亞楠　)　好好学英语 (　胥洁　张玉　安欣　)
漆黑の追跡者 (　徐黃緯　)　青稞 (　譚芳　宏杰　王璐　)
ndkjdvdjsjsjdjdodbdvfigjgk (　翟逸群　刘洋　忠　)　为了部落 (　肖作可　魏新华　)　647 (　张宇　)
饿了吗 (　云欣悦　李士哲　刘佳慧　)　unbelieve (　裴婷　张燕燕　樊晓娟　田媛　)

为了部落(魏新华 肖作可)

1.Why people's view gradually change?

Because there is a key factor to prove that the DNA is the best choice of genetic material.

光阴的故事(侯娜 蘇 諾爾 劉亞楠 孙彤彤)

Why the view changed?

Because the experiments with microorganisms yielded unexpected results.

漆黑の追跡者(徐黃緯)

①Why the old view that protein is the genetic material gradually changed?

Answer:The experiments with microorganism yielded unexpected results.

②What's the candidates for the genetic meterial?

Answer:DNA and protein.

③What does genes exist as?

Answer:Genes exist as part of chromosomes

好好学英语(张玉 胥浩 安欣)

1.Why people have different view later? Microorganisms vielded unexpected results.

2.What modern organism was used to prove DNA in heredity?

DNA in heredity was first worked out while studying bacteria.

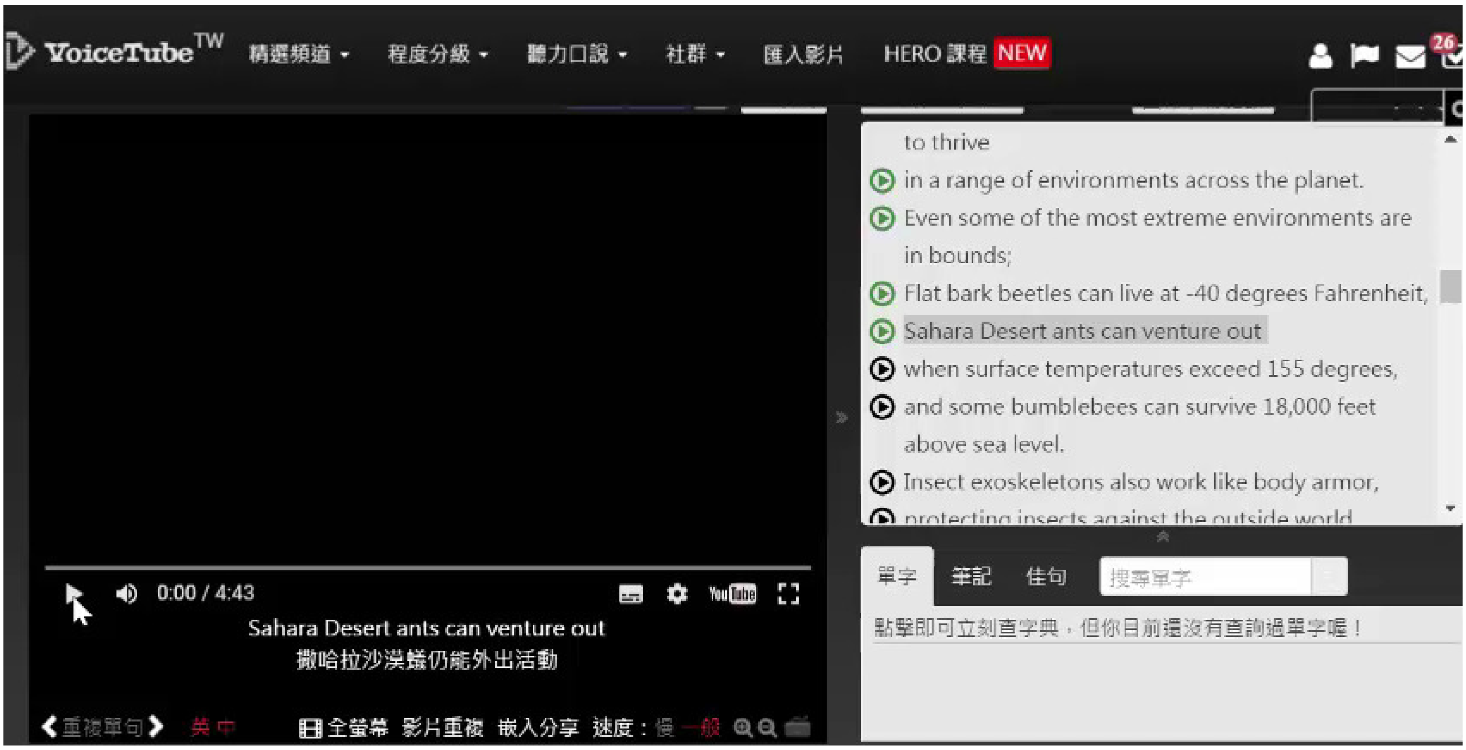
3.Where the search for the genetic material?

In some detail.

Good at paraphrasing!

【TED-Ed】蟲蟲危機從何而來？ (Why are there so many insects?)

https://tw.voicetube.com/videos/35769?ref=teded



Read:【TED-Ed】蟲蟲危機從何而來？ (Why are there so many insects?)
https://tw.voicetube.com/videos/35769?ref=teded
Transform key concepts/key words you found in the film into 3-5 questions and answers

1. What happens if insect suddenly become large beings and numbers?

A: They will destroy us simply because they outnumber us by more than a billion to one.

2. What are the secrets for insects to success?

They breed many offspring; so even they die a lot, still many survive.

They mature rapidly so their cycles of reproduction resume quickly.

Insect exoskeleton also protects them against the outside world

Insects are tiny, so they can make use of all the available resources around it. This means they can occupy hundreds of niches across ecosystems

3. How could insect adapt so well on earth given their huge species diversity and individual numbers?

A: Fast reproduction means insect contains great genetic diversity allowing them to adapt different environment.

4. What is the advantage of metamorphosis in insect?

It not only transform insect but also help them to maximize the available resources in an ecosystem.

Take butterfly, in the larval caterpillar form, they feed on leaves. But when they emerge as butterfly, these insects feed only on flower nectar.

So the larvae and adults share an ecological niche without competing the same resource.

Read:【TED-Ed】蟲蟲危機從何而來？ (Why are there so many insects?)
https://tw.voicetube.com/videos/35769?ref=teded
Transform key concepts/key words you found in the film into 3-5 questions and answers

徐黃緯

(1)What does insect abundance come down to or what's their secret to success?

Answer:

①Together make them some of the most adaptable and resilient creature.

②Their impressive ability to breed.

③Insects harbor a tremendous amount of genetic diversity to suit various environment.

④Insect exoskeletons also work like body armor,which can protect them from danger.

⑤Insect with tiny shape can make good use of space and all the available resources within it.

(2)What's the mighty power of metamorphosis?

Answer:

This traint not only transforms Insects,but also helps them maximize the available resources in an ecosystem.

(3)What does metamorphosis mean?

Answer:

It means the larvae and adults of one species will never compete for the same resources.

劉亞楠

1.Why are there so many insects?

First,insects have impressive ability to beed,and the cycle of reproduction resumes quickly.

Second, insects harbor a tremendous amount of genetic diversity.

2.Why we had be crushed simply if insects suddenly morphed into large beings, and decided to wage war on us?

Because of their sheer numbers.

3.The number of insects means what?

It means that as a class, insects harbor a tremendous amount of genetic diversity.

4.What a wealth of genetic data can give insects ?

It can give them the necessary adaptations they need to thrive in a range of environments across the planet.

5.Metamorphosis means what?

It means the larvae and adults of one species will never compete for the same resource, they successfully share an ecological niche without limiting their own success.

王洁琦

1.Why humans would lose ,if insects decided to wage war on us?

Because their sheer numbers would crush humans.

2.Approximately how many insects on Earth ?

There are an estimated 10 quintillion individual insects on Earth.

3.Which numebers are existing at special level?

These invertebrates are existing at special level.

These are questions on fa
but try ask fact
ideas

何小龍

1.Why are there so many insects on earth?

Answer:Insect abundance comes down to many things that together make them some of the most a daptable and resilient creatures,beginning with their impressive ability to breed.

2.How terrible the number of insects?

Answer:Compared with our population of about 7 billion, these invertebrates out number us by mor e than a billion to one.

3.How come we don't feel that the numbers of insects is lage?

Answer:Beause we're big and they're small,so it's easy to forget that these critters are moving in their millions all around us,all the time.

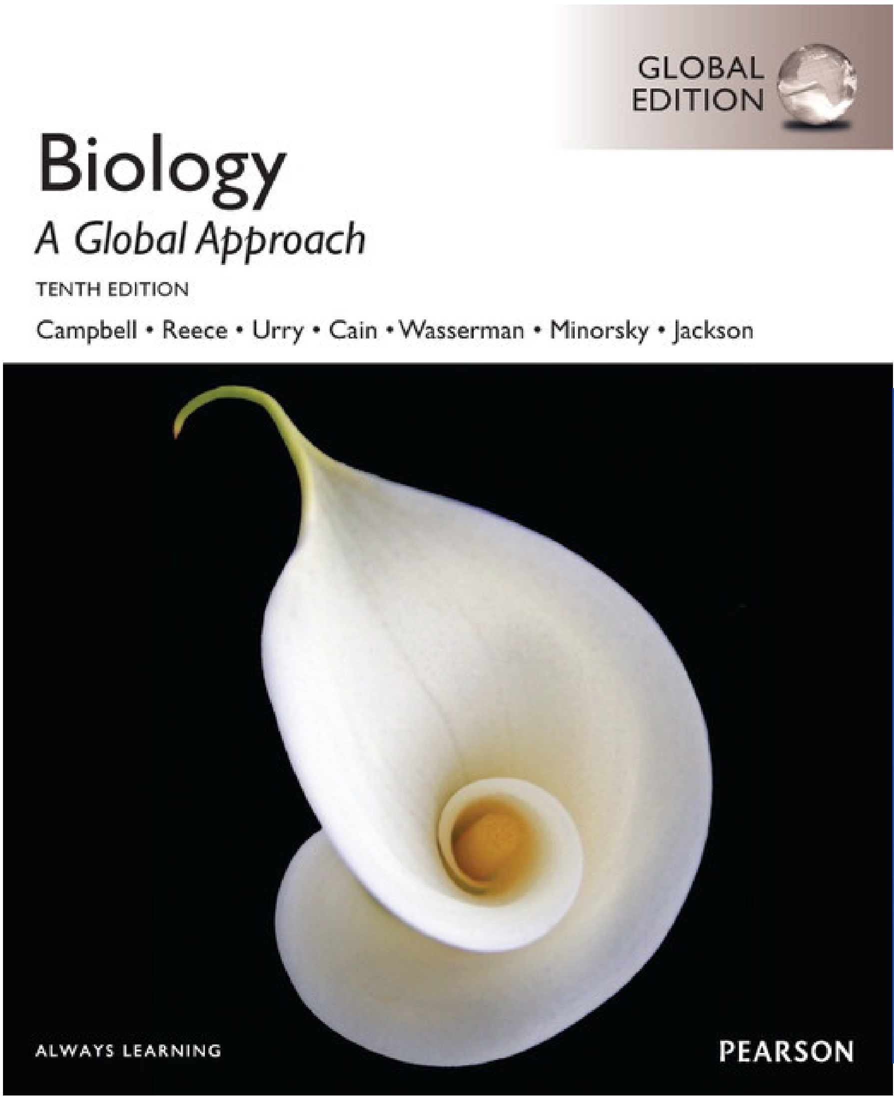
邢麗華

try ask fact + ideas

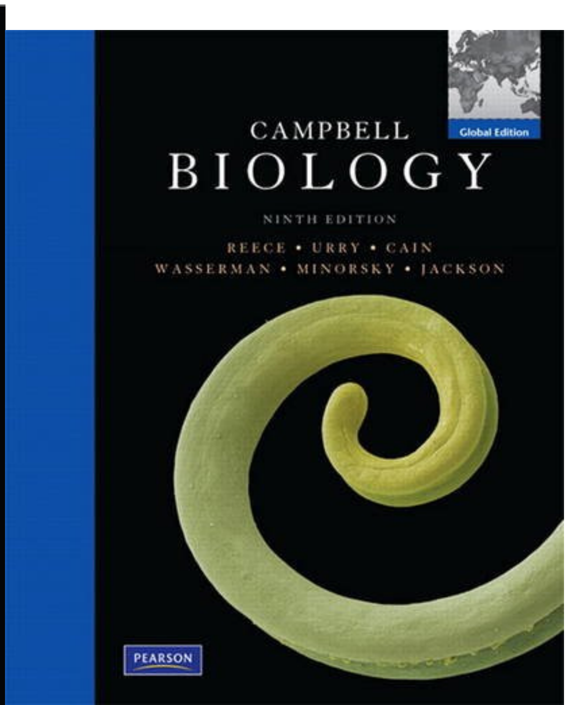
1.key words:outnumber astounding number ,breed ,offspring, tremendous genetic diversity,exceed, tiny,niches,metamorphosis,conqueror2.question:why we would simply be crushed by insects sheer numbers? answes:there are an estimated 10 quintillion individual insects on earth that's a followed by 19 zeroes.3.why insect's astounding number exist at the species level?
because there are more than 6000 vertebrate species on the planet.but the class of insects contains a million known species ,and mang othersthat haven't been classificed infact these critters make up approximately 75% of all animals on earth ,3.why insects can ccupy hundreds of different niches across ecosystem most species are so tiny million of insects can inhabit a small space and made use of all the vailable resources within it.4why insects is the true conquerors of the planet .because examin almost any patch of ground,and you're sure to find them there numbers are immense and their success is unmatches.

Before you begin to read your assignment:

1. Look at the way the material is organized.
2. Read the titles and sub headings.
3. Be sure to read all the captions for pictures.
4. Read the title and the axes labels for charts and graphs.
5. If there are questions at the end of the material, read them. You will have a good idea which concepts are of key importance.



Skim Ch. 1
P. 18-23



While you read:

1. Read the entire paragraph or section without making notes or underlining anything.
2. Think about what the major ideas are in contrast to the details.

The Role of Hypotheses in Inquiry

In science, a **hypothesis** is a tentative answer to a well-framed question—an explanation on trial. It is usually a rational accounting for a set of observations, based on the available data and guided by inductive reasoning. A scientific hypothesis leads to predictions that can be tested by making additional observations or by performing experiments.

We all use hypotheses in solving everyday problems. Let's say, for example, that your flashlight fails during a camp-out. That's an observation. The question is obvious: Why doesn't the flashlight work? Two reasonable hypotheses based on your experience are that (1) the batteries in the flashlight are dead or (2) the bulb is burnt out. Each of these alternative hypotheses leads to predictions you can test with experiments. For example, the dead-battery hypothesis predicts that replacing the batteries will fix the problem. **Figure 1.24** diagrams this campground inquiry. Of course, we rarely dissect our thought processes this way when we are solving a problem using hypotheses, predictions, and experiments. But the hypothesis-based nature of science clearly has its origins in the human tendency to figure things out by trial and error.

Figure 1.24

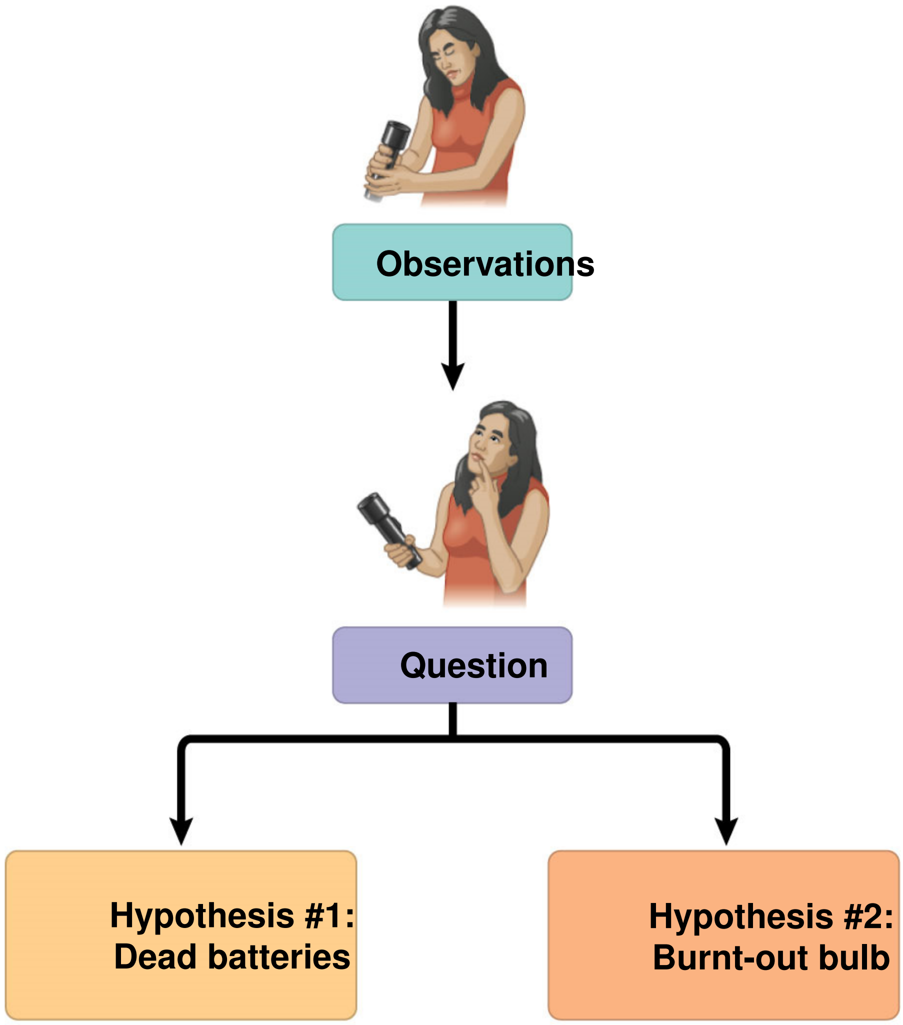
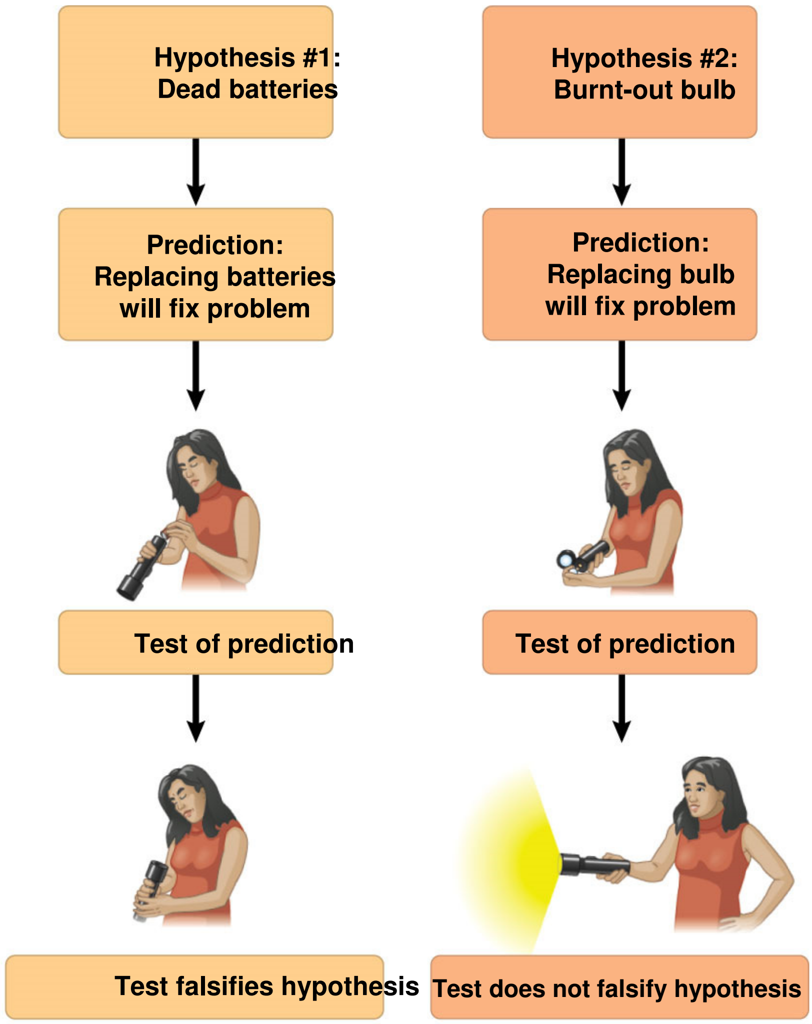


Figure 1.24b



After reading a paragraph or section:

1. Use a pen or pencil, not a highlighter. With a pen or pencil, you can paraphrase and add margin notes.
2. Marking your textbook
   a. Lines:
   Highlighted for major ideas.
   single lines for minor ideas or explanation of main ideas.
   b. Margin notes:
   In the left/right margin write . . .
   1. Memory phrases
   2. Summaries and paraphrases of main ideas and details (These are answers of predicted test questions, see below)
   3. Predicted test questions (based on main ideas)

3. Definitions and Examples
a. Write "def" or "ex" in the margin.
b. Underline definitions in thick and (put parenthesis around examples)

4. Important concepts: Put a circle or box around these to make them stand out.

5. Captions (a title or explanation for a picture): underline and mark these just as you would the text.

potential explanations—that is, hypotheses.

The Role of Hypotheses in Inquiry

How to make a hypothesis?

def

In science, a **hypothesis** is a tentative answer to a well-framed question—an explanation on trial. It is usually a rational accounting for a set of observations, based on the available data and guided by inductive reasoning. A scientific hypothesis leads to predictions that can be tested by making additional observations or by performing experiments.

ex

We all use hypotheses in solving everyday problems. Let's say, for example, that your flashlight fails during a camp-out. That's an observation. The question is obvious: Why doesn't the flashlight work? Two reasonable hypotheses based on your experience are that (1) the batteries in the flashlight are dead or (2) the bulb is burnt out. Each of these alternative hypotheses leads to predictions you can test with experiments. For example, the dead-battery hypothesis predicts that replacing the batteries will fix the problem. **Figure 1.24** diagrams this campground inquiry. Of course, we rarely dissect our thought processes this way when we are solving a problem using hypotheses, predictions, and experiments. But the hypothesis-based nature of science clearly has its origins in the human tendency to figure things out by trial and error.

Answer:
>problem
>hypothesis
>prediction
>test(experiments)

ex

Step

def

- How about your dream?

撒種的比喻

- 『有一個撒種的出去撒種，撒的時候，有落在路旁的，飛鳥來喫盡了。有落在土淺石頭地上的，土既不深，發苗最快，日頭出來一曬，因為沒有根，就枯乾了。有落在荊棘裏的，荊棘把他擠住了。又有落在好土裏的，就結實，有一百倍的，有六十倍的，有三十倍的。有耳可聽的，就應當聽。

馬太福音十三章

- 撒在石頭地上的，就是人聽了道，當下歡喜領受，只因心裏沒有根，不過是暫時的，及至為道遭了患難，或是受了逼迫，立刻就跌倒了。撒在荊棘裏的，就是人聽了道，後來有世上的思慮、錢財的迷惑、把道擠住了，不能結實。撒在好地上的，就是人聽道明白了，後來結實，有一百倍的，有六十倍的，有三十倍的。』

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. A
this made me
like to join him
explore the bi

學生回饋

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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 better 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 teacher,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 choice 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 consulting a lot of information，I chose the biological sciences in the rest of my profession.I have confidence in this major.

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

學生回饋

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Because in high school,I chose to learn sciences,but in it,I only learnt Biology well.I was interested in it very much.It is said that the 21th century is the era of Biology.I want to try my best to learn some advanced 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 major.

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

To be honest,because my college entrance examination result is not very high,I couldn't go to my ideal university or major.I had to choose the subject which I like best in high school ,so I choosed life science. 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 standard line in chenmitry,So I deside choose the life science finally, though it is not my prime choose,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

學生回饋

better present your idea on how you gonna to achieve so se/index/26803/chapter_list/50081/console/2665279/single/

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

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

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 found...

學生回饋

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

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.

Watch the film [静观伦敦]柴静专访剑桥大学校长. Tell me what do you think 3-5 most important values a university should have. (use sentences rather than words)

播放

點選進行計時播放

No tutor? How about me?

四剑客(爽 何琦奇 张玉 宵洁)

1. give students enough time and space

2. encourage students to debate challenge outmoded conventions

3. tutors are responsible for one to one guidance

Fact only or opinion?

格格巫(赵家乐 李雪梅 王芙美 李娜 郑晓帆 郭恒)

1、Giving priority to students .2、Freedom more important than anything.3、All resistance are effective.

香蕉你个banana(许可 张敏 李士哲 云欣悦)

No free speech?

1.Students should be allowed to have free speech and should encourage that.

2.The university should be pay attention to the student personal education and ability.

3Administrative management is composed of staff rather than administrative personnel.

645(成功 张敏娜 趙雅君)

No staff?

it should wide the view of students.

保温杯(王璐 武欣艳 刘春 艳 張 曉 譚芳 毕南南 宏杰)

I think a successful university should have a belief about freedom.It should have debate rather than blind obey.And it must have the creative ability unbelievable(樊晓娟 田媛 王璐瑶 张燕燕 裴婷 刘冬美)

1.Do not take the interests for the purpose, to educate the students as the fundamental.

2.To have a broad mind to accept different voices.

3.Training students to explore their interests and potential.

没有名字(刘洋 翟逸群)

We should have dependent thinking ability.

Train our eloquence.Create our subjectivity,

Different voice?

fancy(郝瑞花 潘建安 吴小南 高娜)

1.A university should have debating.

2.A university should have patience.

3.A university should have passion.

光阴的故事(蘇 諾爾 侯娜 光因 孙彤彤 劉亞楠)

Not bound students ideological thinking.

Let the students have the right to express their views.

Pay attention to every student and encourage them to chanllenge.

Let the students have the right to express their views

No right to express view? Ideological thinking? For example?

228(邢麗華 陳潔 李豆 贾翠红 肖南西 李凤妍 賈慧芳)

1、Because it give students free to debate, to speak out their own opinion.

2、Because not a university,it is a unit college ,every college have i

3、one to one

學生回饋

228(邢麗華 陳潔 李豆 贾翠红 肖南西 李凤妍 賈慧芳)

1、Because it give students free to debate, to speak out their own opinion.

2、Because not a university,it is a unit college ,every college have it own rule.

3、one to one

Then tell me your opinion!

为了部落(白杰 魏新华 肖作司 宋欣泽)

They can create their own future and decide their destination by the higher education.

Pay attention to the potential of teachers and students , found their wisdom.

The can give enough space and time to students.

Incomplete, how they create their own future?

长得丑的进不来(朱敏 赵晓倩)

1 can widen students' horizon

2 every person have their own space

吾皇巴扎黑(杜孟欣 姚重阳)

1.At the univeristy of cambzidge in adipting the mentor of tutorial system, develop an in dependent personanlity of the ideal student. 2.

pia pia(忠 石晓 刘佳 邓茹 程琛)

students should have free thought !

time management

friendship

Beauty&Beast;(王洁琦 国情文 朱育楼 郭雨晴)

At first,a university is more important to students' personal abilities and encourage themselves to do what they are good at. Secondly,they're not contraint their thoughts. Finally,university hopes them,they have ambition to change the world.

Yes, but how?

不二不二哟~~(格根 高凤芝 李娜)

I think a university should respect the feeling of ever student ,and give chances to each of them , and encourage them to think .

Retail league(王浩宇)

Giving students enough free.   de_administration.   academic pursuit

二班长，我的意大利炮呢！(孔伶瑞 弛 刘雅娜 王萌 胡靖)

1.School must be patient with students

2.School should free students thought

3.School fail to define failure

漆黑の追跡者(徐黃緯 宋有利 何小龍)

①Encouraging students to debate,develop critical thinking,change the world rather than bondage them.

Cultivate student?

②Sparing no effor to cultivate student.

③University provide for freedom space and time to creat students brilliant mind.

retail league (王玮 袁鑫宇)

The quality of respect other is very important.For our future.For our parents expectation.let us make up our mind to destroy obstacles and embrace our challenge to win sucess.

respect?

Marking tips for textbook readings

- Dissect out paragraph structures so that you learn the author's logic (topic, supporting and concluding sentences)
- Mark key term/concept, def, ex, steps, fact, main idea and explanation of main ideas
- However, too many markings are unrealistic (Try not to mark over 30%)
- In English, each paragraph usually just contains one major idea. Remember this when you write.

- Campbell biology: Inheritance
- Chapter 15, 16 (P.286-324)

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

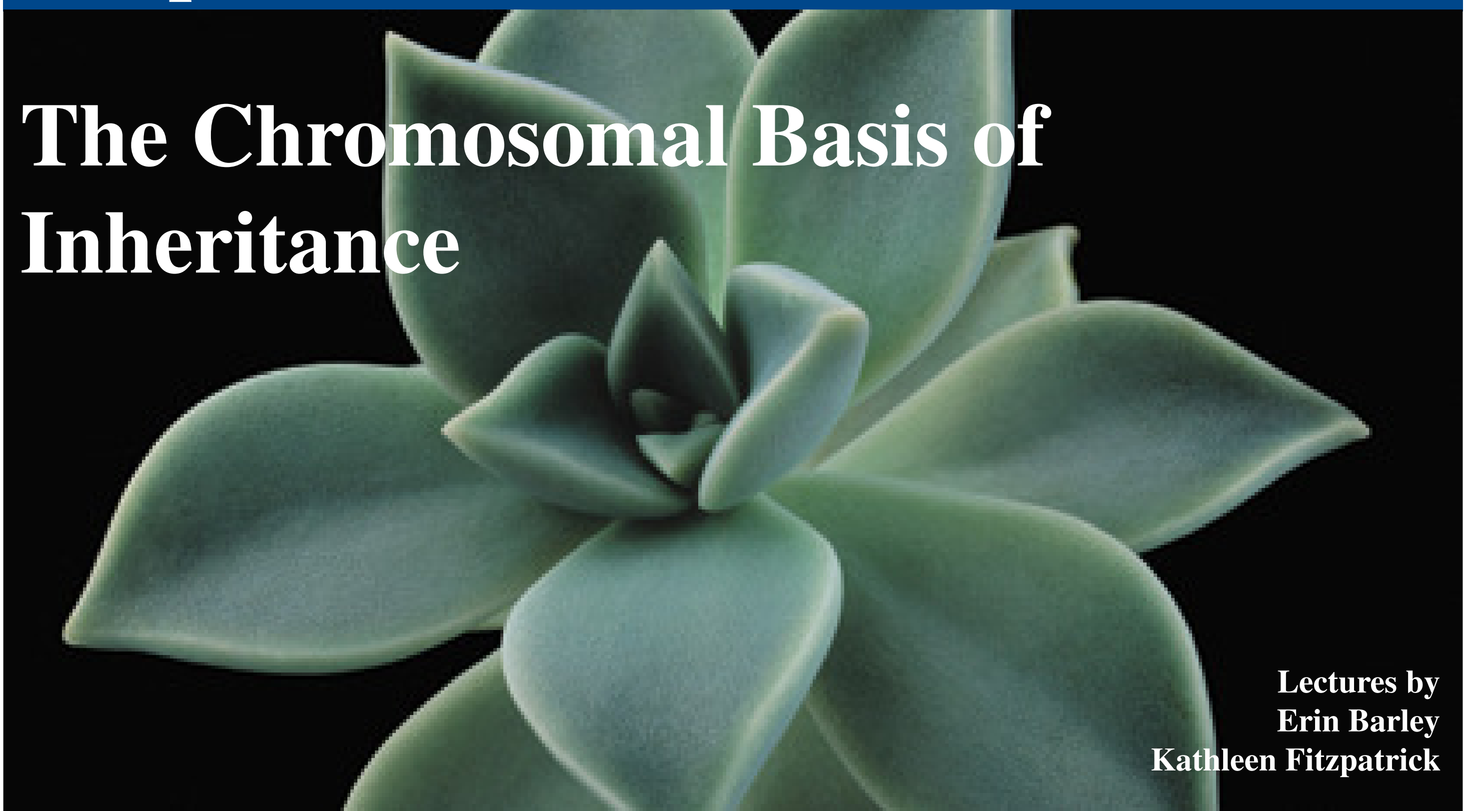
concluding

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

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

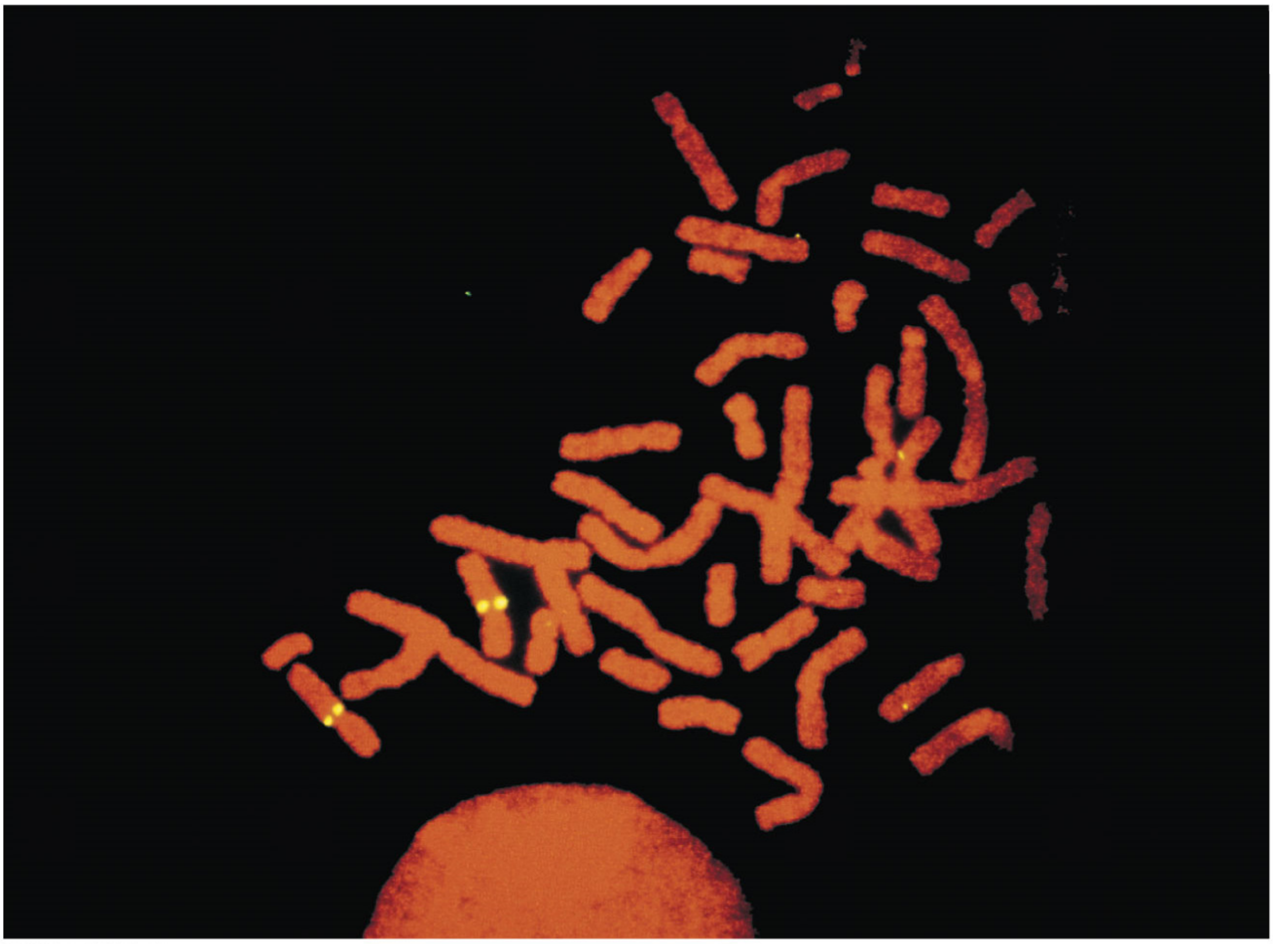
Chapter 15

The Chromosomal Basis of Inheritance



Lectures by
Erin Barley
Kathleen Fitzpatrick

Figure 15.1



Overview: Locating Genes Along Chromosomes

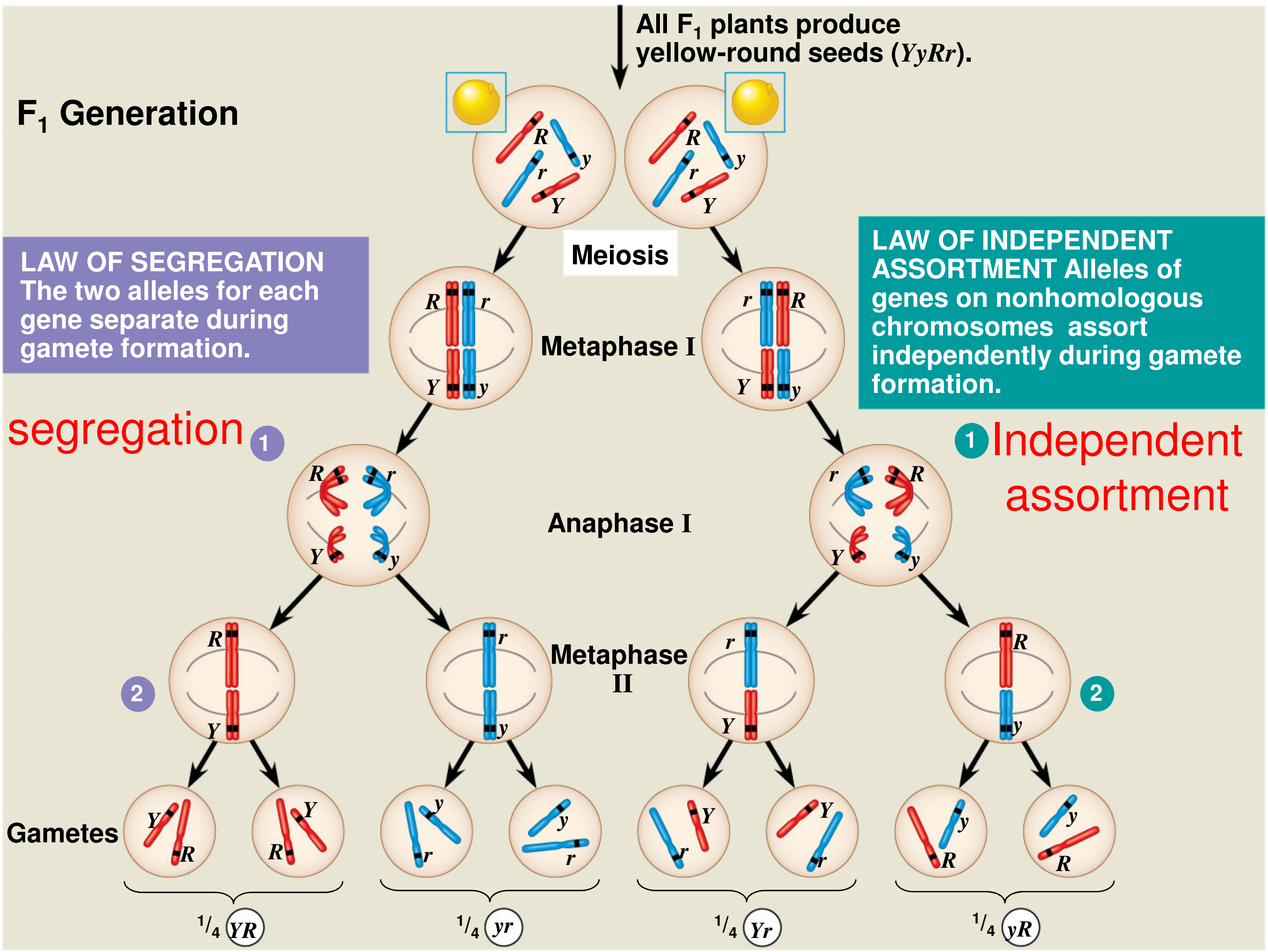
- Mendel's "hereditary factors" were genes
- Today we can show that genes are located on chromosomes
- The location of a particular gene can be seen by tagging isolated chromosomes with a fluorescent dye that highlights the gene (FISH)

Fluorescence in situ hybridization

Concept 15.1: Mendelian inheritance has its physical basis in the behavior of chromosomes

- Mitosis and meiosis were first described in the late 1800s (1875, 1890)
- The **chromosome theory of inheritance** states:
  - Mendelian genes have specific loci (positions) on chromosomes
  - Chromosomes undergo segregation and independent assortment
- The behavior of chromosomes during meiosis can account for Mendel's laws of segregation and independent assortment

Figure 15.2b



Morgan's Experimental Evidence: *Scientific Inquiry*

- The first solid evidence associating a specific gene with a specific chromosome came from Thomas Hunt Morgan, an embryologist
- Morgan's experiments with fruit flies provided convincing evidence that chromosomes are the location of Mendel's heritable factors

Morgan's Choice of Experimental Organism

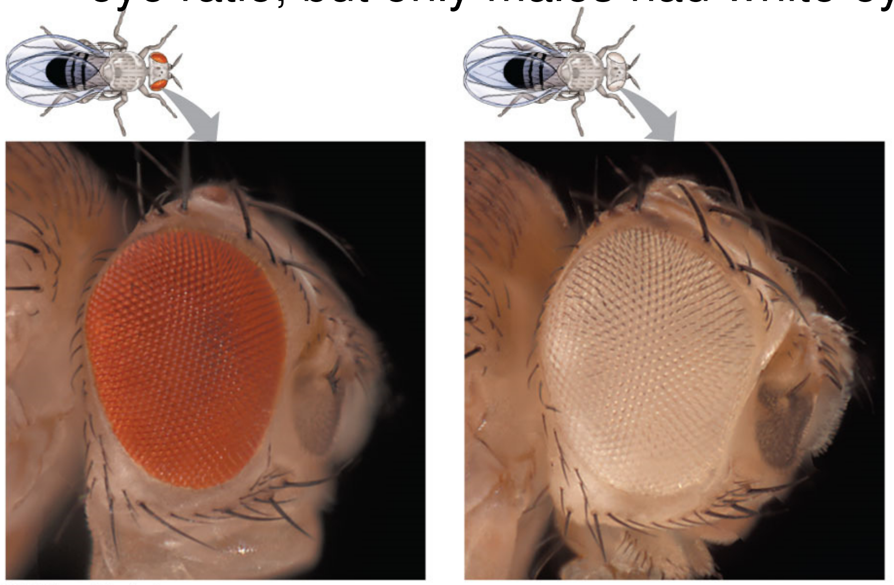
- Several characteristics make fruit flies a convenient organism for genetic studies
  - They produce <u>many offspring</u>
  - A <u>generation</u> can be bred every <u>two weeks</u>
  - They have only four pairs of chromosomes
- Morgan noted **wild type**, or normal, phenotypes that were common in the fly populations
- Traits alternative to the wild type are called mutant phenotypes

Figure 15.3

after more than two years breeding – Morgan persisted

The F_1 generation all had red eyes

The F_2 generation showed the 3:1 red:white eye ratio, but only males had white eyes



Morgan determined that the white-eyed mutant allele must be located on the X chromosome

Figure 15.4

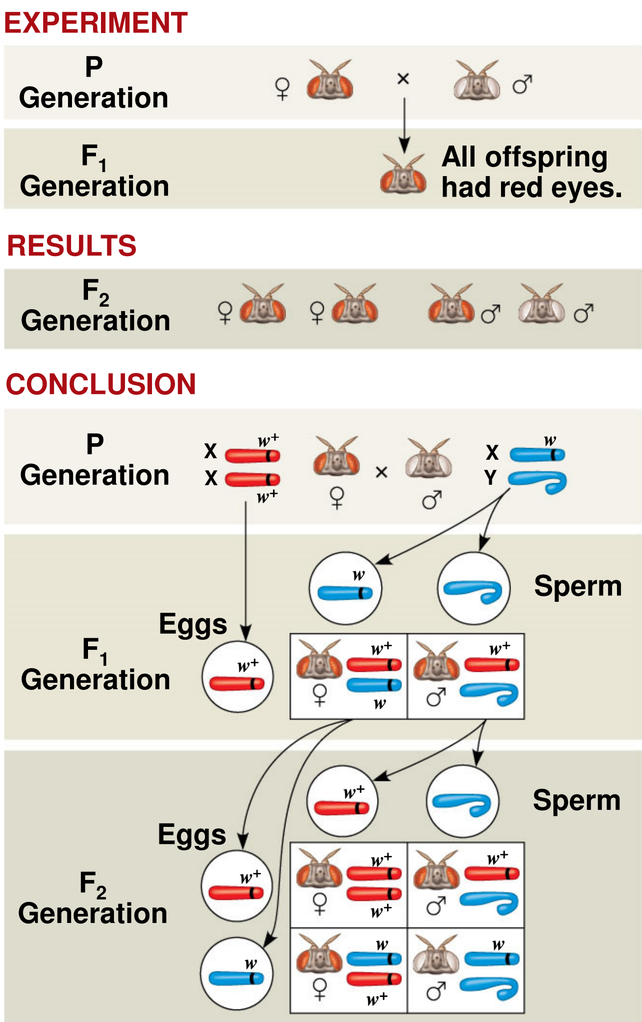
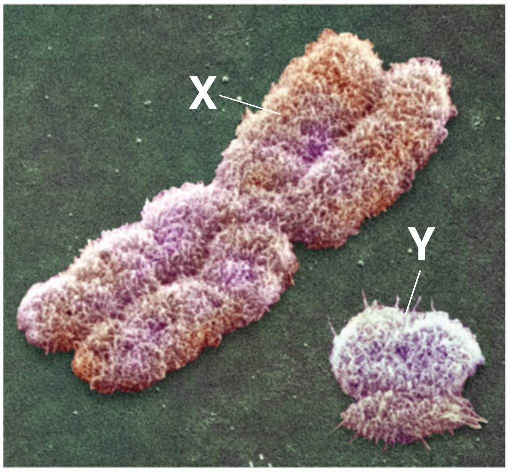


Figure 15.5

sex-linked genes

X-linked genes
1100 genes

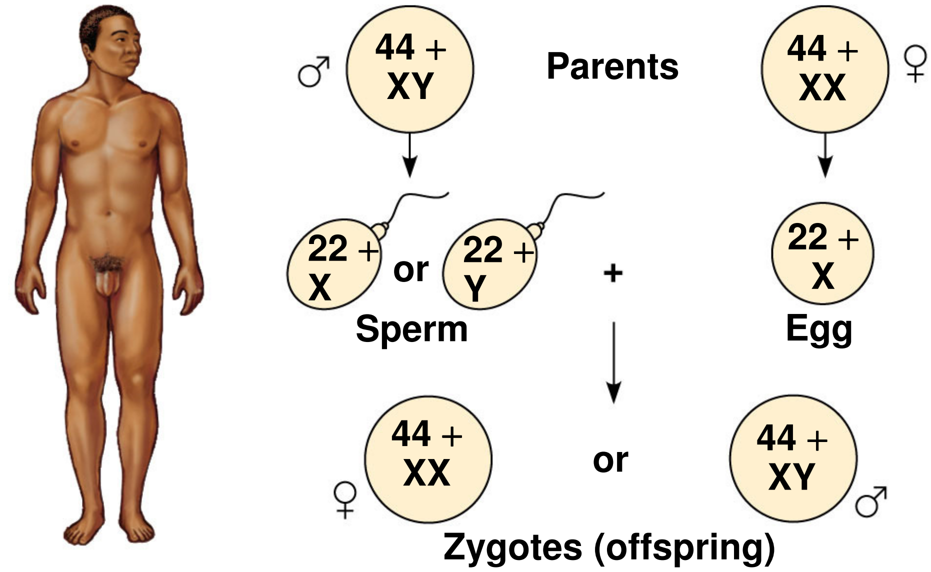


78 genes, 25 proteins,
few disordered
Y-linked genes

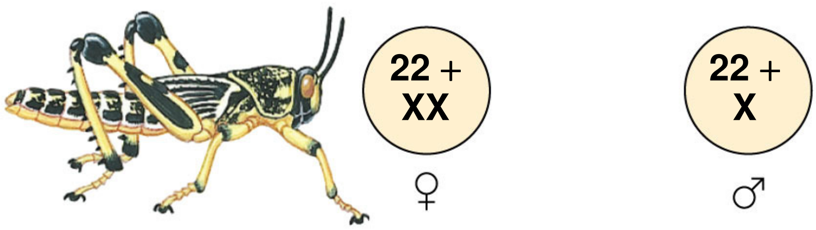
Concept 15.2: The Chromosomal Basis of Sex

- In humans and other mammals, there are two varieties of sex chromosomes: a larger X chromosome and a smaller Y chromosome
- Only the ends of the Y chromosome have regions that are homologous with corresponding regions of the X chromosome (why?)
- The *SRY* gene on the Y chromosome codes for a protein that directs the development of male anatomical features (2 months old embryo for testis)

Figure 15.6a

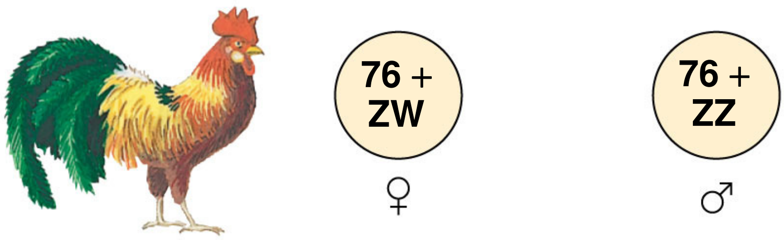


(a) The X-Y system



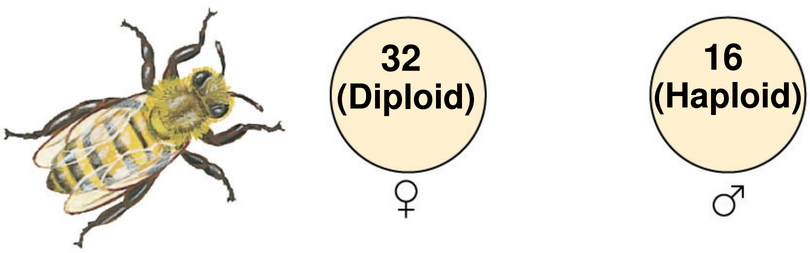
(b) The X-0 system

Figure 15.6b



(c) The Z-W system **egg determine the sex of offspring**

a male has no father and cannot have sons



(d) The haplo-diploid system Hymenoptera

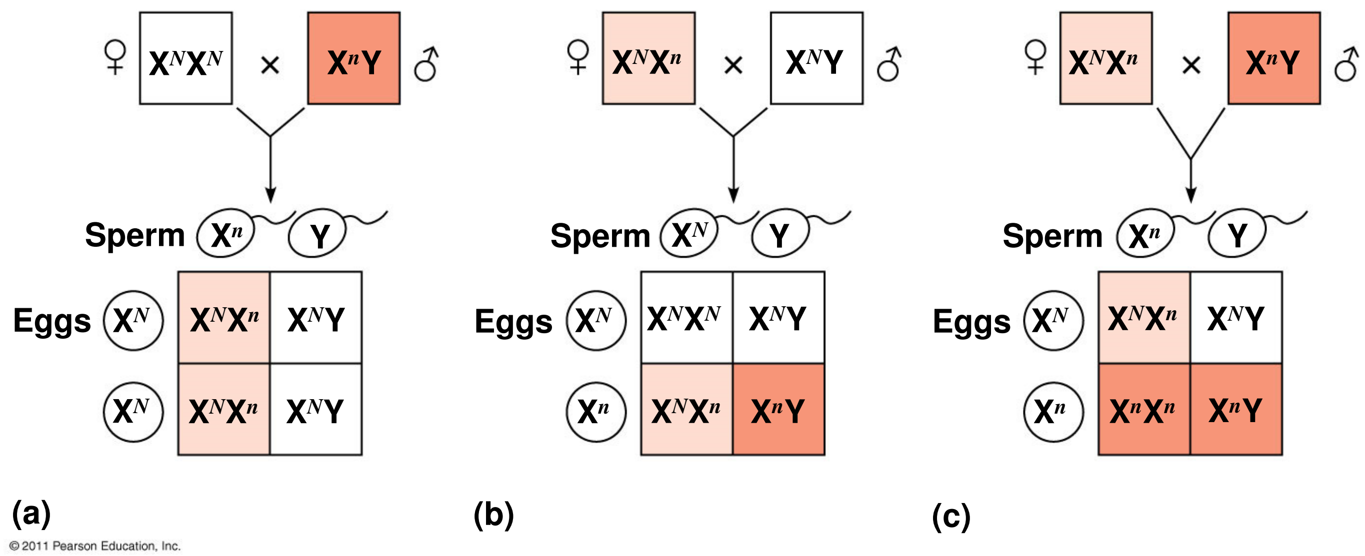
unfertilized egg-> haploid male, no father

Inheritance of X-Linked Genes

- X chromosome have genes for many characters unrelated to sex, whereas the Y chromosome mainly encodes genes related to sex determination
- For a recessive X-linked trait to be expressed
  - A female needs two copies of the allele (homozygous)
  - A male needs only one copy of the allele (hemizygous)
- X-linked recessive disorders are much more common in males than in females

- Some disorders caused by recessive alleles on the X chromosome in humans
  - Color blindness (mostly X-linked)
  - **Duchenne muscular dystrophy**
  - **Hemophilia**

Figure 15.7



Color blindness will transmit the mutant alleles to all daughters

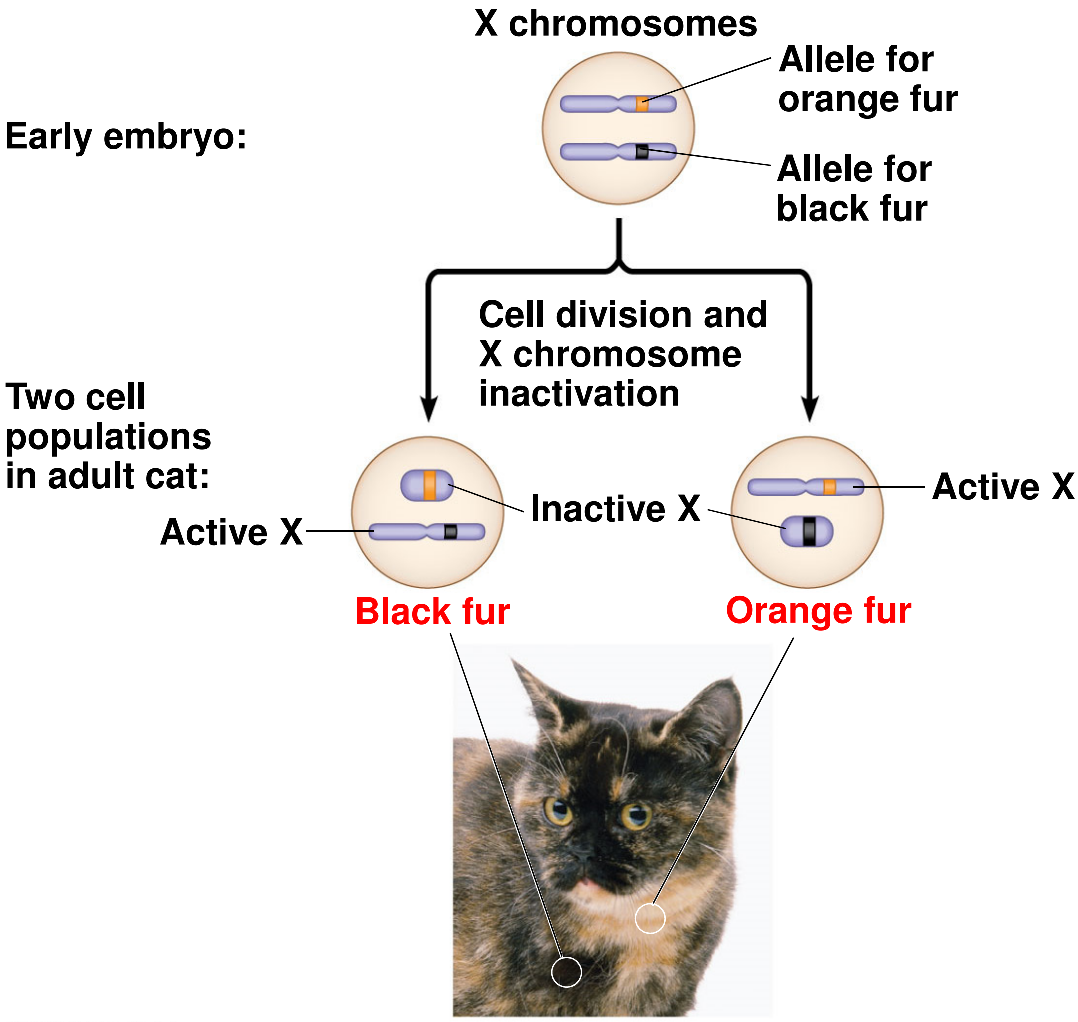
If a carrier mate with a normal male, 50% males have the disorder; 50% females are carriers

A carrier mate a color-blind, 50% child will have the disorder. Normal daughter is carrier

X Inactivation in Female Mammals

- In mammalian females, one of the two X chromosomes in each cell is randomly inactivated during embryonic development
- The inactive X condenses into a **Barr body**
- If a female is heterozygous for a particular gene located on the X chromosome, she will be a mosaic for that character

Figure 15.8



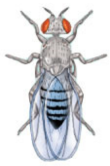
How Linkage Affects Inheritance?

Morgan crossed flies that differed in traits of body color and wing size

F

EXPERIMENT

P Generation (homozygous)



×

Wild type (gray body, normal wings)

b⁺ b⁺ vg⁺ vg⁺

Double mutant (black body, vestigial wings)

b b vg vg

Figure 15.9-2

EXPERIMENT

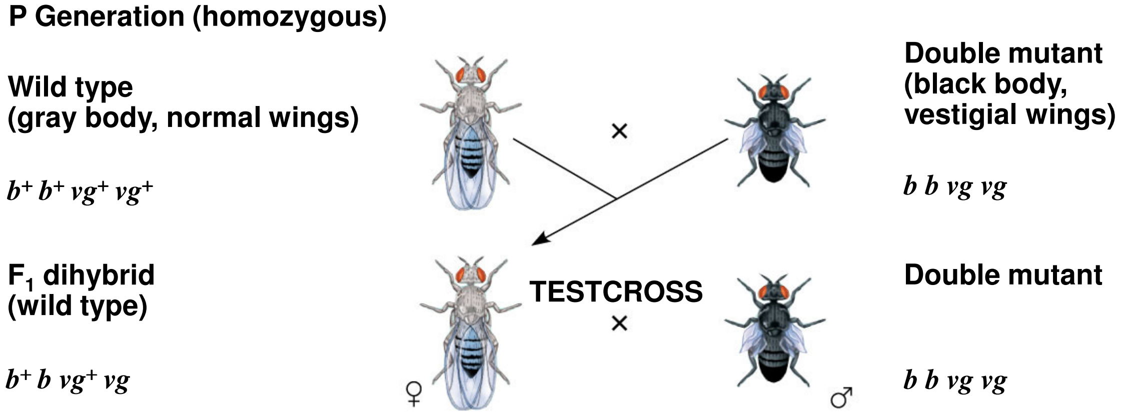


Figure 15.9-3

EXPERIMENT

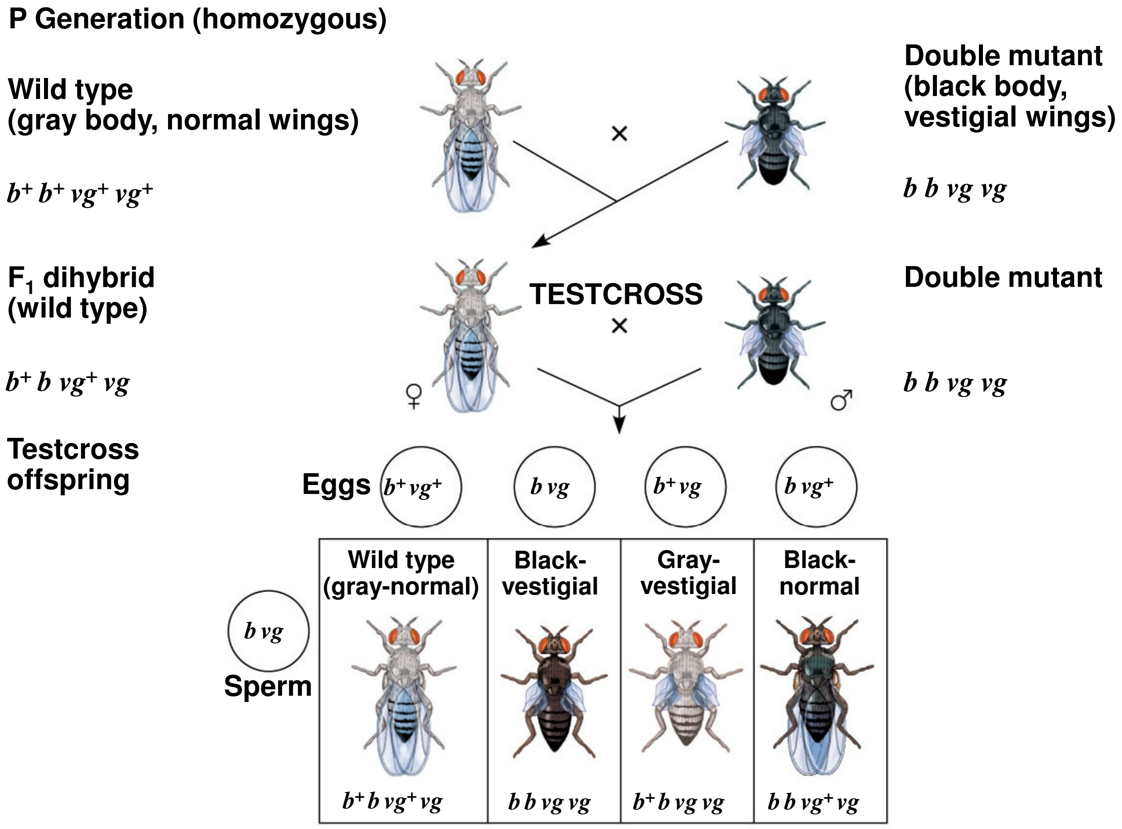
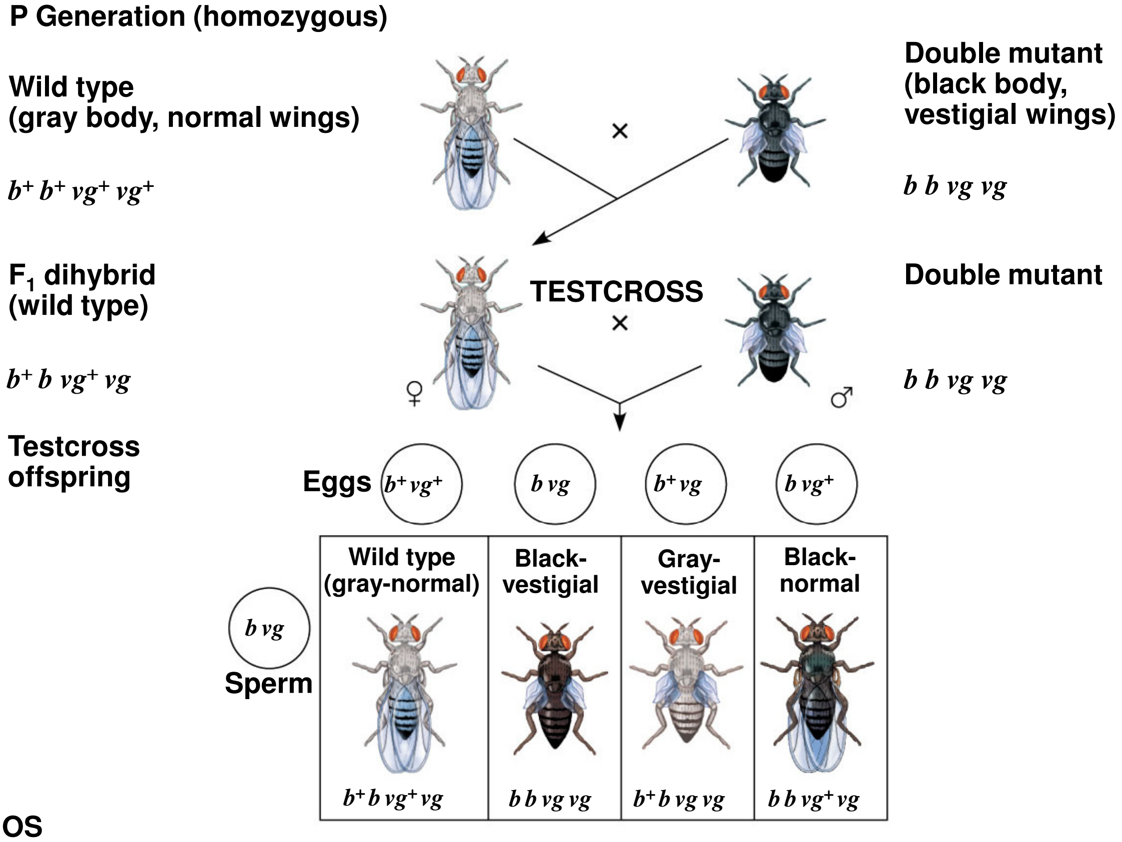


Figure 15.9-4

EXPERIMENT



PREDICTED RATIOS

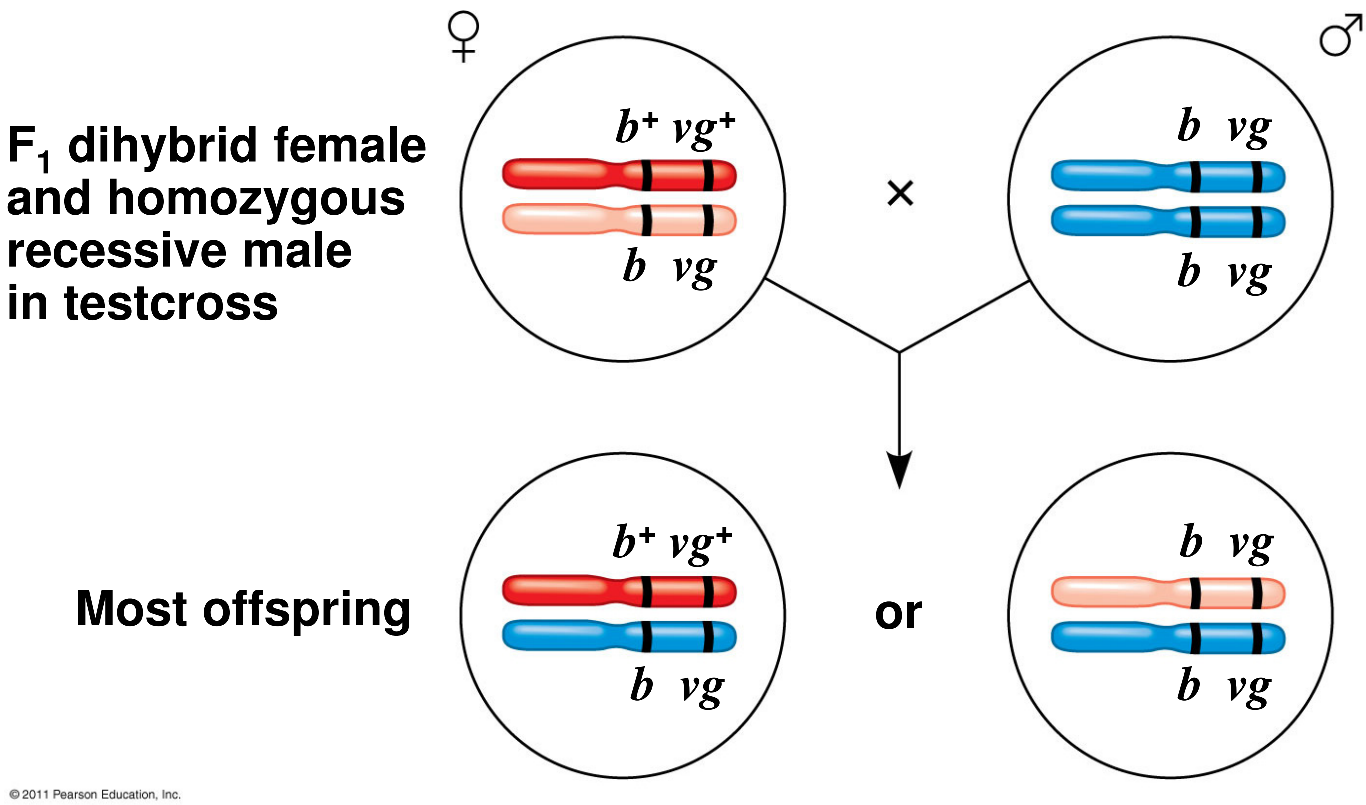
If genes are located on different chromosomes:	1	:	1	:	1	:	1
If genes are located on the same chromosome *and* parental alleles are always inherited together:	1	:	1	:	0	:	0
RESULTS	965	:	944	:	206	:	185

Concept 15.3: Linked genes tend to be inherited together because they are located near each other on the same chromosome

- Each chromosome has hundreds or thousands of genes (except the Y chromosome)
- Genes located on the same chromosome that tend to be inherited together are called **linked genes**
- This against law of independent assortment
- Linked genes may not necessary close to each other on chromosomes

- Morgan found that body color and wing size are usually inherited together in specific combinations (parental phenotypes)
- He noted that these genes do not assort independently, and reasoned that they were on the same chromosome

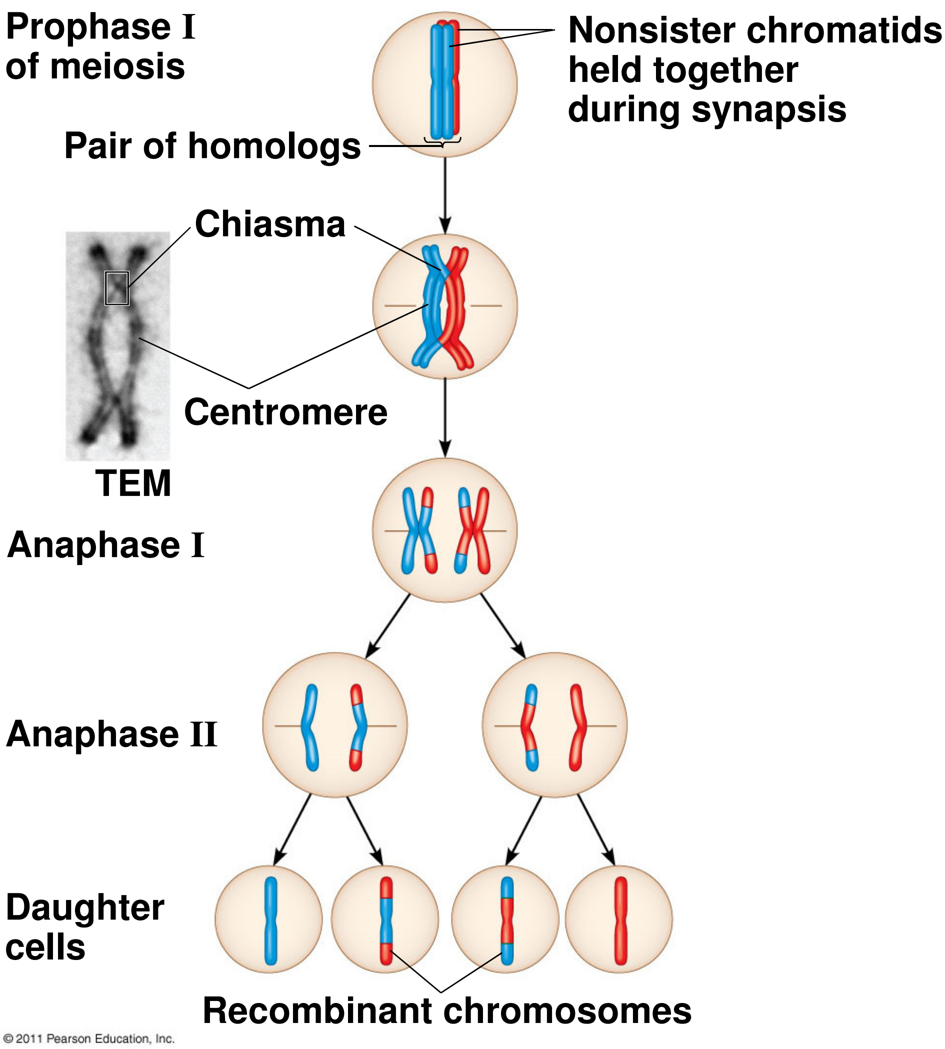
Figure 15.UN01



Genetic Recombination and Linkage

- However, nonparental phenotypes were also produced
- Understanding this result involves exploring **genetic recombination**, the production of offspring with combinations of traits differing from either parent
- The genetic findings of Mendel and Morgan relate to the chromosomal basis of recombination
- That mechanism was the **crossing over** of homologous chromosomes

Figure 13.11-5



Recombination of Unlinked Genes: Independent Assortment of Chromosomes

- Mendel observed that combinations of traits in some offspring differ from either parent
- Offspring with a phenotype matching one of the parental phenotypes are called **parental types**
- Offspring with nonparental phenotypes (new combinations of traits) are called **recombinant types**, or **recombinants**
- A 50% frequency of recombination is observed for any two genes on different chromosomes

Figure 15.UN02

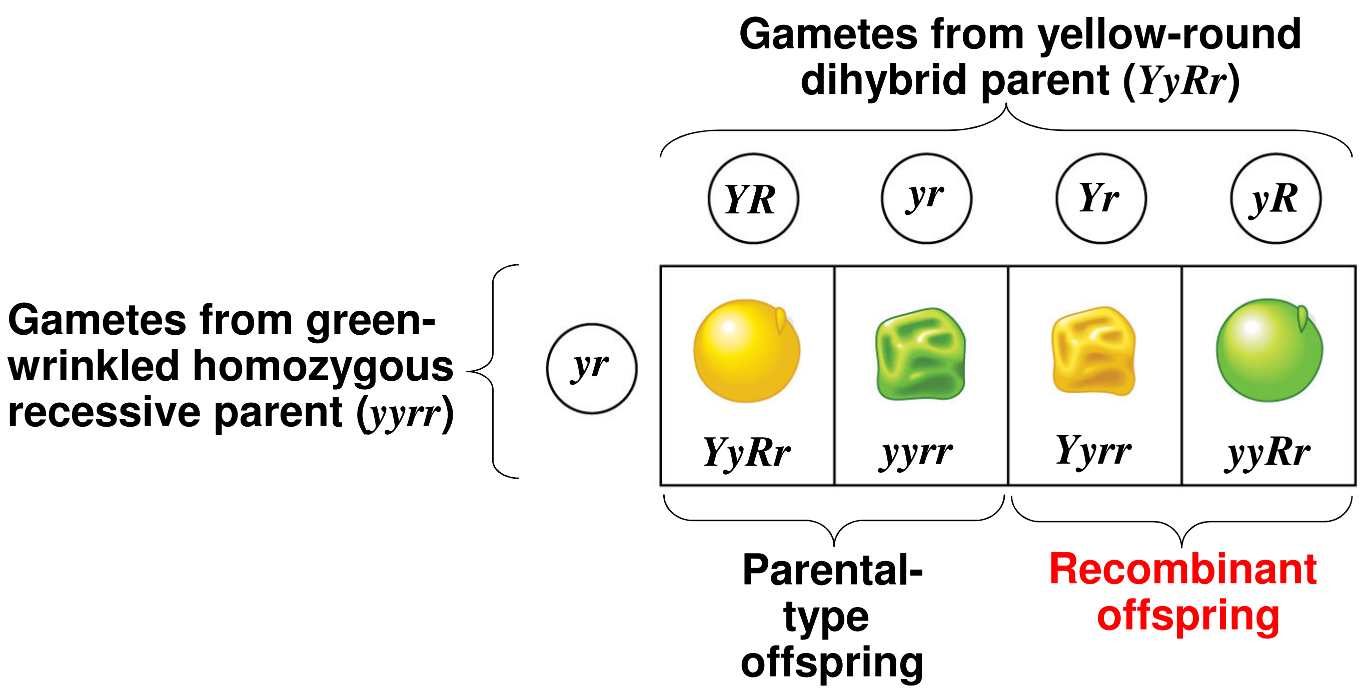


Figure 15.10a

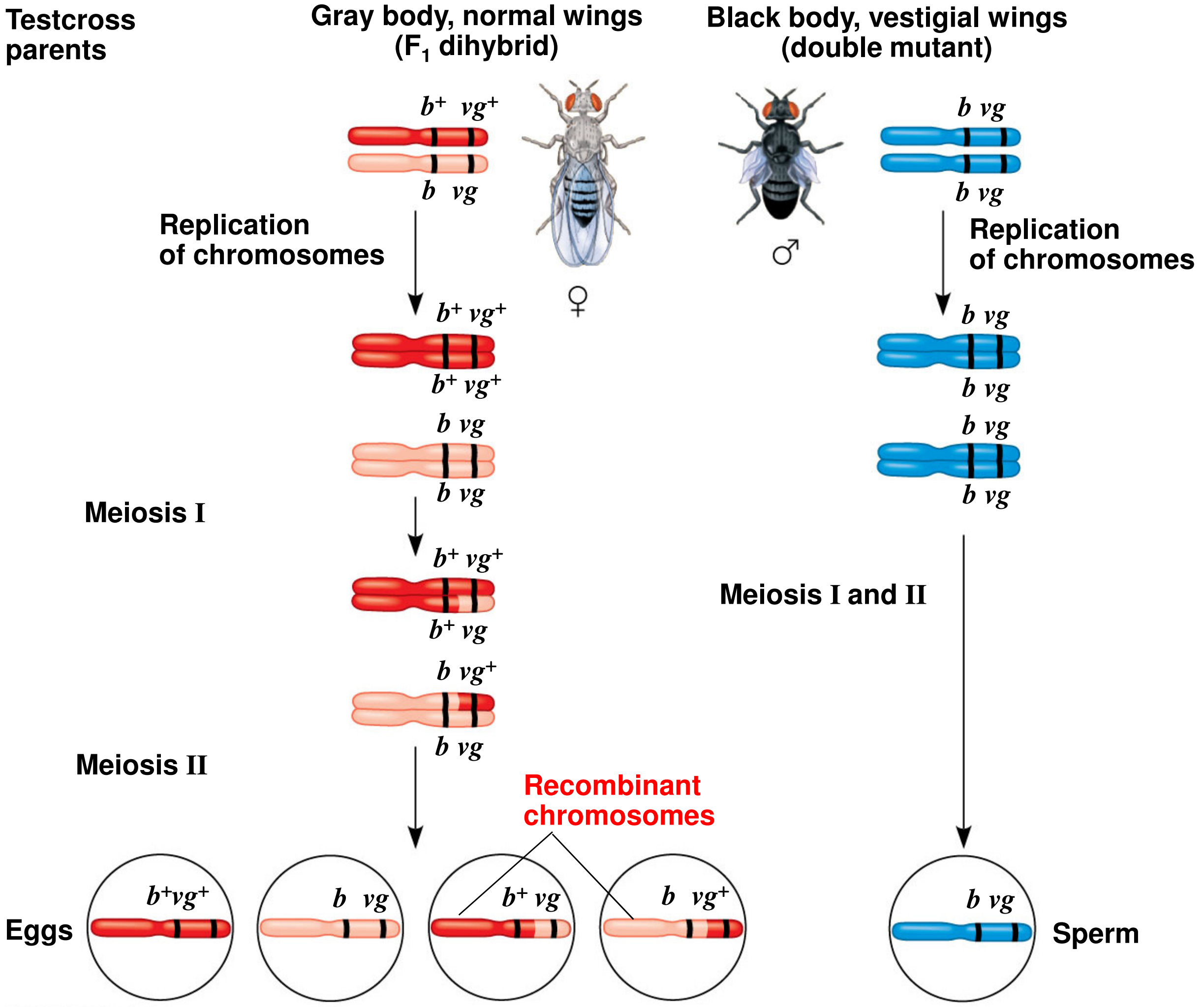
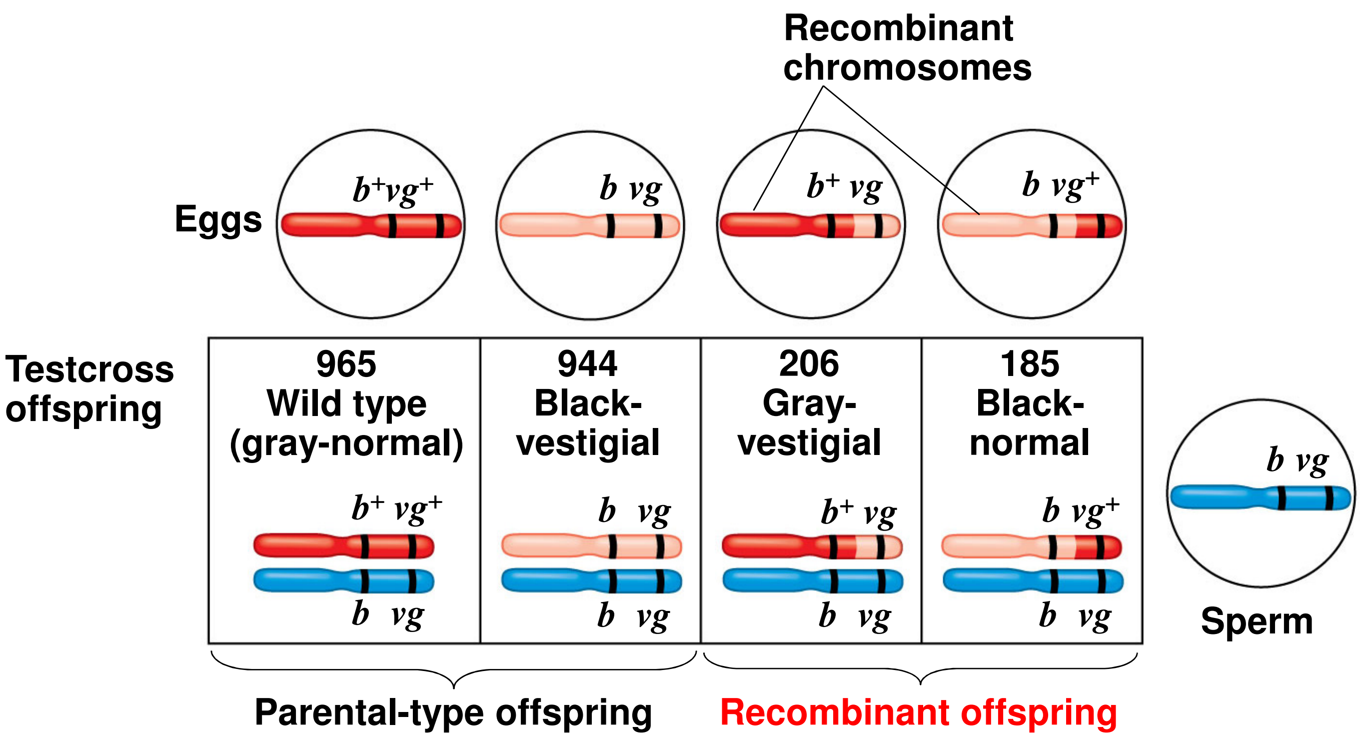


Figure 15.10b

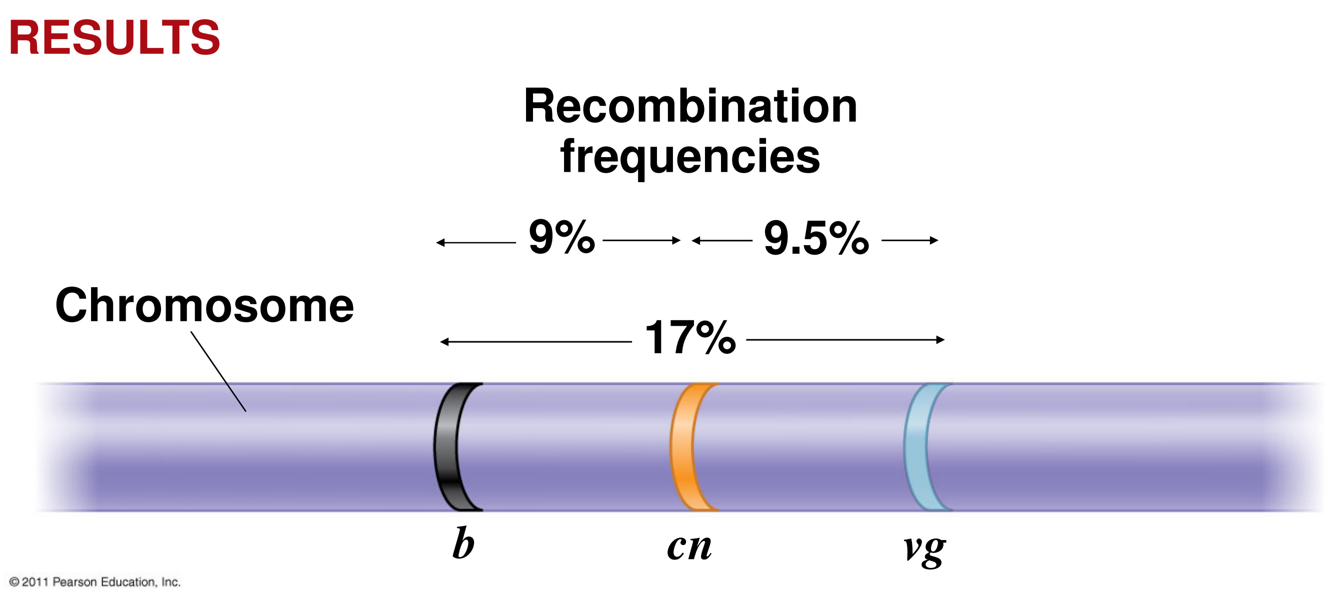


$$\text{Recombination frequency} = \frac{391 \text{ recombinants}}{2{,}300 \text{ total offspring}} \times 100 = 17\%$$

Mapping the Distance Between Genes Using Recombination Data: *Scientific Inquiry*

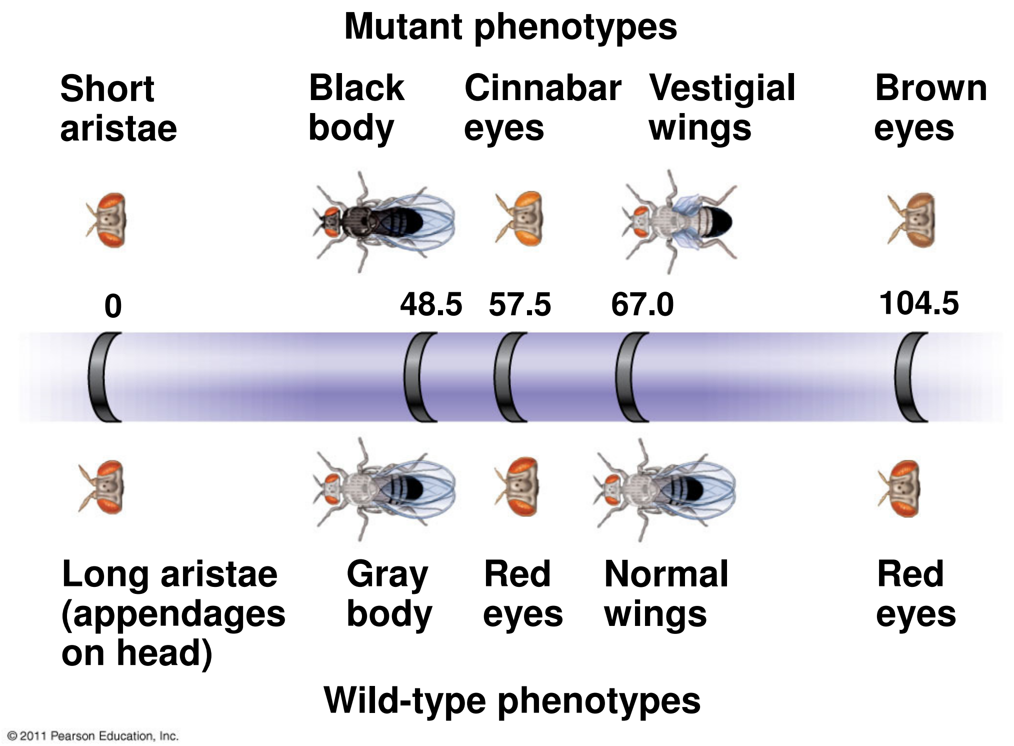
- Alfred Sturtevant, one of Morgan's students, constructed a **genetic map**, an ordered list of the genetic loci along a particular chromosome
- Sturtevant predicted that *the farther apart two genes are, the higher the probability that a crossover will occur between them and therefore the higher the recombination frequency*

Figure 15.11



- A **linkage map** is a genetic map of a chromosome based on recombination frequencies
- Distances between genes can be expressed as **map units**; one map unit, or centimorgan, represents a 1% recombination frequency
- Map units indicate relative distance and order, not precise locations of genes

Figure 15.12



Homework 15-1. Mapping the Distance Between Genes

1. Imagine a species with three loci thought to be on the same chromosome. The recombination rate between locus A and locus B is 35% and the recombination rate between locus B and locus C is 33%. Predict the recombination rate between A and C.

2.Red-green color blindness is caused by a sex-linked recessive allele. A color blind man marries a woman with normal vision whose father was color-blind. What is the probability that they will have a color-blind daughter? What is the probability that their first son will be color blind?

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 16

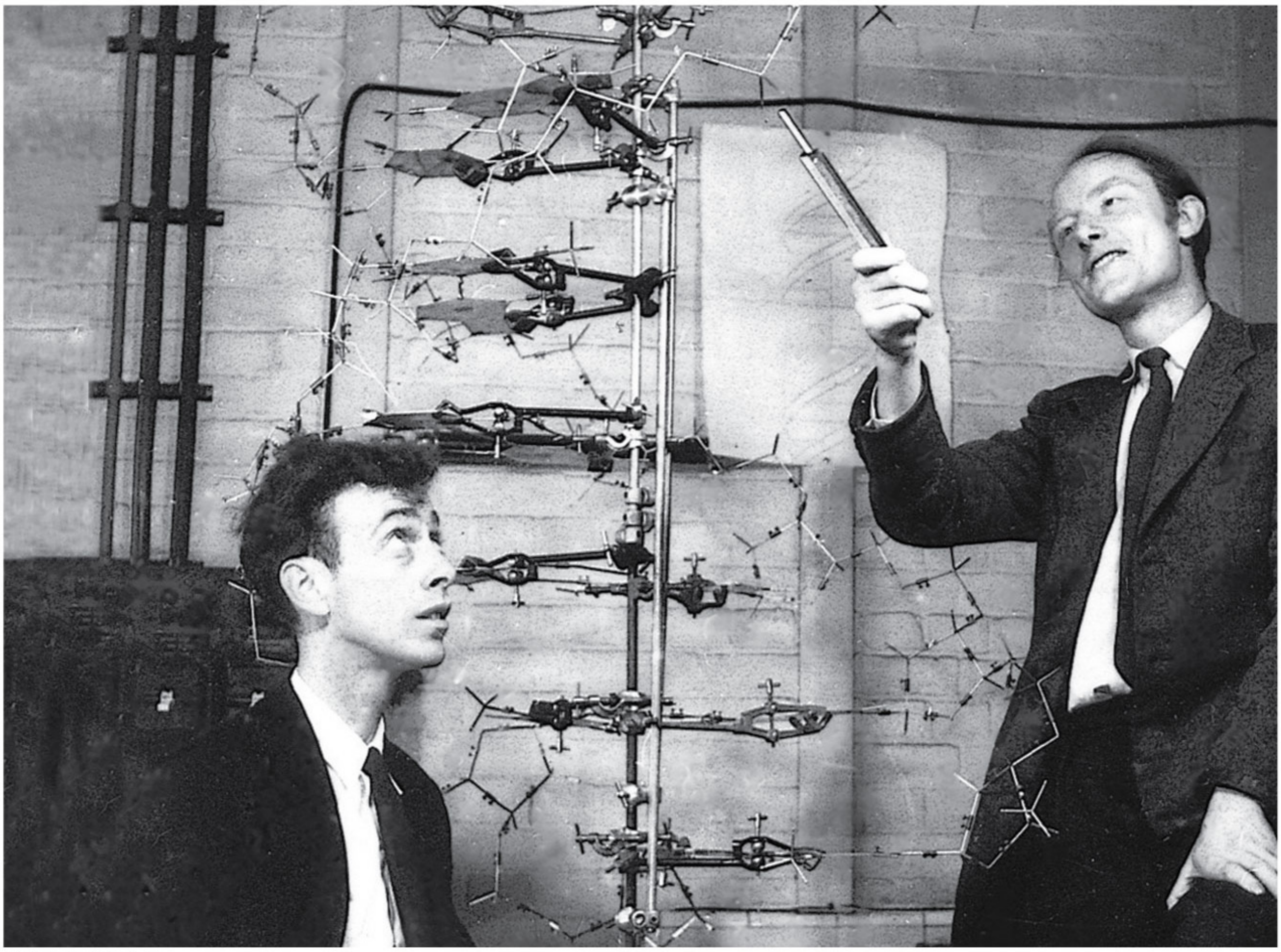
The Molecular Basis of Inheritance

Lectures by
Erin Barley
Kathleen Fitzpatrick

Overview: Life's Operating Instructions

- In 1953, James Watson and Francis Crick introduced an elegant double-helical model for the structure of deoxyribonucleic acid, or DNA
- DNA, the substance of inheritance, is the most celebrated molecule of our time
- Hereditary information is encoded in DNA and reproduced in all cells of the body
- This DNA program directs the development of biochemical, anatomical, physiological, and (to some extent) behavioral traits

Figure 16.1

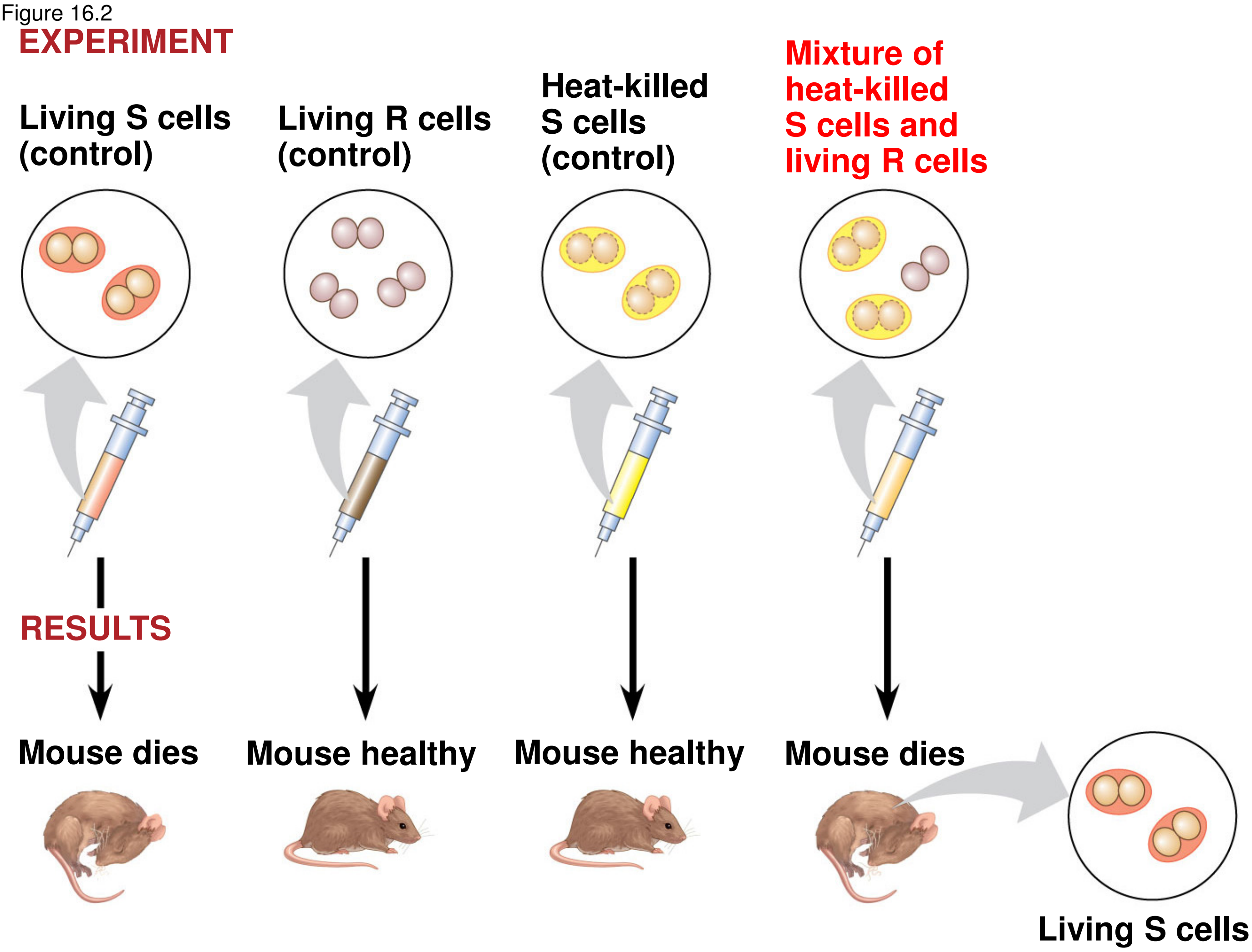


Evidence That DNA Can Transform Bacteria

- Early in the 20th century, the identification of the molecules of inheritance loomed as a major challenge to biologists
- The discovery of the genetic role of DNA began with research by Frederick Griffith in 1928
- Griffith worked with two strains of a bacterium, one pathogenic and one harmless
- When he mixed heat-killed remains of the pathogenic strain with living cells of the harmless strain, some living cells became pathogenic

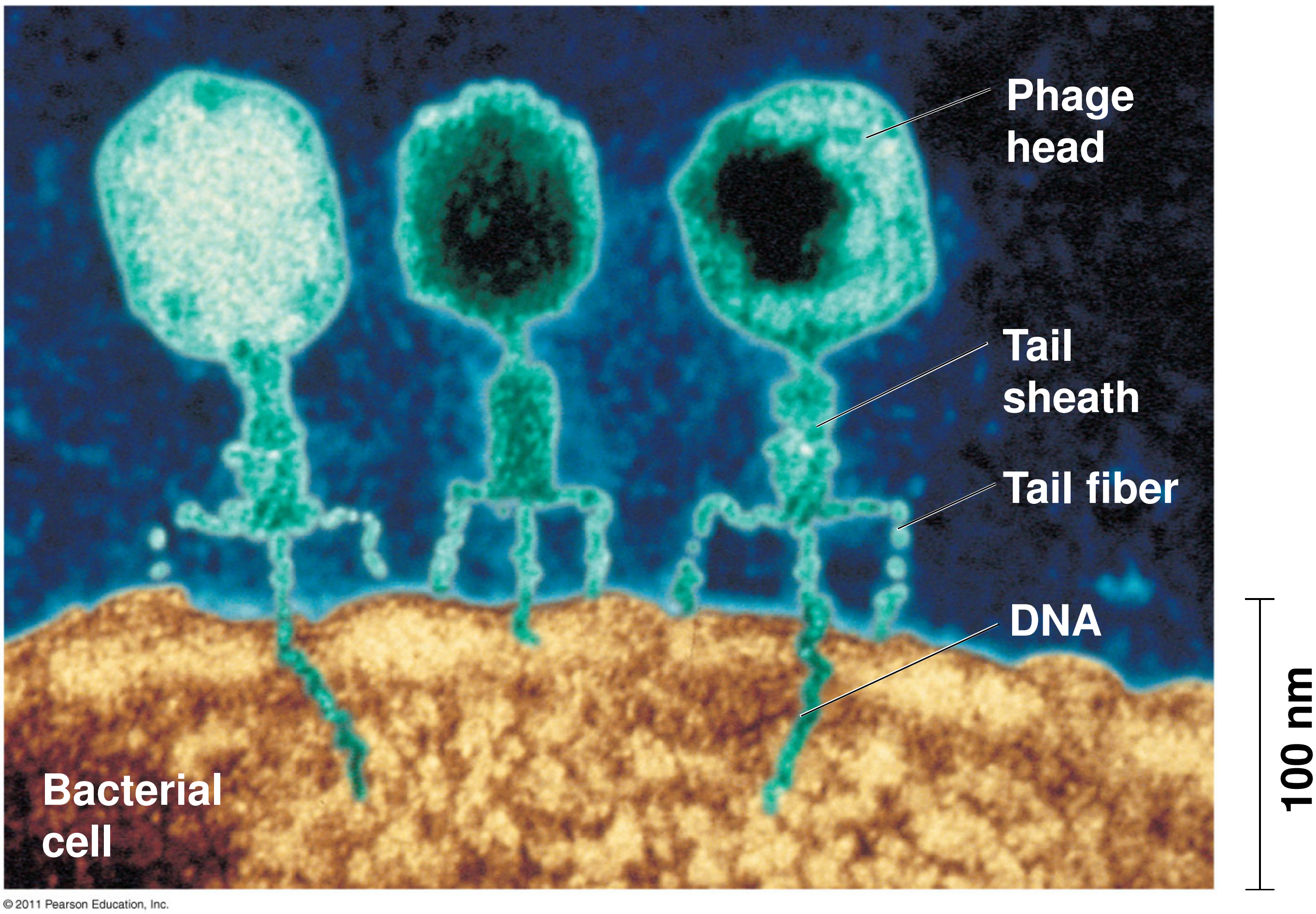
(something from killed remains transfer to harmless living cell)

Figure 16.2



- He called this phenomenon **transformation**, now defined as a change in genotype and phenotype due to assimilation of foreign DNA
- In 1944, Oswald Avery, Maclyn McCarty, and Colin MacLeod announced that the transforming substance was DNA
- Avery broke these pathogenic cells and isolate three candidate: DNA, RNA and protein, only DNA can be transformed.

Figure 16.3

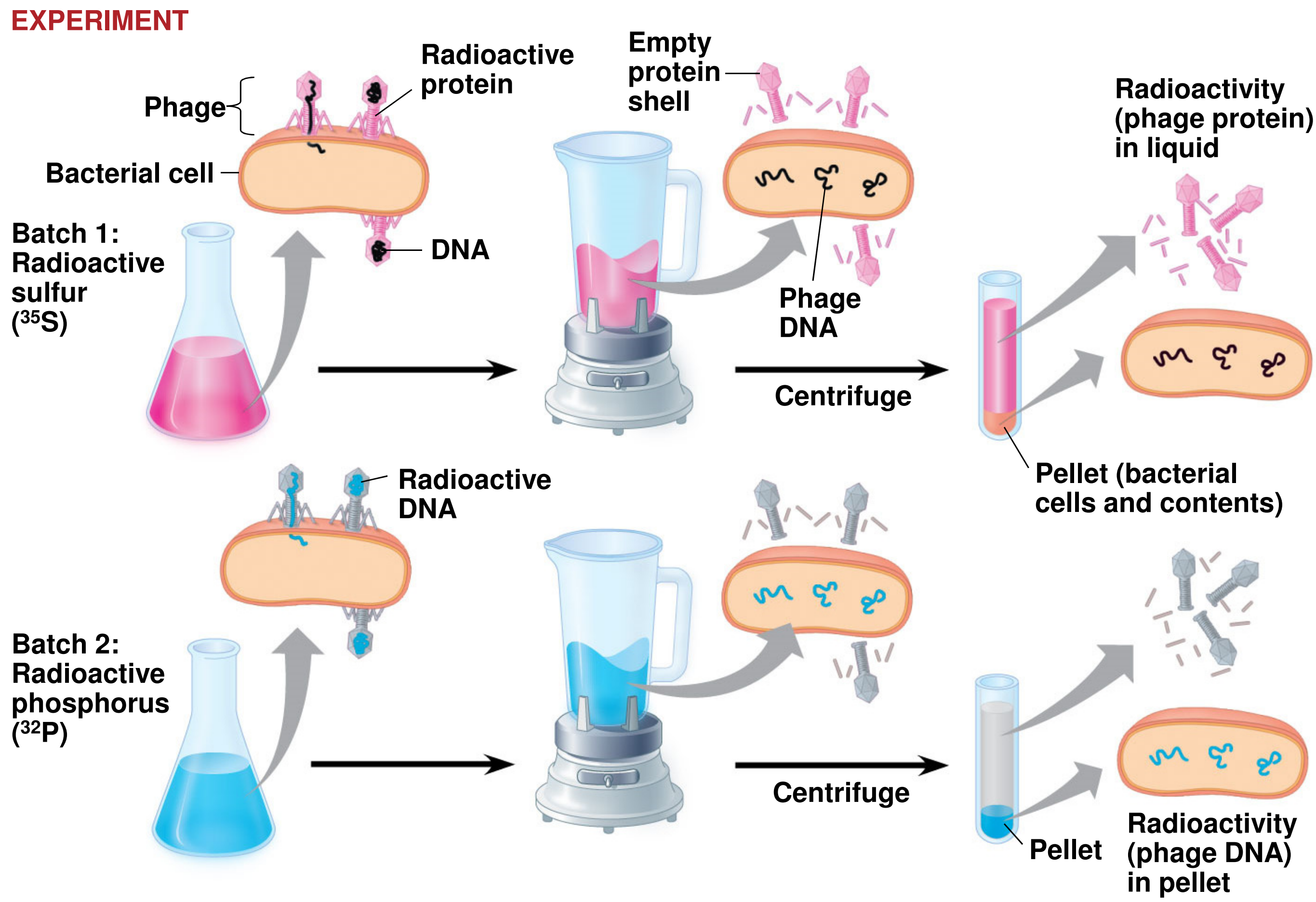


Evidence That Viral DNA Can Program Cells

- More evidence for DNA as the genetic material came from studies of viruses (**bacteriophages** or **phages**), that infect bacteria
- In 1952, Alfred Hershey and Martha Chase performed experiments showing that DNA is the genetic material of a phage known as T2
- To determine this, they designed an experiment showing that only one of the two components of T2 (DNA or protein) enters an *E. coli* cell during infection
- They concluded that the injected DNA of the phage provides the genetic information

Animation: Hershey-Chase Experiment
Right-click slide / select "Play"

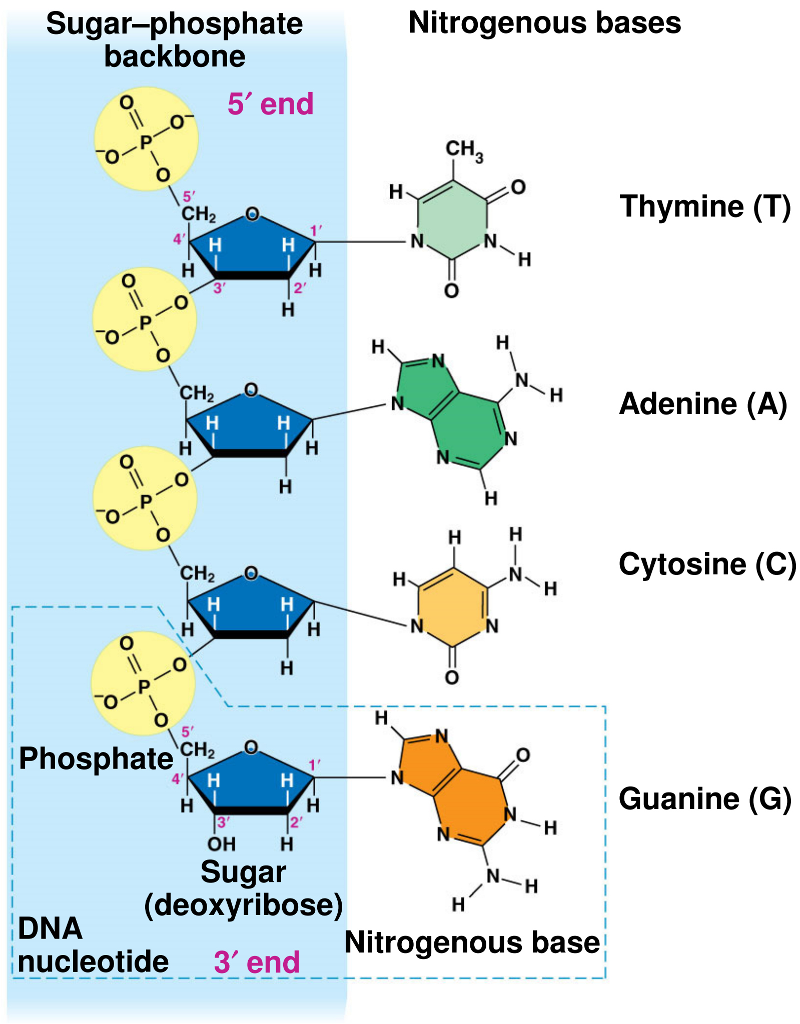
Figure 16.4-3



Additional Evidence That DNA Is the Genetic Material

- It was known that DNA is a polymer of nucleotides, each consisting of a nitrogenous base, a sugar, and a phosphate group
- In 1950, Erwin Chargaff reported Two findings became known as **Chargaff's rules**
  – The base composition of DNA varies between species (human: A, T=30.3%; G, C=19.7%)
  – In any species the number of A and T bases are equal and the number of G and C bases are equal

Figure 16.5

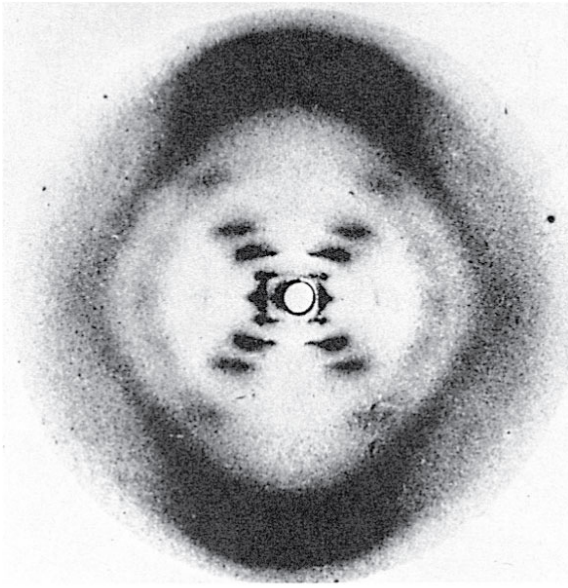


Building a Structural Model of DNA: *Scientific Inquiry*

- After DNA was accepted as the genetic material, the challenge was to determine how its structure accounts for its role in heredity
- Maurice Wilkins and Rosalind Franklin were using a technique called X-ray crystallography to study molecular structure
- Franklin's X-ray crystallographic images of DNA enabled Watson to deduce that DNA was helical

Figure 16.6

(a) Rosalind Franklin



(b) Franklin's X-ray diffraction photograph of DNA

Died in 1958, at the age of 38

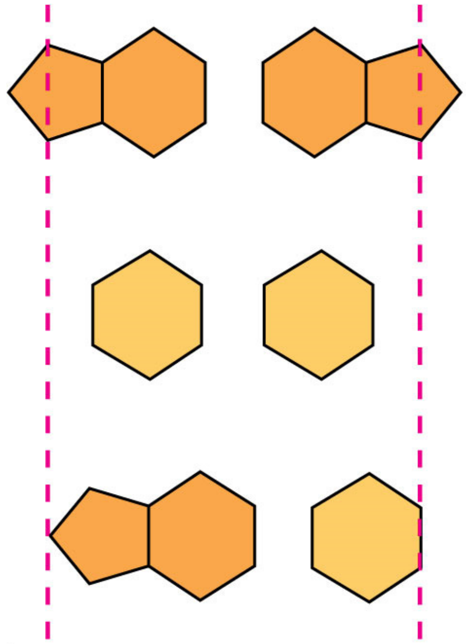
DNA was helical

- Franklin's unpublished work indicated:

1. Sugar-phosphate (negatively charged) backbones were outside (hydrophobic nitrogenous base interior away from the surrounding aqueous solution)
2. Watson suggested two backbones are **antiparallel** (allowing nitrogen inside)
3. One full turn of helix (with 10 base pairs) is 3.4 nm long and 2 nm in diameter
4. Double helix had a uniform diameter so purine and pyrimidine must pairing (Chargaff's rules)

- The pattern in the photo suggested that the DNA molecule was made up of two strands, forming a **double helix**

Figure 16.UN01

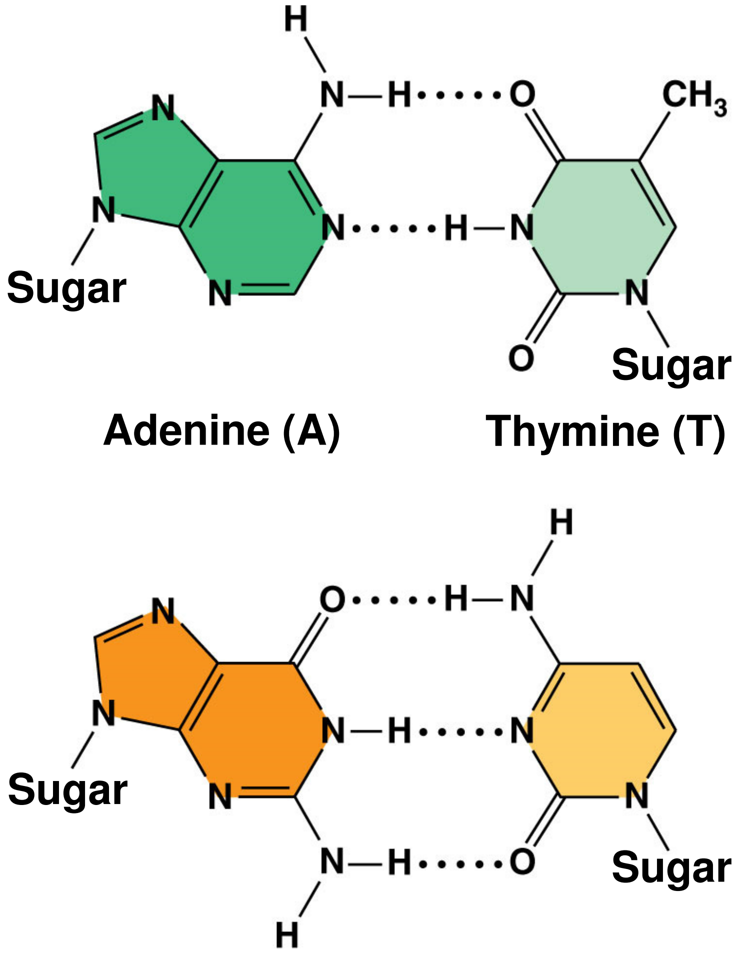


Purine + purine: too wide

Pyrimidine + pyrimidine: too narrow

Purine + pyrimidine: width consistent with X-ray data

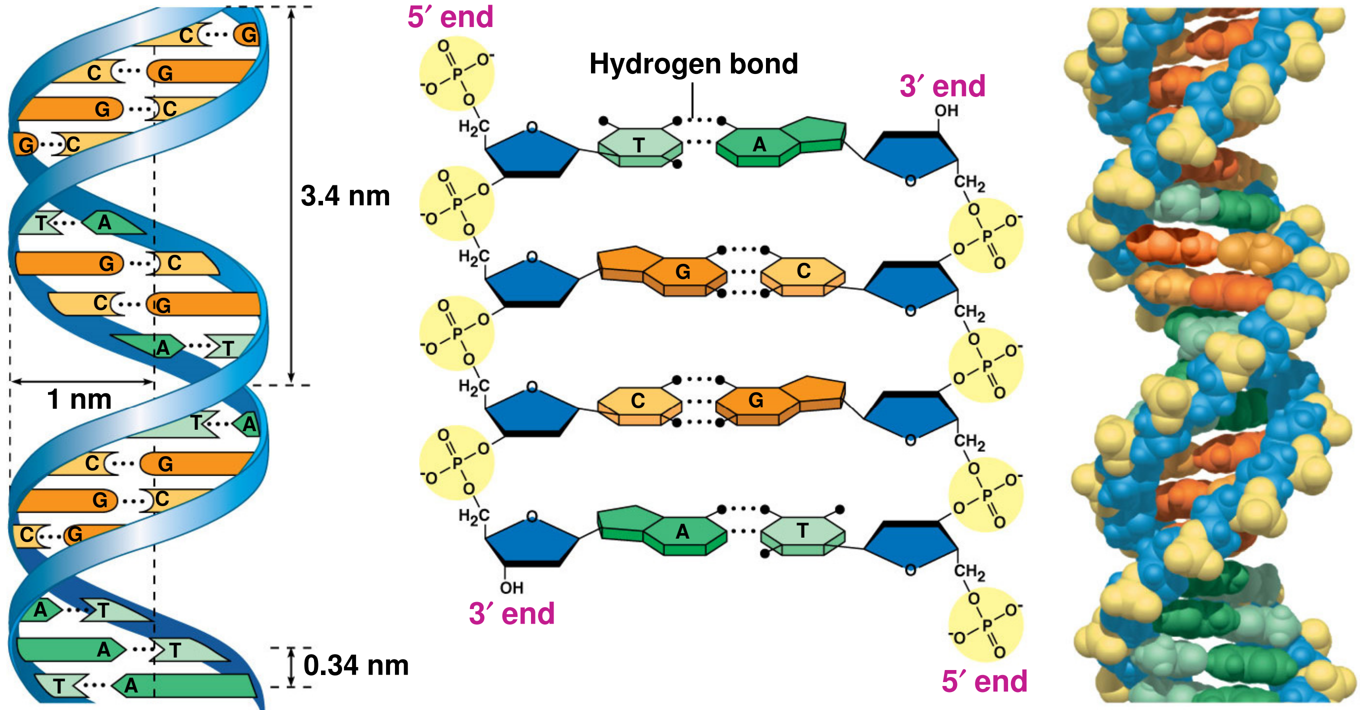
Figure 16.8



Adenine (A) **Thymine (T)**

Guanine (G) **Cytosine (C)**

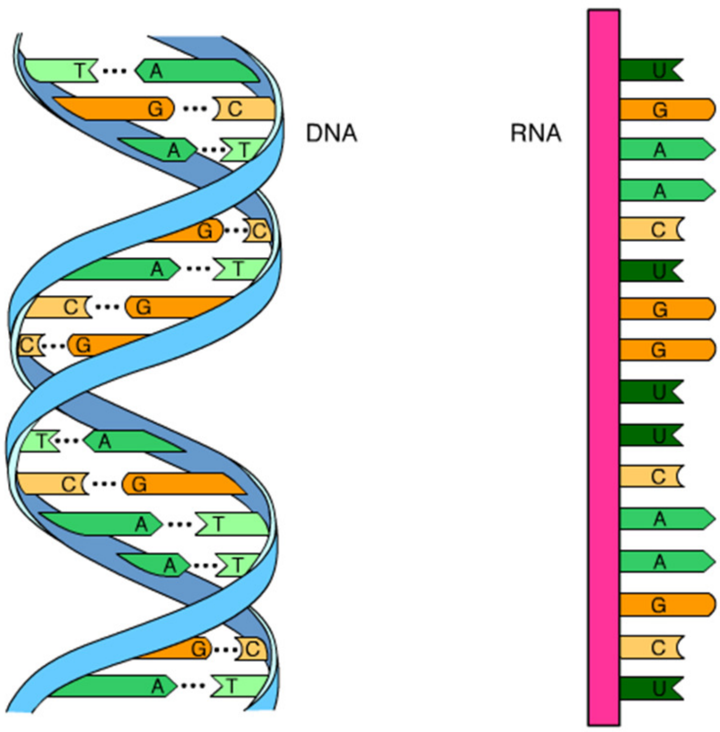
Figure 16.7



(a) Key features of DNA structure

(b) Partial chemical structure

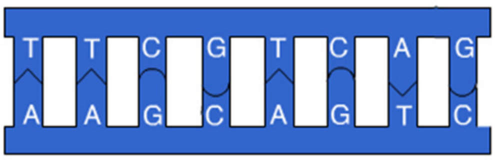
(c) Space-filling model



Animation: DNA and RNA Structure
Right-click slide / select "Play"

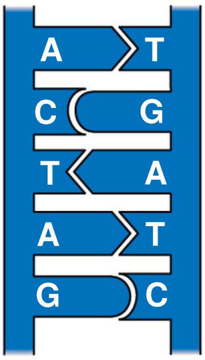
Concept 16.2: Many proteins work together in DNA replication and repair

- The relationship between structure and function is manifest in the double helix
- Watson and Crick noted that the specific base pairing suggested a possible copying mechanism for genetic material
- Since the two strands of DNA are complementary, each strand acts as a template for building a new strand in replication



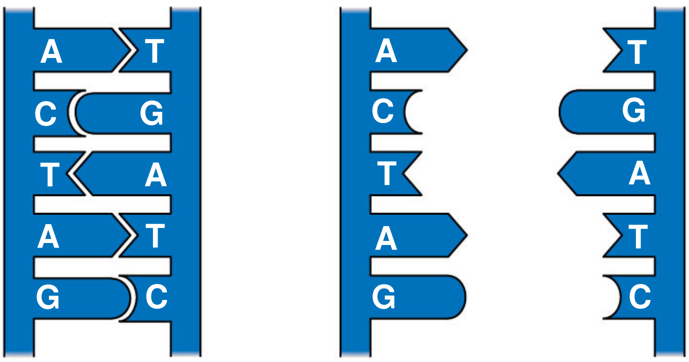
Animation: DNA Replication Overview
Right-click slide / select "Play"

Figure 16.9-1



(a) Parent molecule

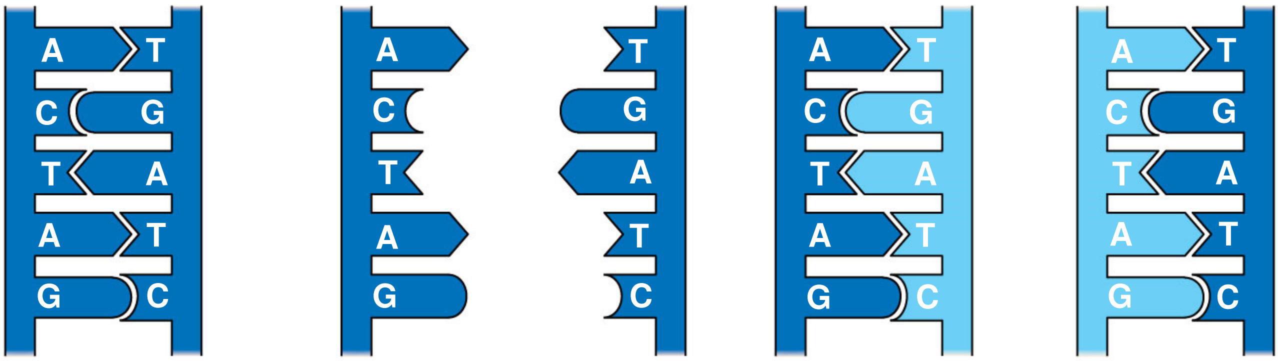
Figure 16.9-2



(a) Parent molecule

(b) Separation of strands

Figure 16.9-3



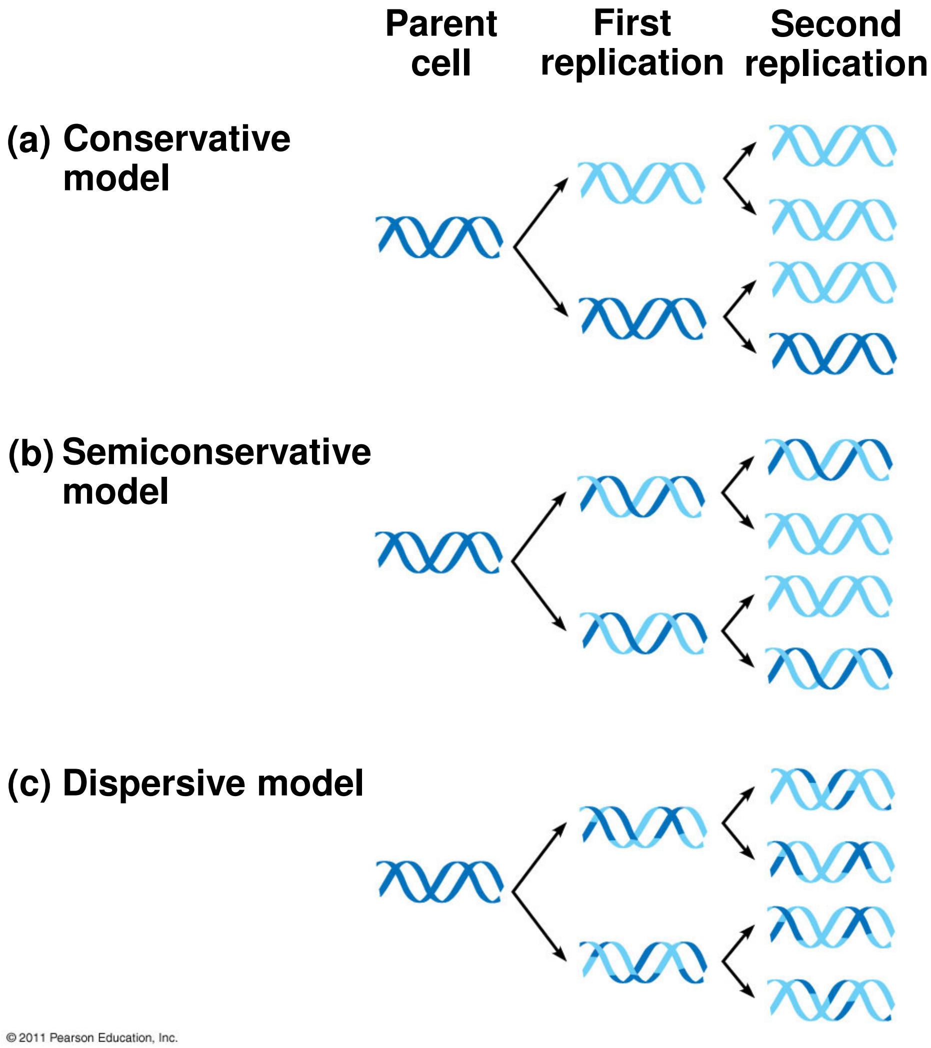
(a) Parent molecule

(b) Separation of strands

(c) "Daughter" DNA molecules, each consisting of one parental strand and one new strand

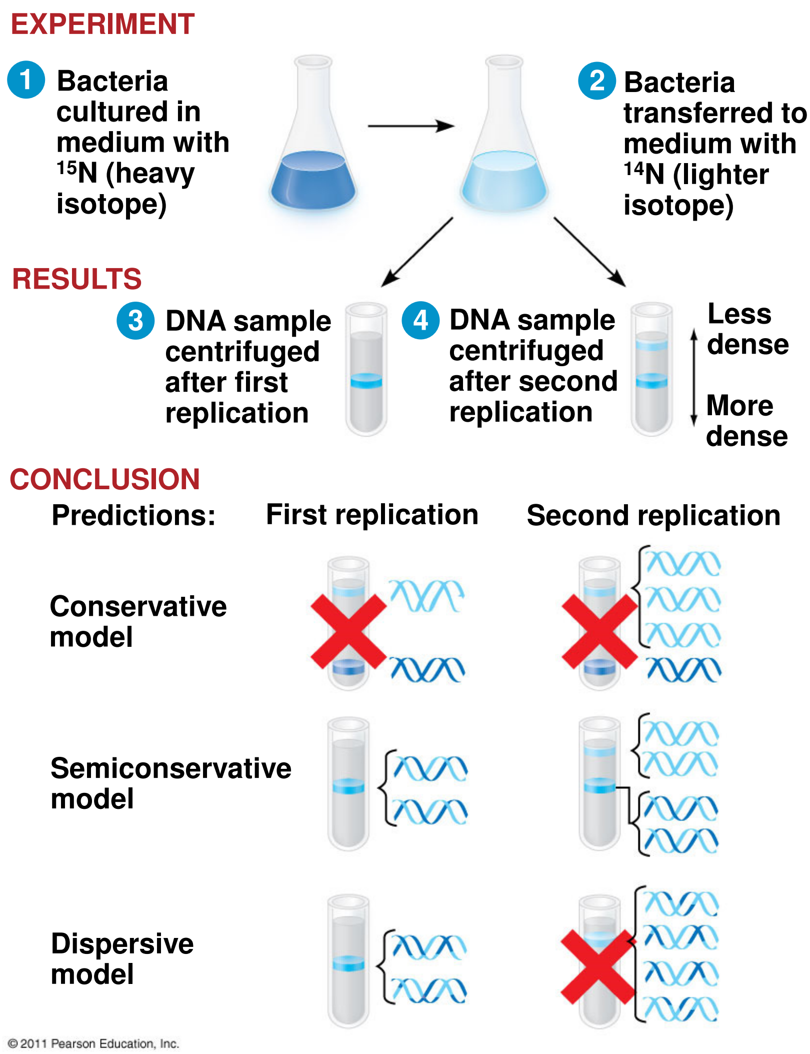
- Watson and Crick's **semiconservative model** (their second paper) of replication predicts that when a double helix replicates, each daughter molecule will have one old strand (derived or "conserved" from the parent molecule) and one newly made strand
- Competing models were the conservative model (the two parent strands rejoin) and the dispersive model (each strand is a mix of old and new)
- This model of DNA replication remained untested for several years.

Figure 16.10



- Experiments by Matthew Meselson and Franklin Stahl supported the semiconservative model
- They labeled the nucleotides of the old strands with a heavy isotope of nitrogen, while any new nucleotides were labeled with a lighter isotope
- The first replication produced a band of hybrid DNA, eliminating the conservative model
- A second replication produced both light and hybrid DNA, eliminating the dispersive model and supporting the semiconservative model

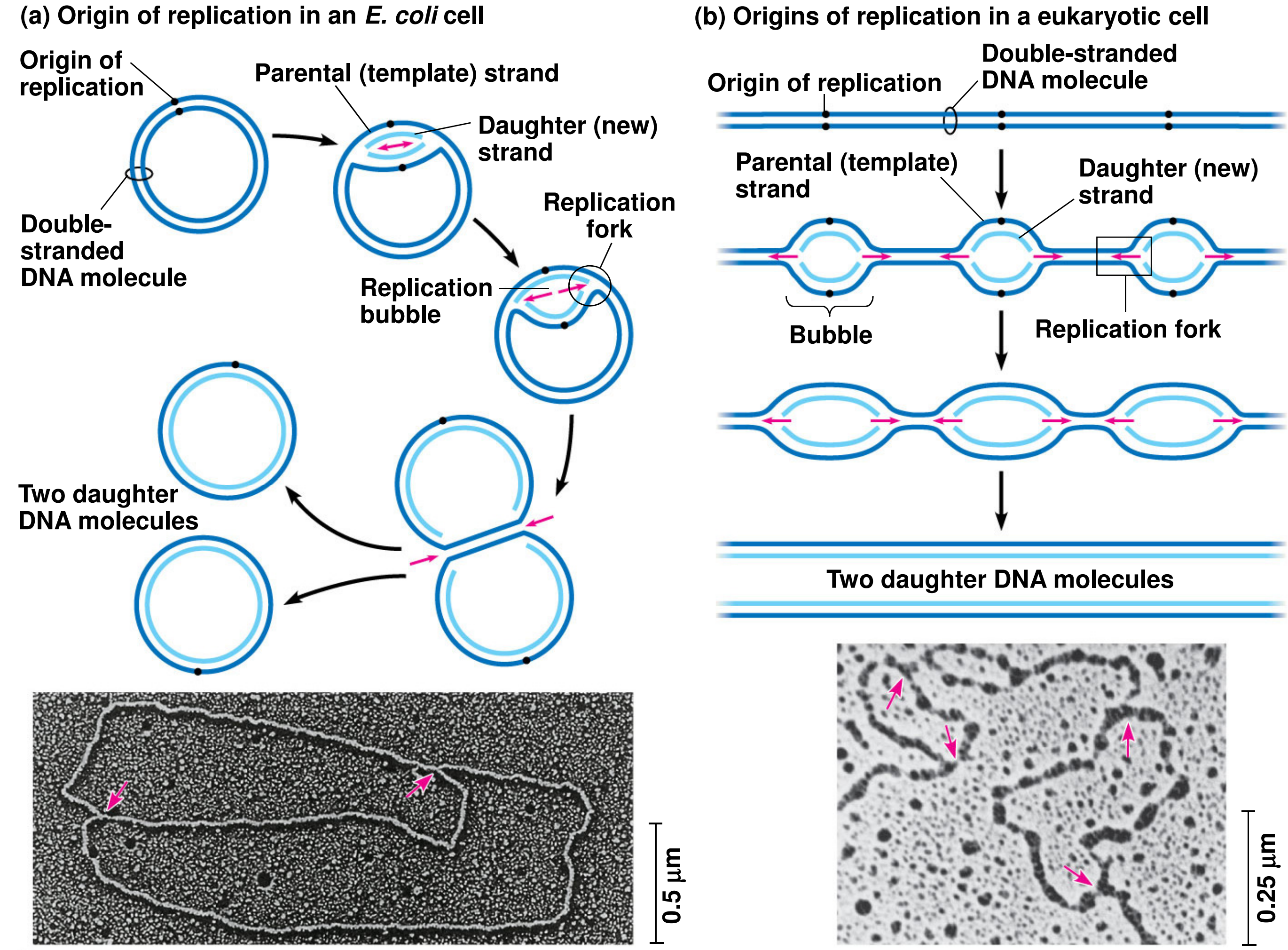
Figure 16.11



DNA Replication: *A Closer Look*

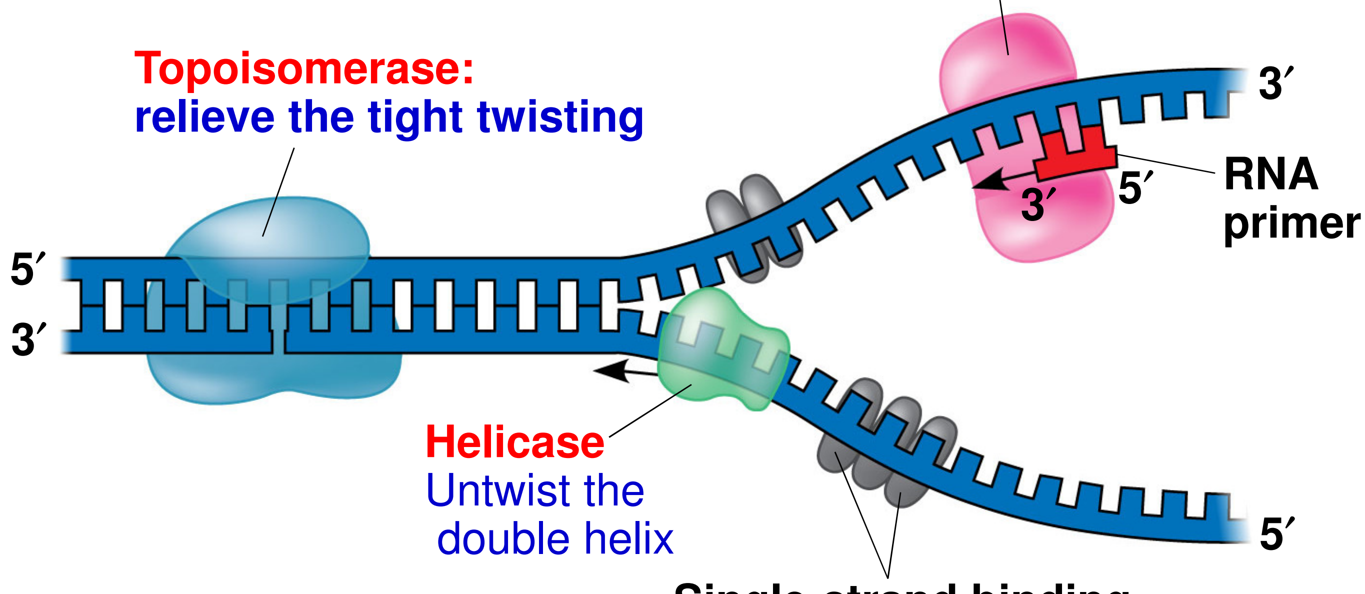
- The copying of DNA is remarkable in its speed and accuracy (4.6 million nucleotide replication < 1 hr)
- Replication begins at particular sites called **origins of replication**, where the two DNA strands are separated, opening up a replication "bubble" (TEM images)
- A eukaryotic chromosome may have hundreds or even thousands of origins of replication
- Replication proceeds in both directions from each origin, until the entire molecule is copied

Figure 16.12



- At the end of each replication bubble is a **replication fork**, a Y-shaped region where new DNA strands are elongating
- **Helicases** are enzymes that untwist the double helix at the replication forks
- **Single-strand binding proteins** bind to and stabilize single-stranded DNA
- **Topoisomerase** corrects “overwinding” ahead of replication forks by breaking, swiveling, and rejoining DNA strands

Figure 16.13



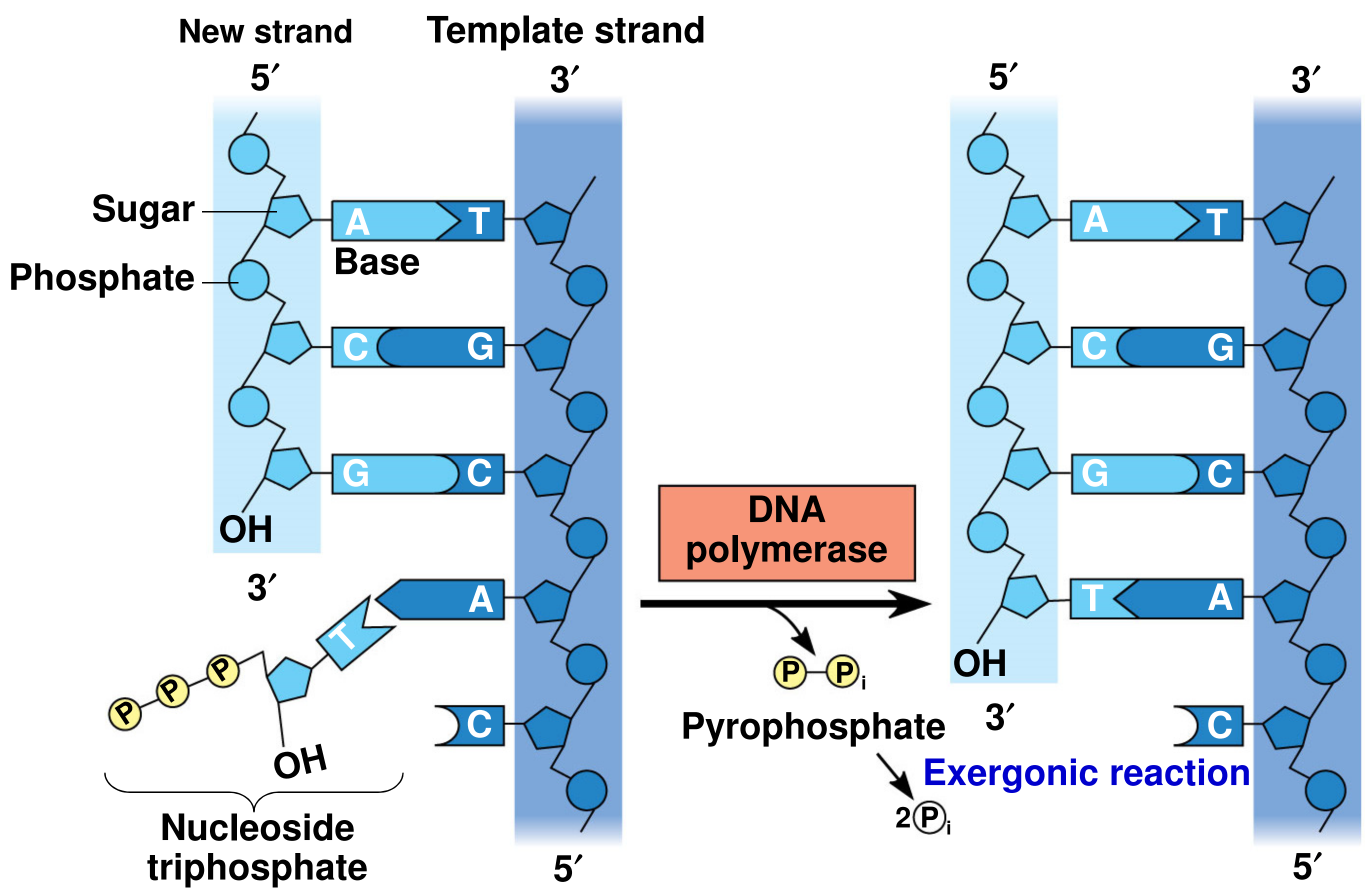
- DNA polymerases cannot initiate synthesis of a polynucleotide; they can only add nucleotides to the 3′ end
- The initial nucleotide strand is a short RNA **primer**
- An enzyme called **primase** can start an RNA chain from scratch and adds RNA nucleotides one at a time using the parental DNA as a template
- The primer is short (5–10 nucleotides long), and the 3′ end serves as the starting point for the new DNA strand

Synthesizing a New DNA Strand

- Enzymes called **DNA polymerases** catalyze the elongation of new DNA at a replication fork
- The rate of elongation is about 500 nucleotides per second in bacteria and 50 per second in human cells
- Each nucleotide that is added to a growing DNA strand is a nucleoside triphosphate
- dATP (deoxyribose - at 2' C) supplies adenine to DNA and is similar to the ATP (ribose) of energy metabolism

exergonic

ɿure 16.14



Antiparallel Elongation

- The antiparallel structure of the double helix affects replication (only in the 5′ to 3′ direction)
- Along one template strand of DNA, the DNA polymerase synthesizes a **leading strand** continuously, moving toward the replication fork
- To elongate the other new strand, called the **lagging strand**, DNA polymerase must work in the direction away from the replication fork
- The lagging strand is synthesized as a series of segments called **Okazaki fragments**, which are joined together by **DNA ligase**

Figure 16.15

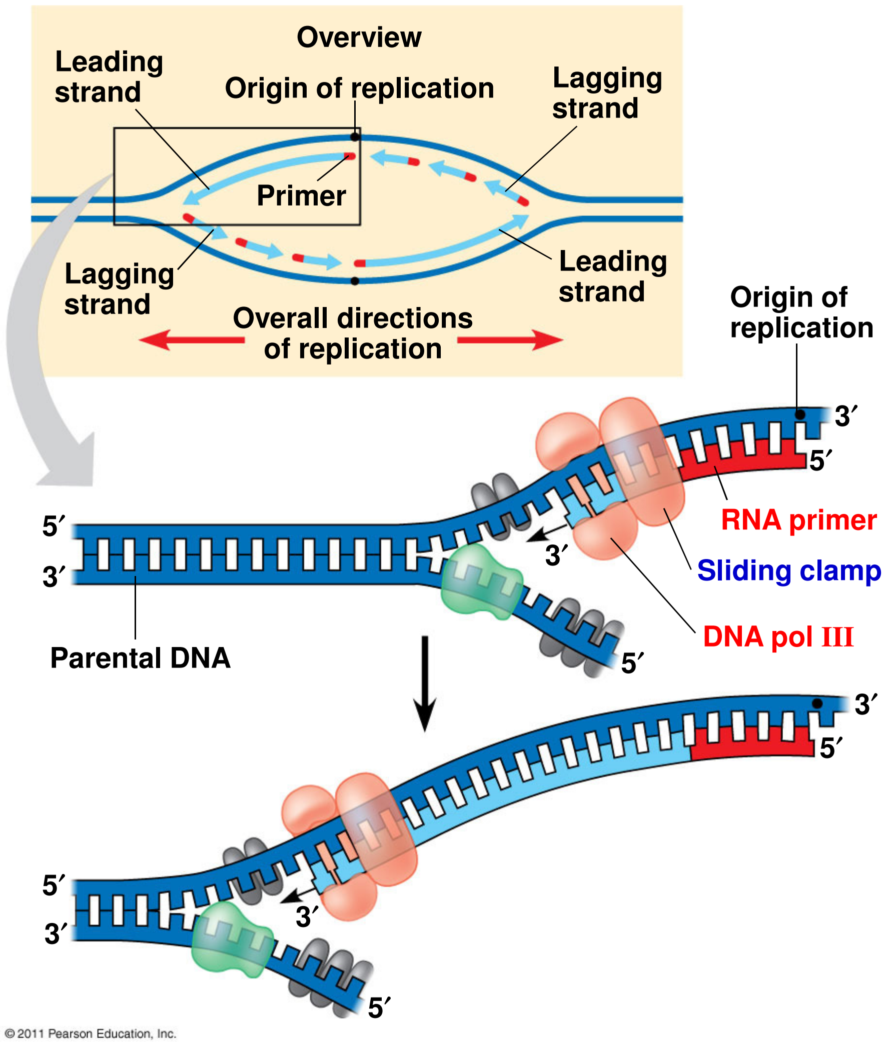


Figure 16.15a

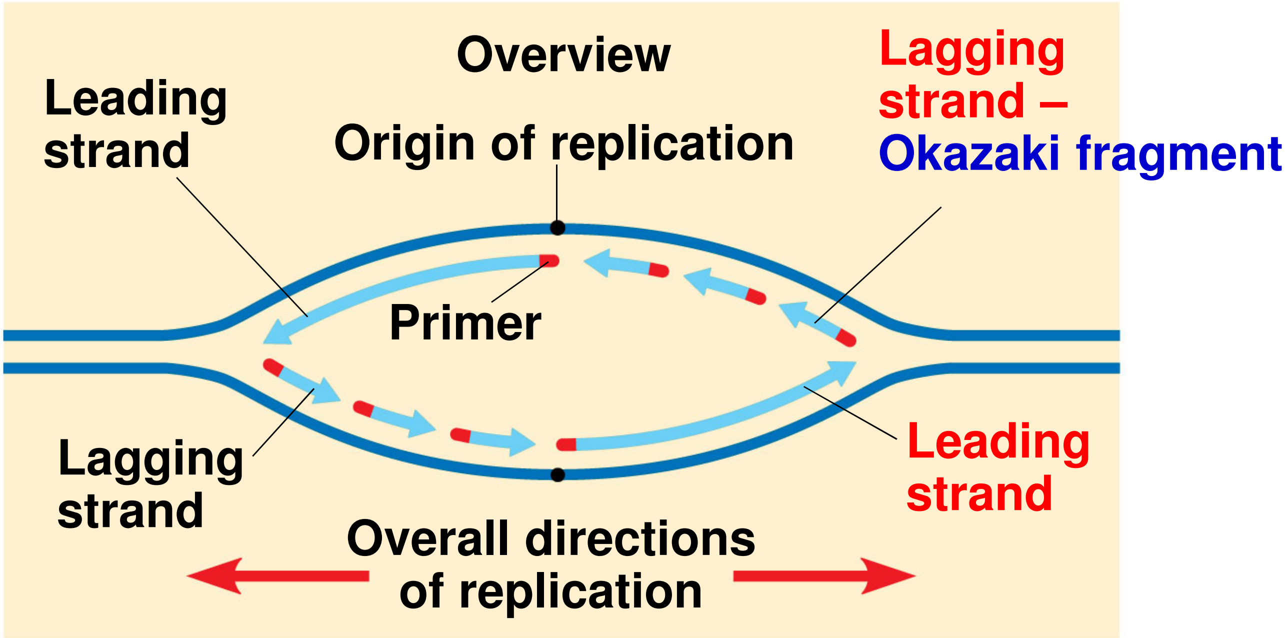


Figure 16.16

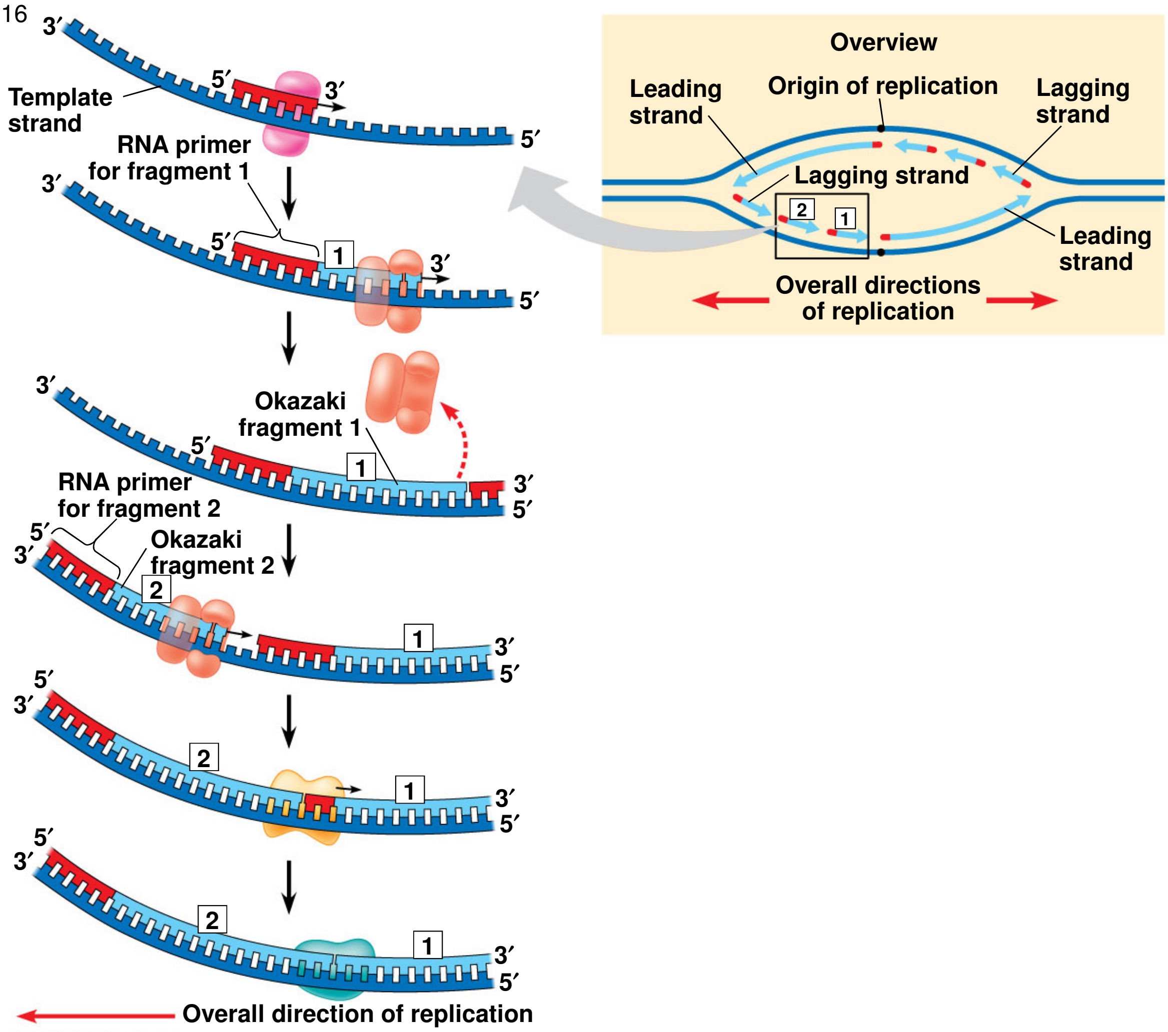
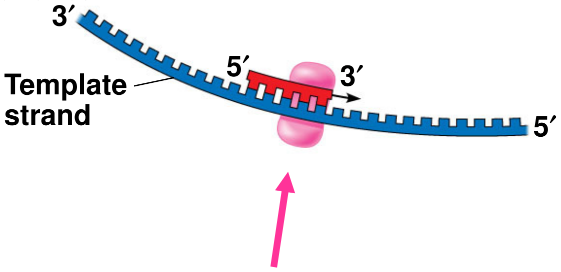


Figure 16.16b-1



Primase initiate RNA into primer

Figure 16.16b-2

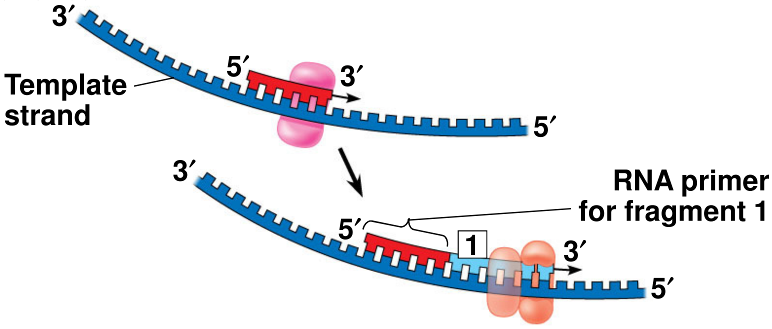
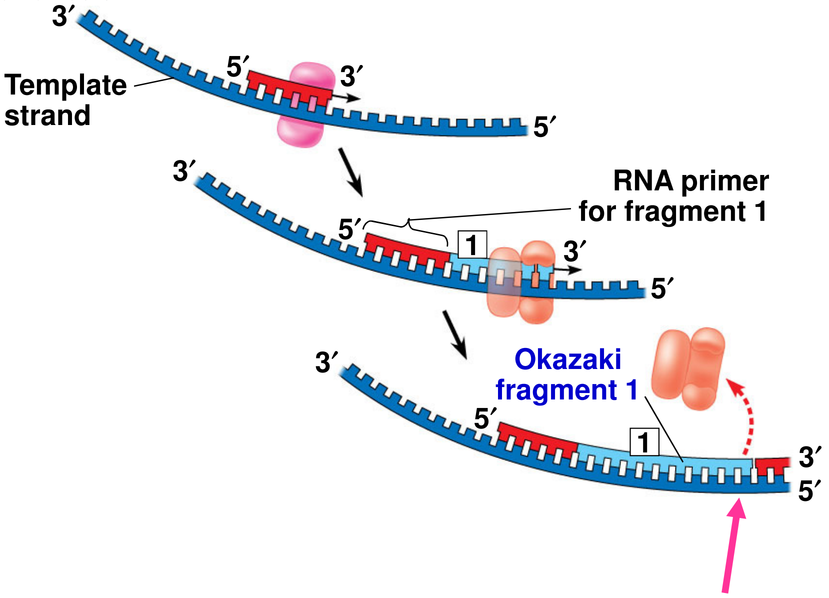


Figure 16.16b-3



DNA pol III detaches after reaching the next RNA

Figure 16.16b-4

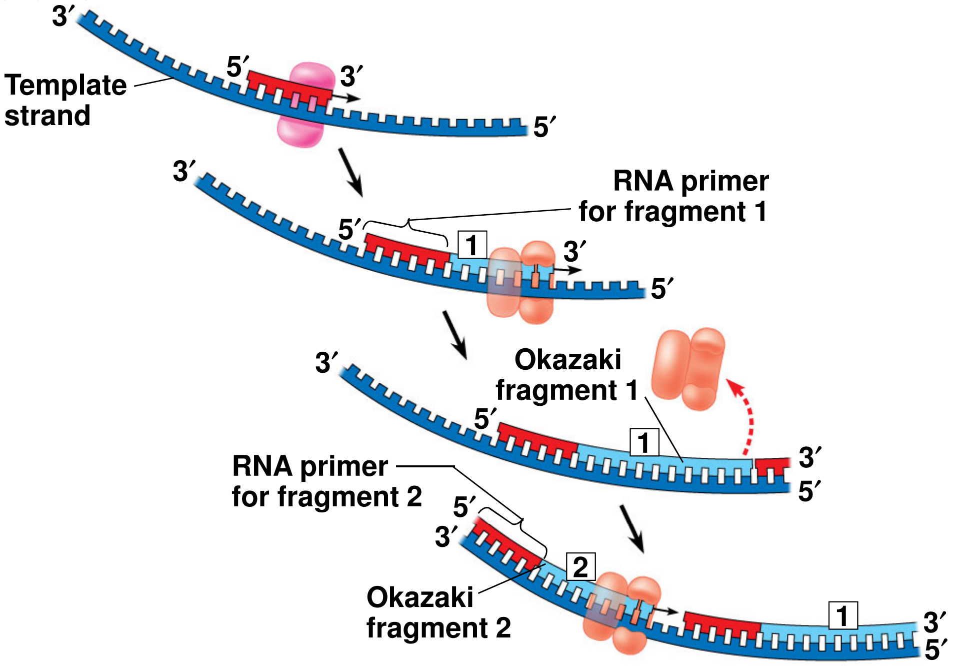


Figure 16.16b-5

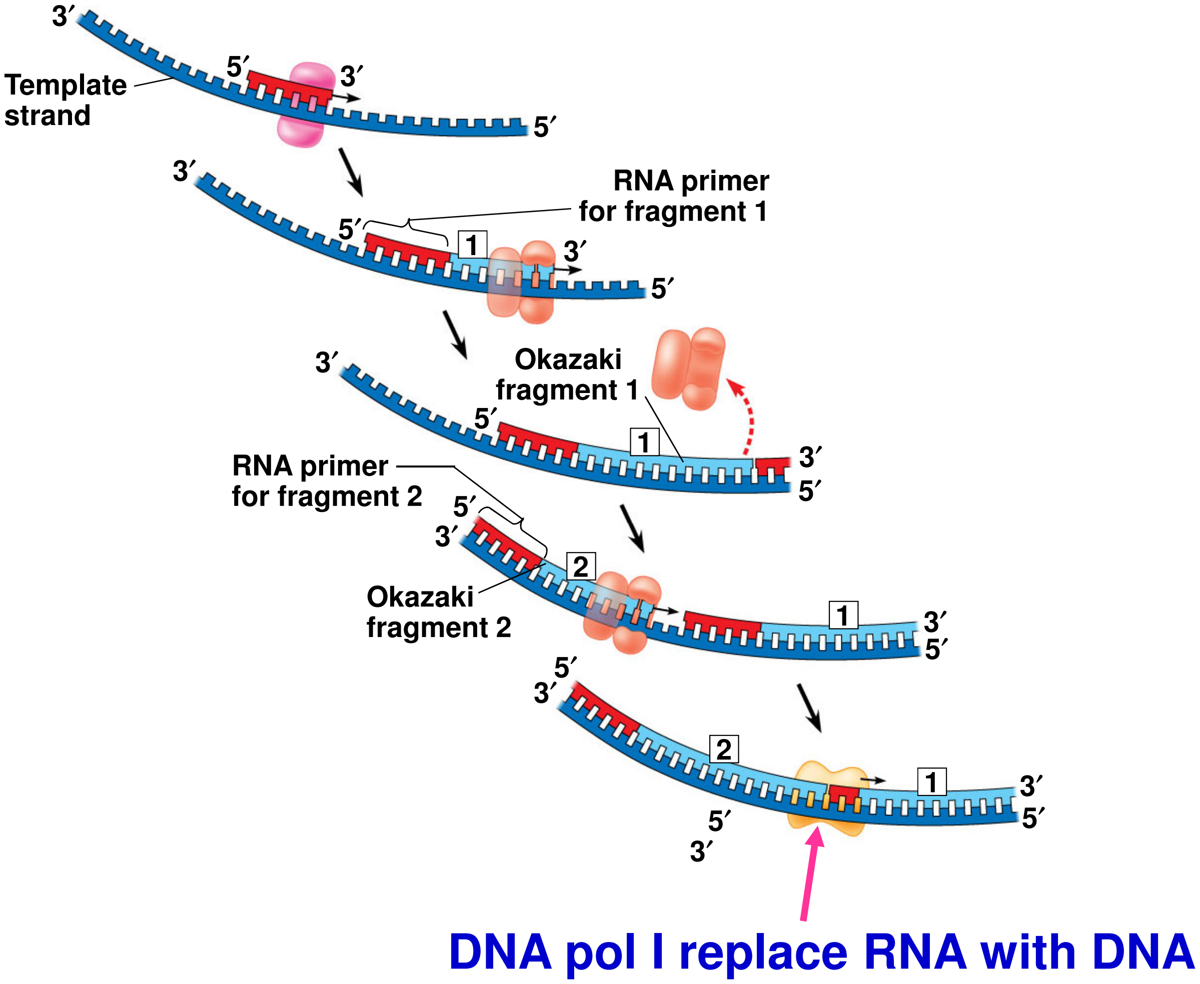


Figure 16.16b-6

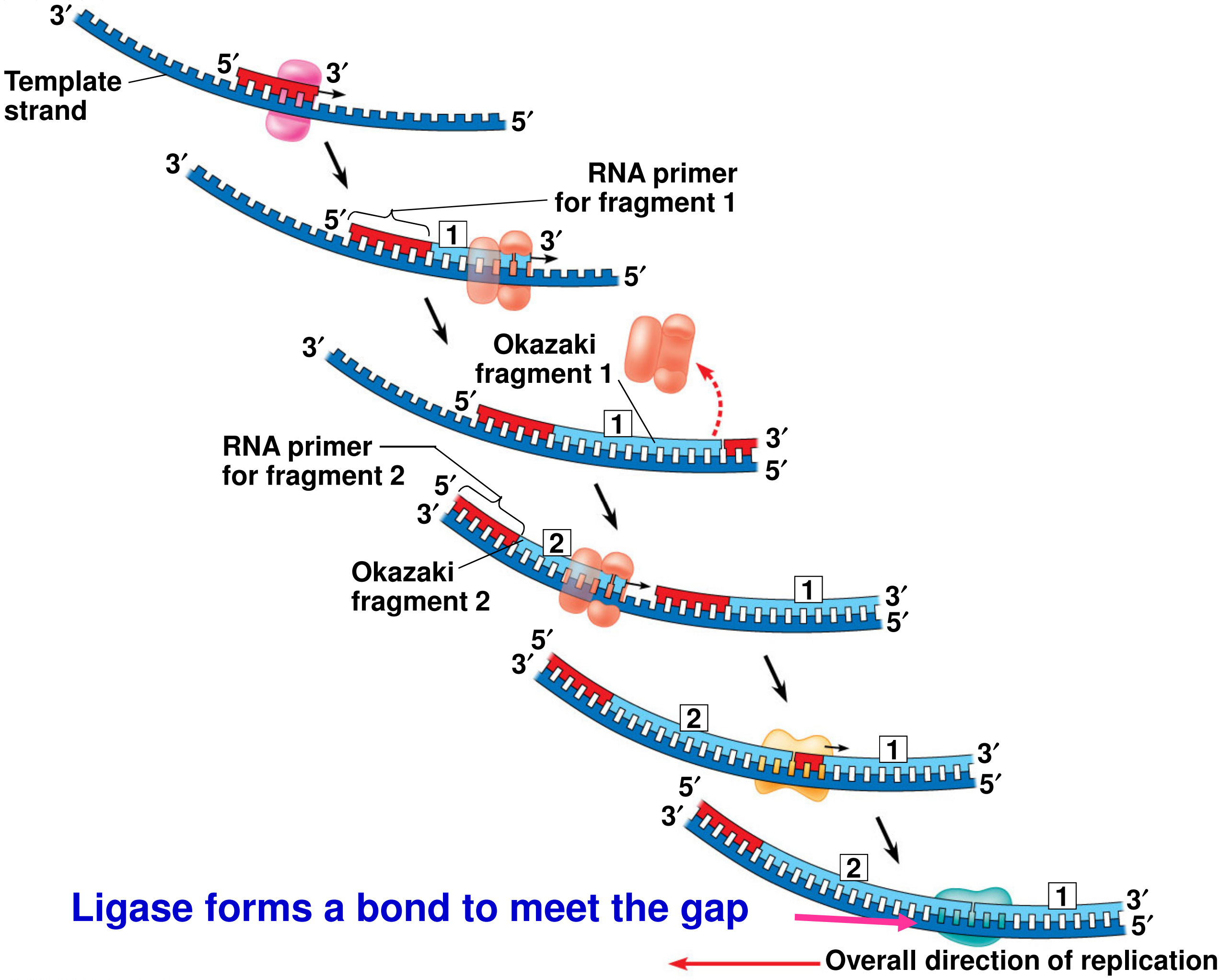


Figure 16.17

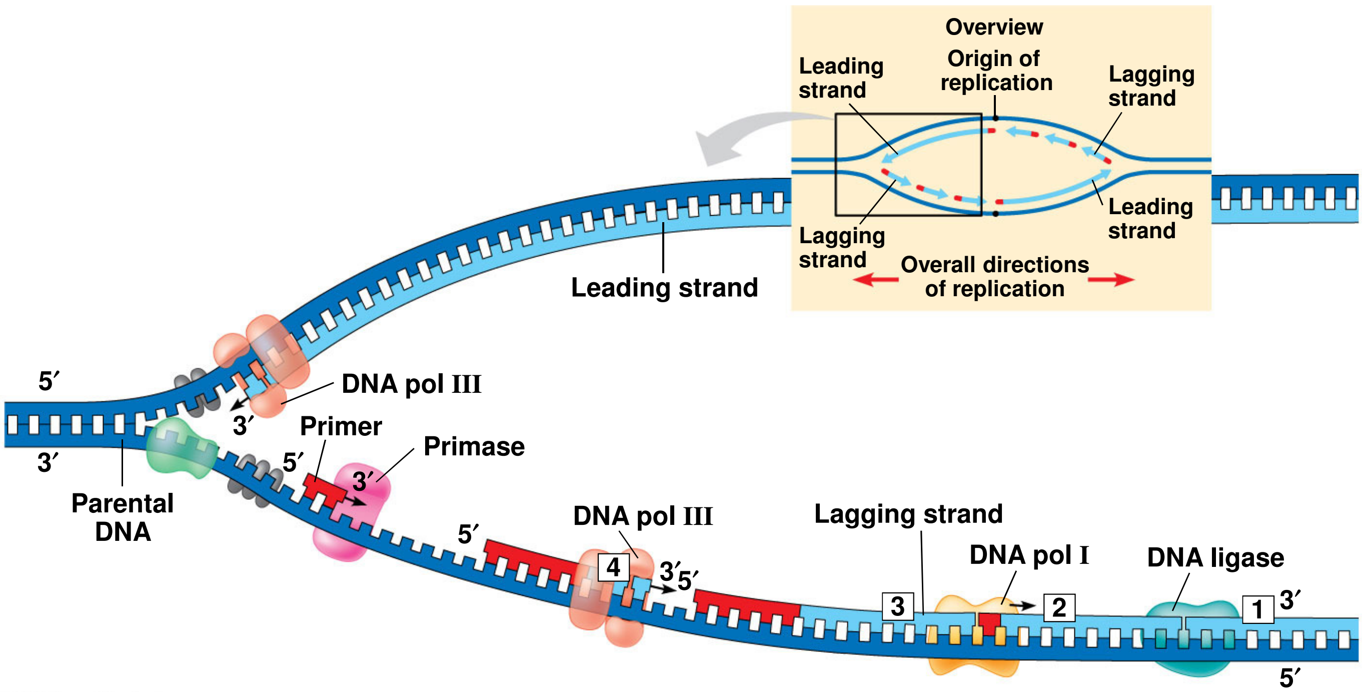
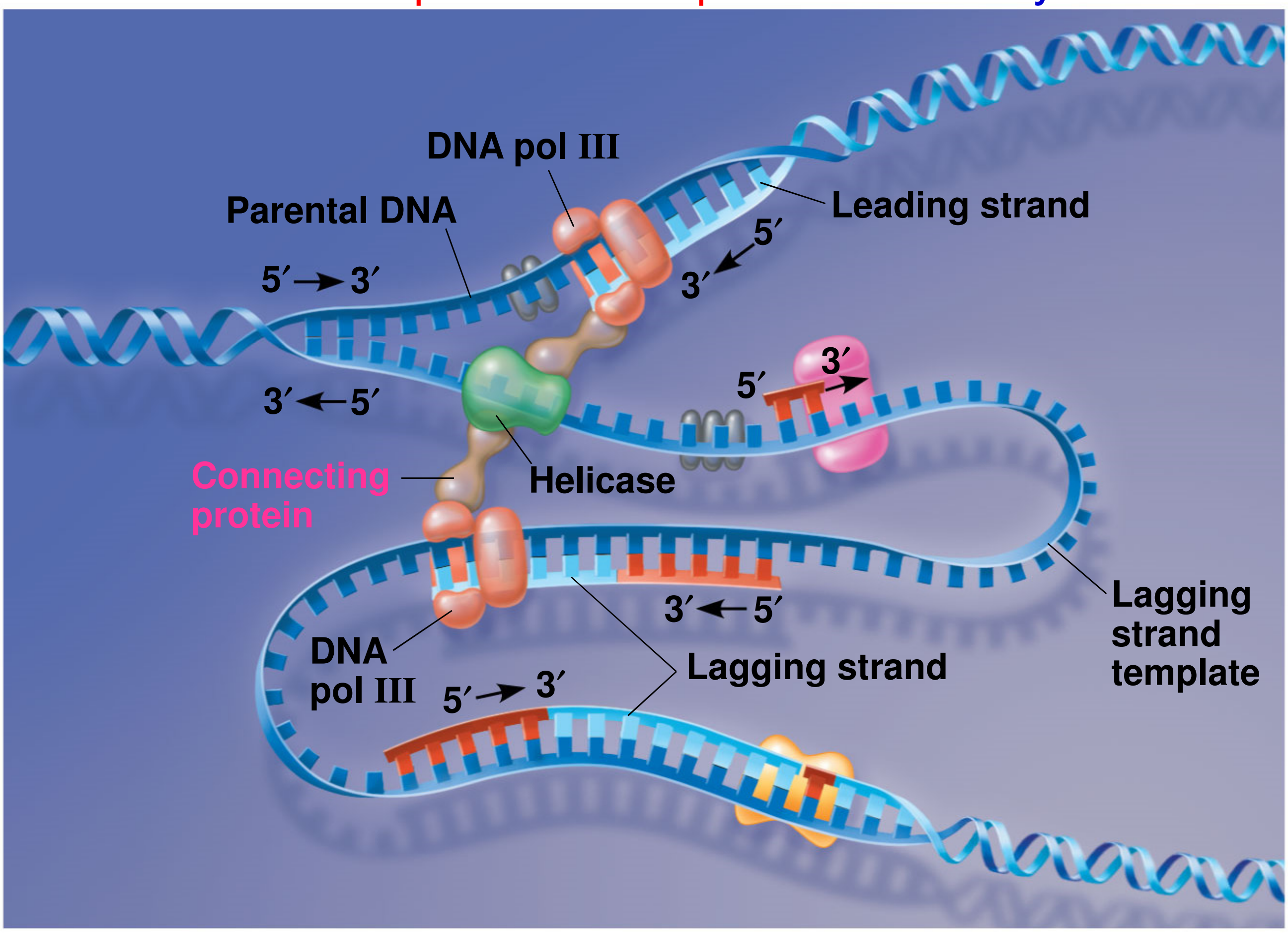


Figure 16.18

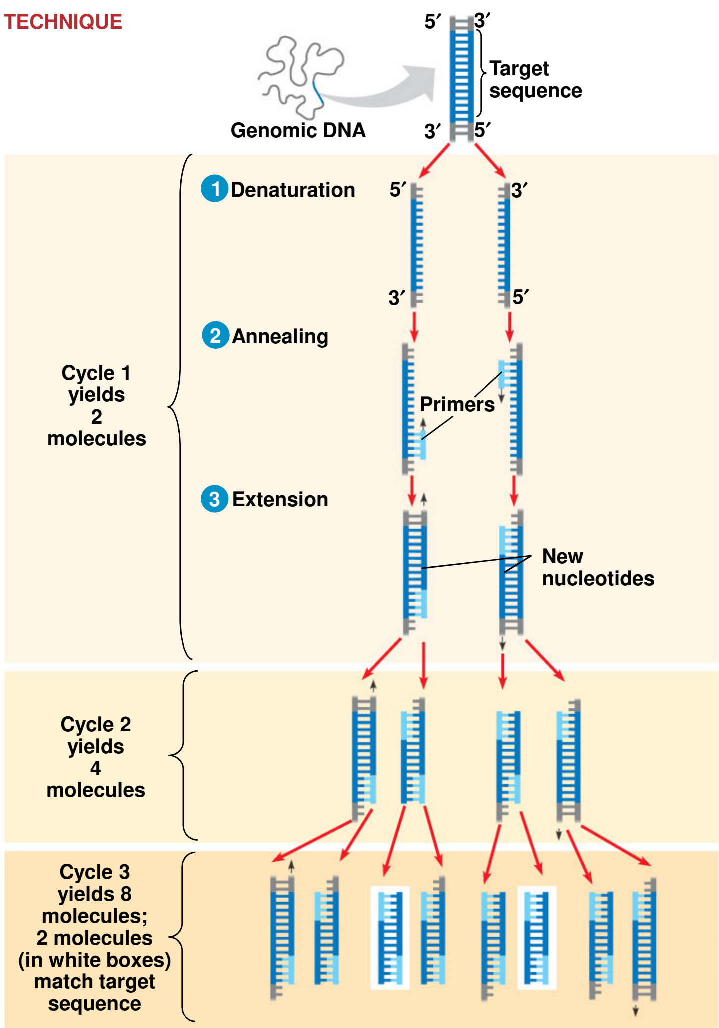
The DNA replication complex is stationary



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.

Figure 20.8



Proofreading and Repairing DNA

- DNA polymerases proofread newly made DNA, replacing any incorrect nucleotides (error rate from $1/10^5$ to $1/10^{10}$)
- In **mismatch repair** of DNA, repair enzymes correct errors in base pairing
- DNA can be damaged by exposure to harmful chemical or physical agents such as cigarette smoke and X-rays; it can also undergo spontaneous changes
- In **nucleotide excision repair**, a **nuclease** cuts out and replaces damaged stretches of DNA

Three types of excision repair

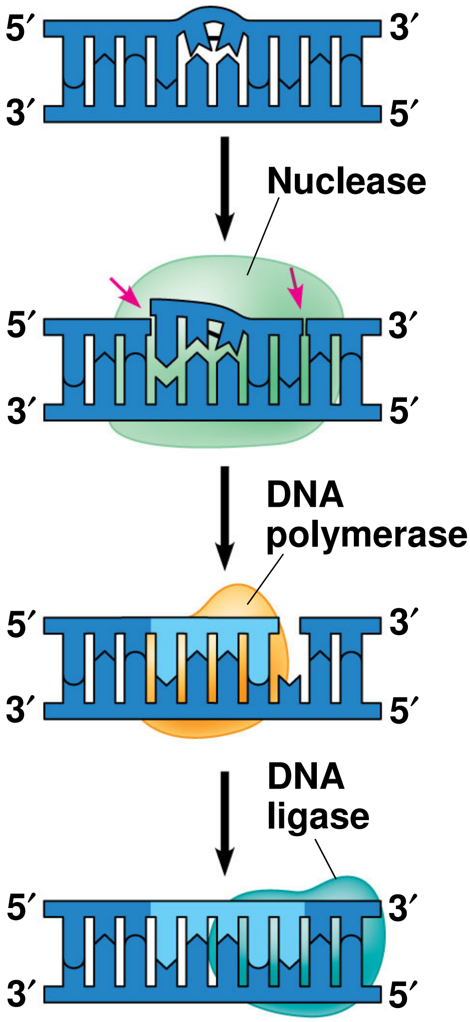
Base excision (Uracil – cytosine mismatch) 直接移除

Nucleotide-excision 整段移除

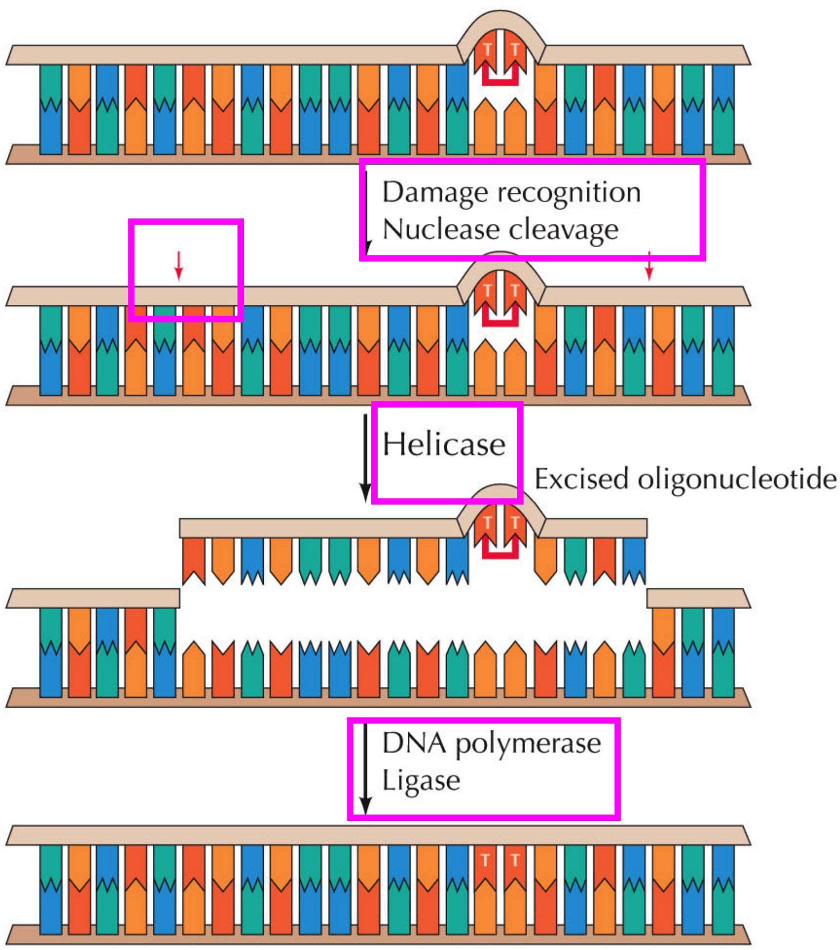
Mismatch repair 整段移除 但用 methylation 標記

Figure 16.19

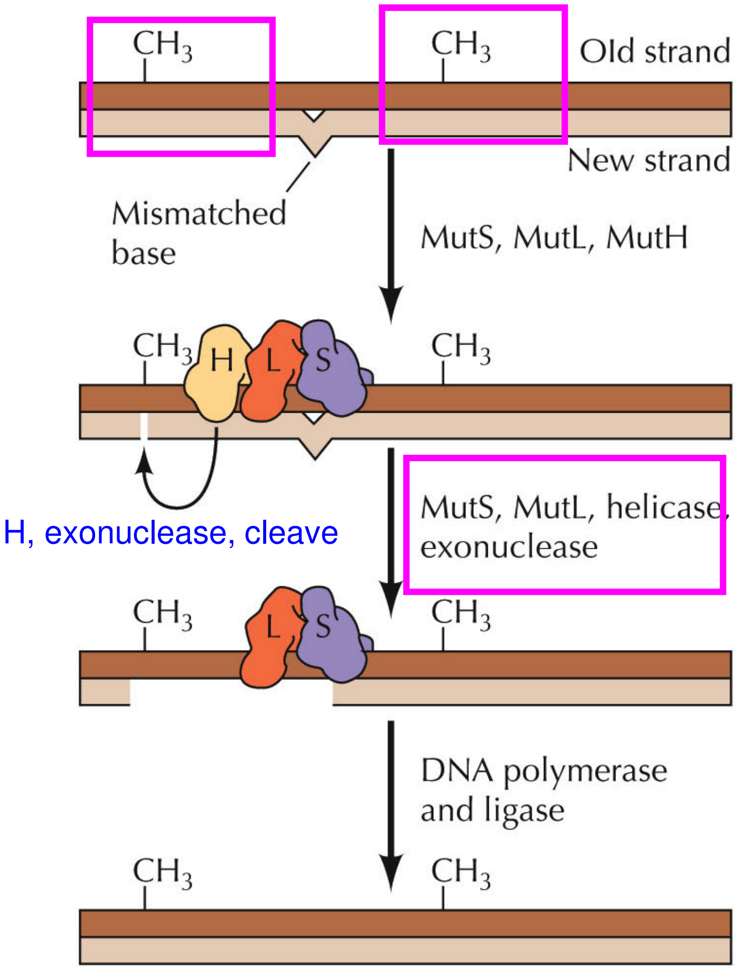
Nucleotide excision repair of DNA damage



6.22 Nucleotide-excision repair of thymine dimers – 整段移除



6.24 Mismatch repair in *E. coli*



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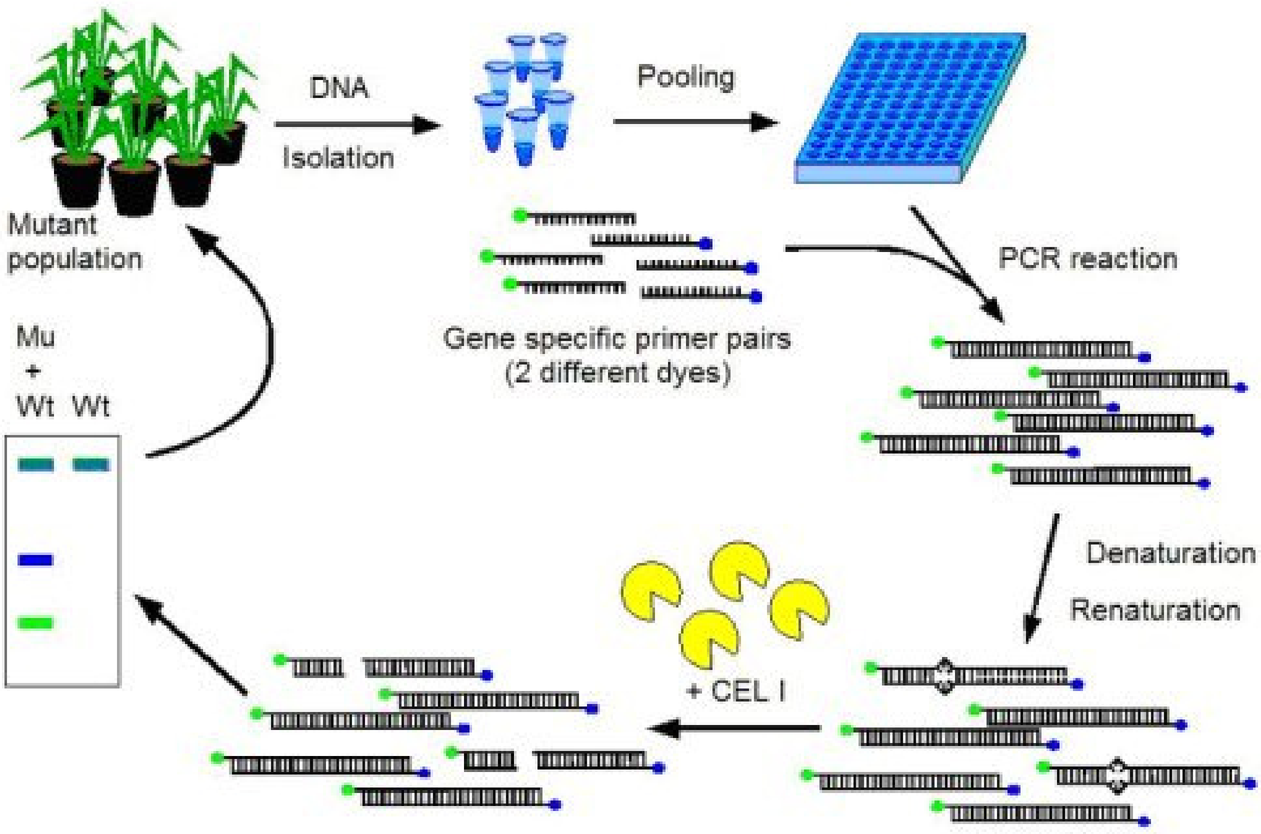
Eco-tilling: mismatch recognition



http://www.risoe.dk/rispubl/PRD/AR2003/plr_Eco-Tilling.htm

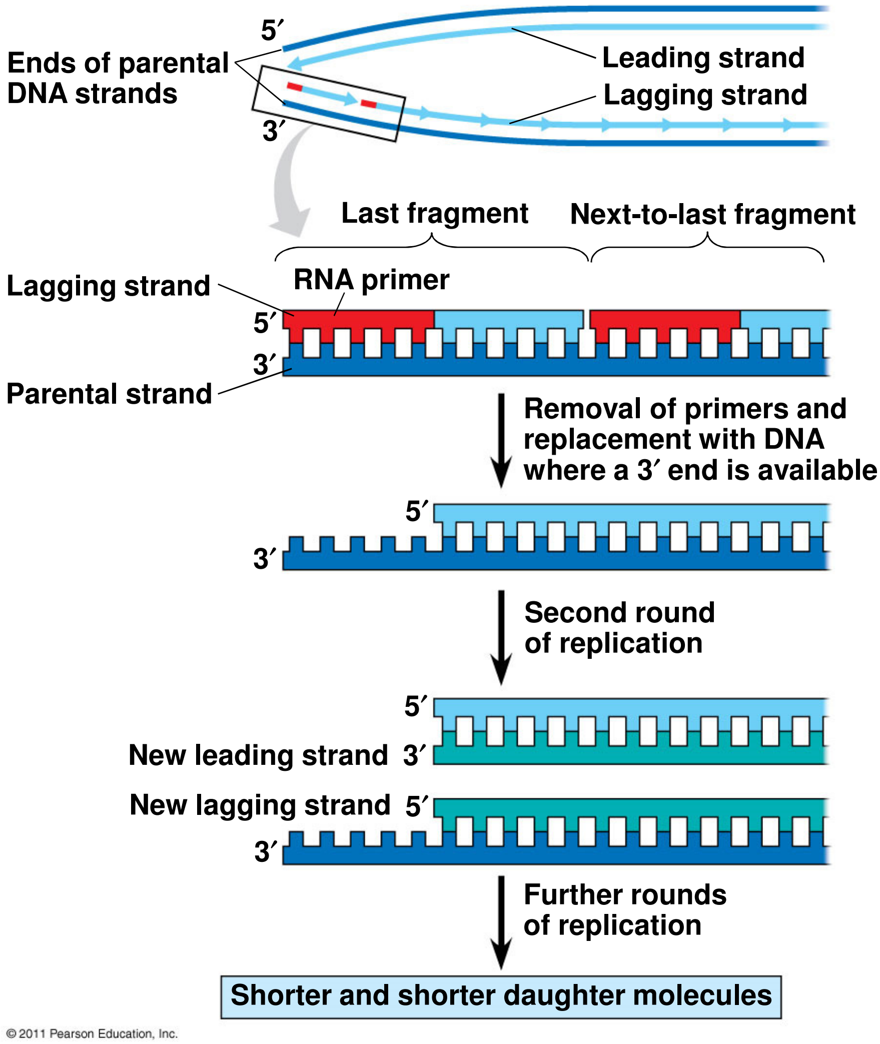
Evolutionary Significance of Altered DNA Nucleotides

- Error rate after proofreading repair is low but not zero (colon cancer from defect of repairing enzyme)
- Sequence changes may become permanent and can be passed on to the next generation
- These changes (mutations) are the source of the genetic variation upon which natural selection operates (but far less than effects from random mating and crossing over)

Replicating the Ends of DNA Molecules

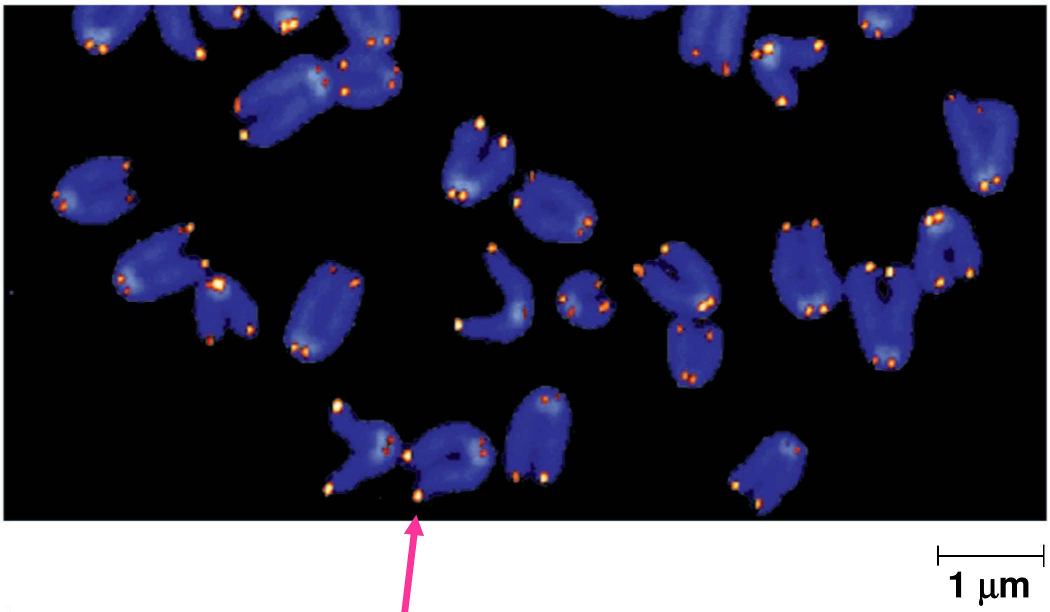
- Limitations of DNA polymerase create problems for the linear DNA of eukaryotic chromosomes
- The usual replication machinery provides no way to complete the 5′ ends, so repeated rounds of replication produce shorter DNA molecules with uneven ends
- This is not a problem for prokaryotes, most of which have circular chromosomes

Figure 16.20



- Eukaryotic chromosomal DNA molecules have special nucleotide sequences at their ends called **telomeres**
- Telomeres do not prevent the shortening of DNA molecules, but they do postpone the erosion of genes near the ends of DNA molecules
- It has been proposed that the shortening of telomeres is connected to aging
- An enzyme called **telomerase** catalyzes the lengthening of telomeres in germ cells

Figure 16.21

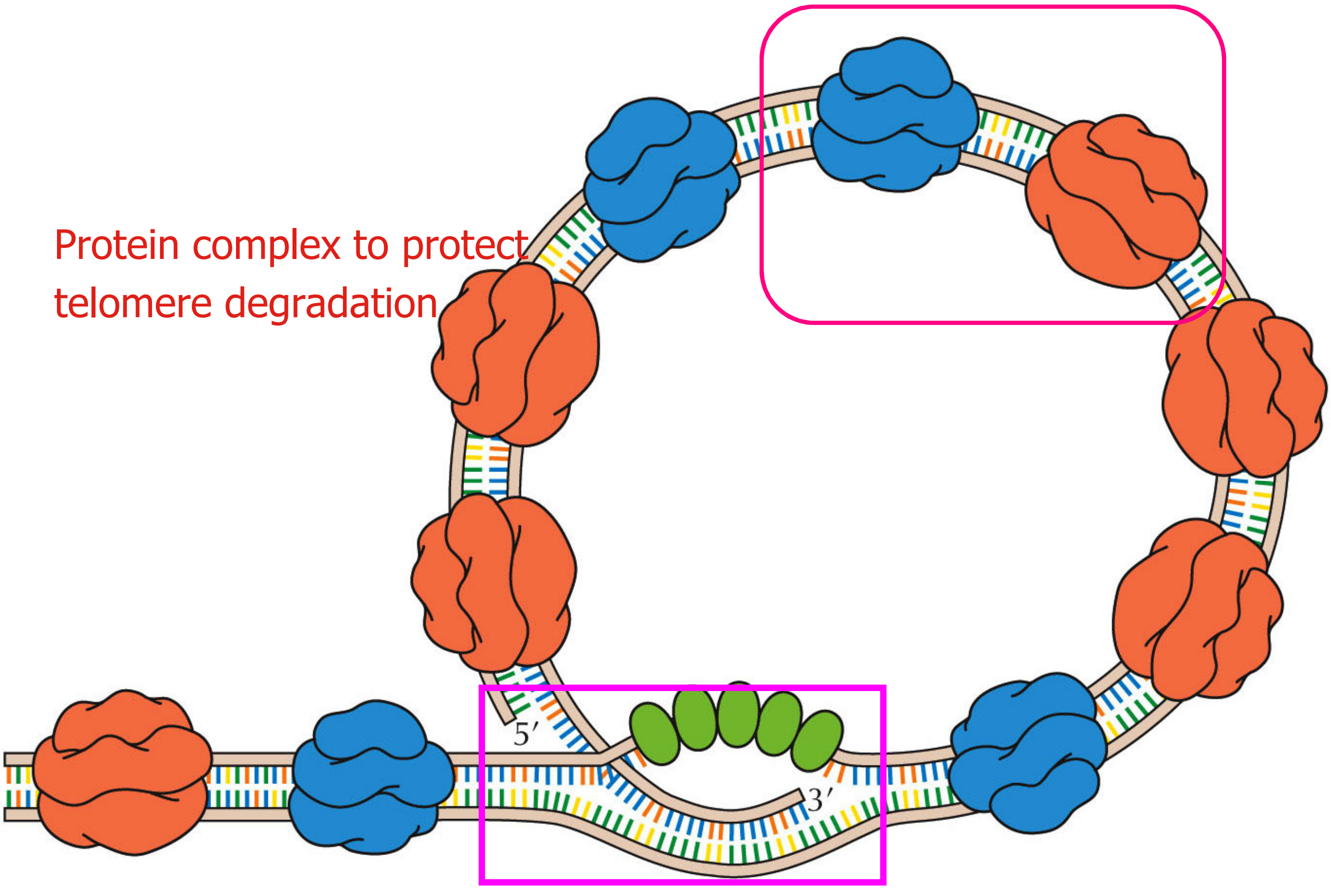


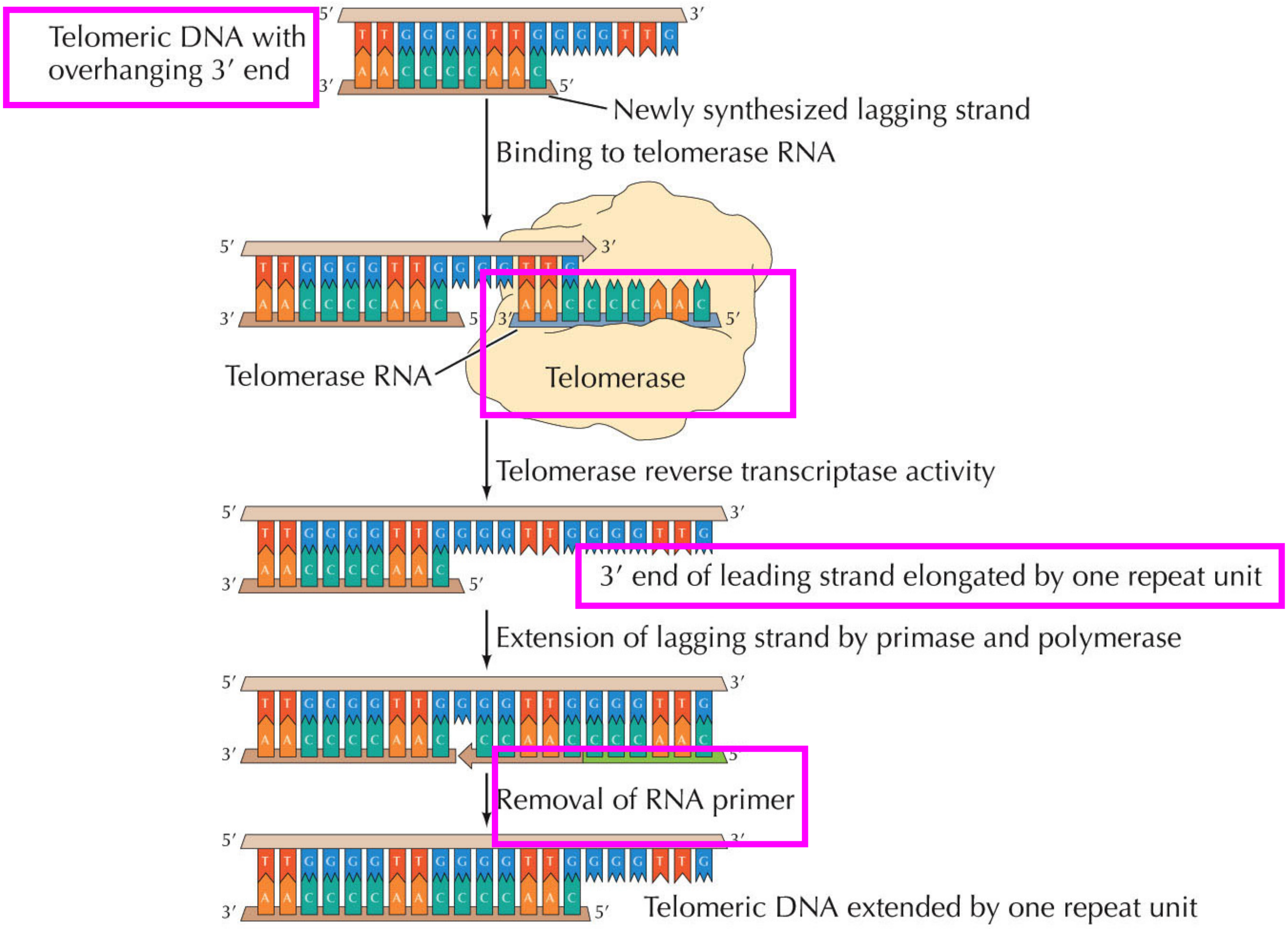
The shortening of telomeres might protect cells from cancerous growth by limiting the number of cell divisions

There is evidence of telomerase activity in cancer cells, which may allow cancer cells to persist

5.22 Structure of a telomere

Protein complex to protect telomere degradation





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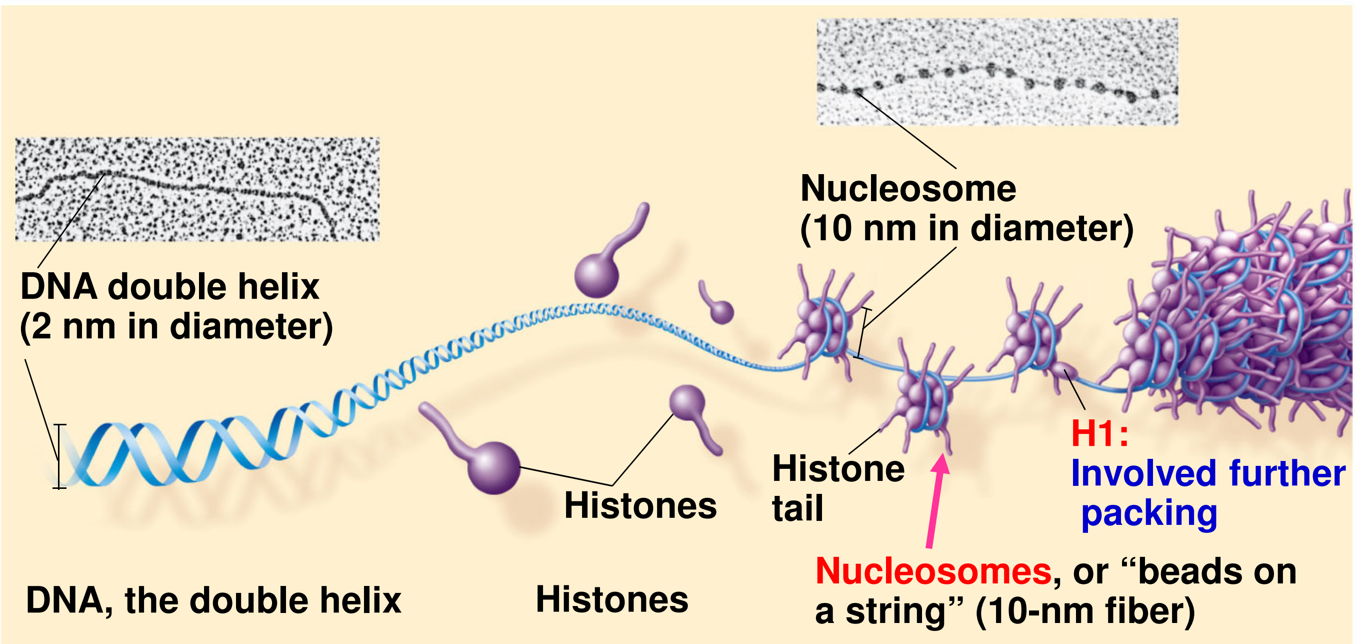
Concept 16.3 A chromosome consists of a DNA molecule packed together with proteins

- The bacterial chromosome is a double-stranded, circular DNA molecule associated with a small amount of protein
- Eukaryotic chromosomes have linear DNA molecules associated with a large amount of protein (called nucleosome complex)
- In a bacterium, the DNA is "supercoiled" and found in a region of the cell called the **nucleoid** (not nucleus)
- **Chromatin**, a complex of DNA and protein, is found in the nucleus of eukaryotic cells

- **Chromatin**, a complex of DNA and protein, is found in the nucleus of eukaryotic cells
- Chromosomes fit into the nucleus through an elaborate, multilevel system of packing

Figure 16.22a

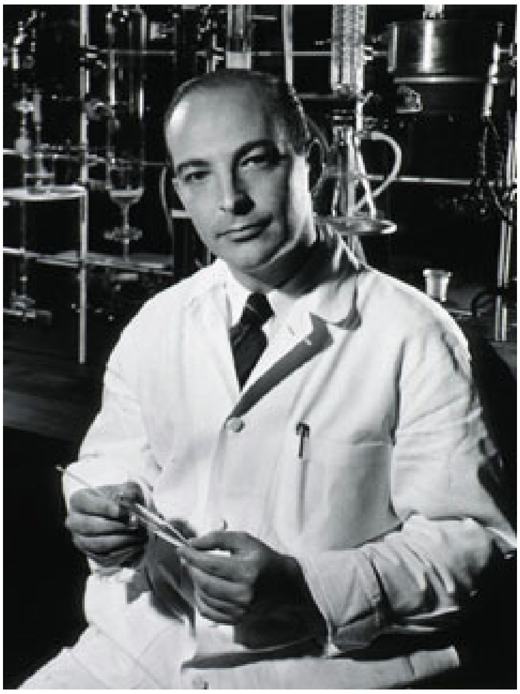
Chromatin, a complex of DNA and protein, is found in the nucleus of eukaryotic cells

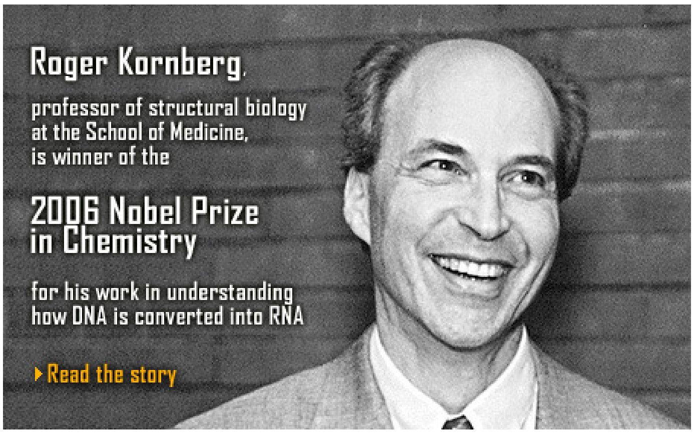


Chromosomes fit into the nucleus through an elaborate, multilevel system of packing

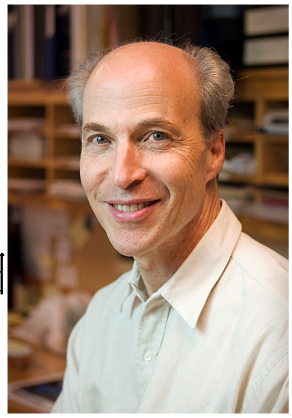
6 the first scientist to identify deoxyribonucleic acid (DNA) polymerase in the intestinal bacterium *E coli*.

- Arthur Kornberg 1959, Nobel Prize, Standford University
- In 1966, Kornberg discovered an enzyme called ligase



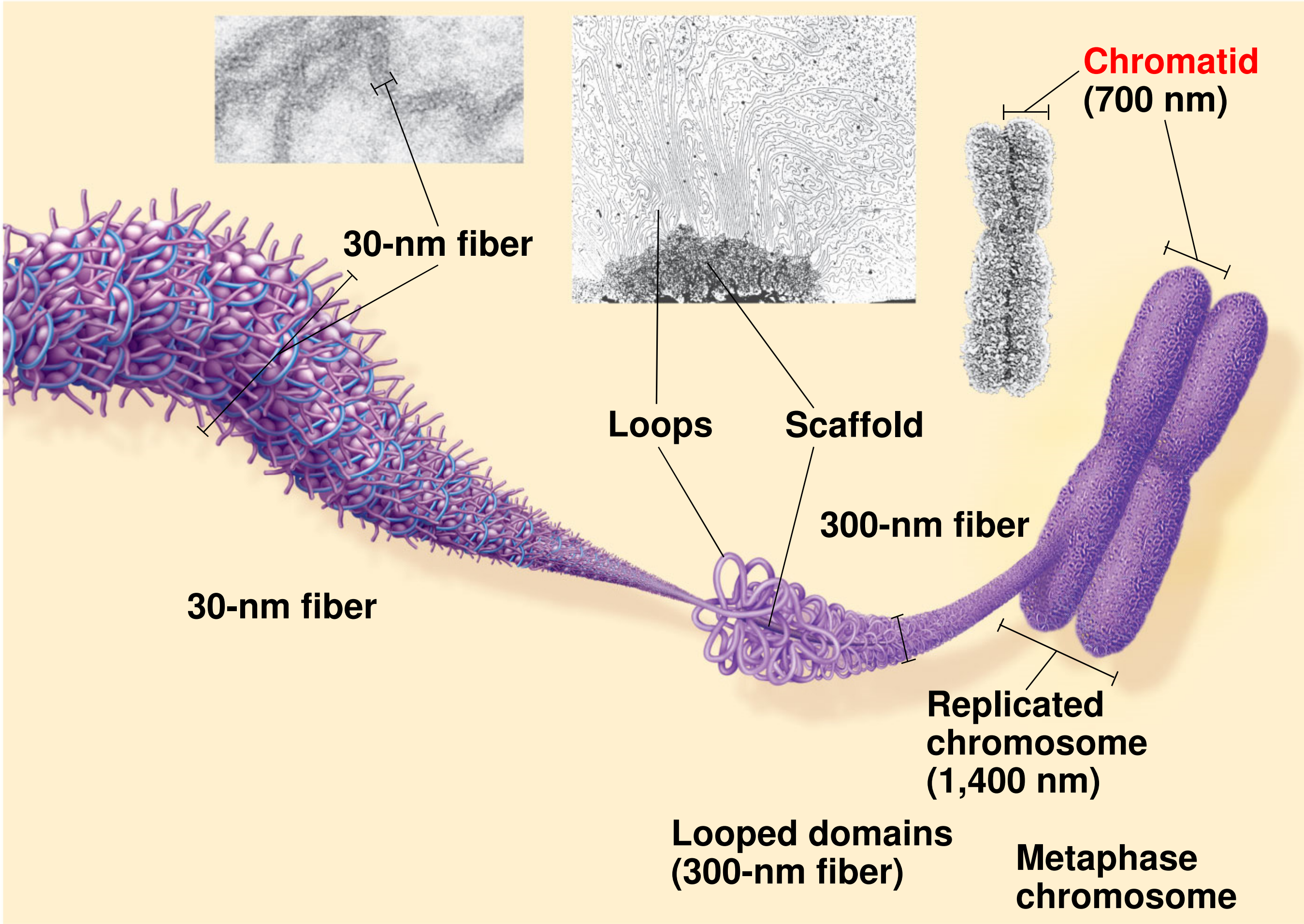


6 "for his studies of the molecular basis of eukaryotic transcription"



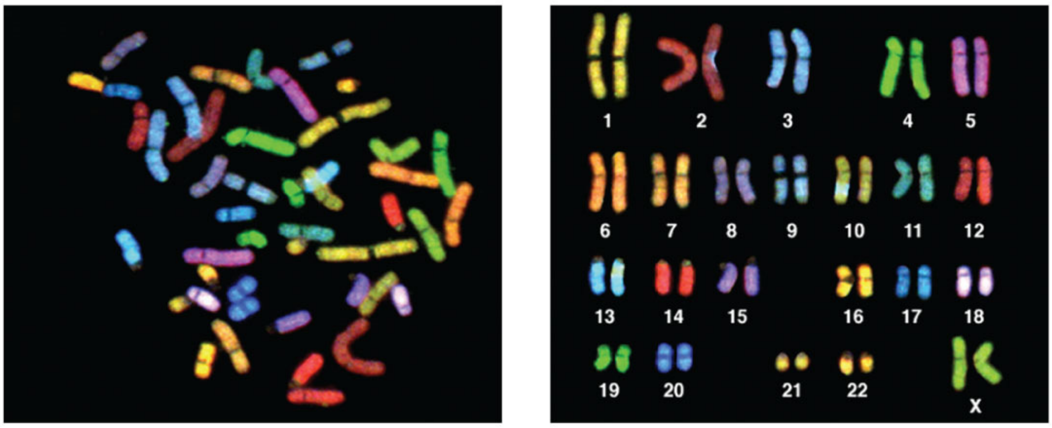
- **諾貝爾化學獎：Roger D. Kornberg**
  在 1970 年代， Kornberg 發現了核仁小體 (nucleosome) ，這種核仁小體是一種存在於真核細胞的細胞核內，包裹染色體 DNA 的蛋白質複合體 (通常稱為「染色質」) 。他之後捕捉到第一個動態轉錄分子機組的晶體影像。那些在分子層級的影像顯現了訊息核糖核酸 (mRNA) 鏈體成長的情形，並進一步闡明這種鏈體在整個過程中，所扮演的關鍵角色地位。
- Kornberg was the first to create an actual picture of how transcription works at a molecular level in the important group of organisms called eukaryotes

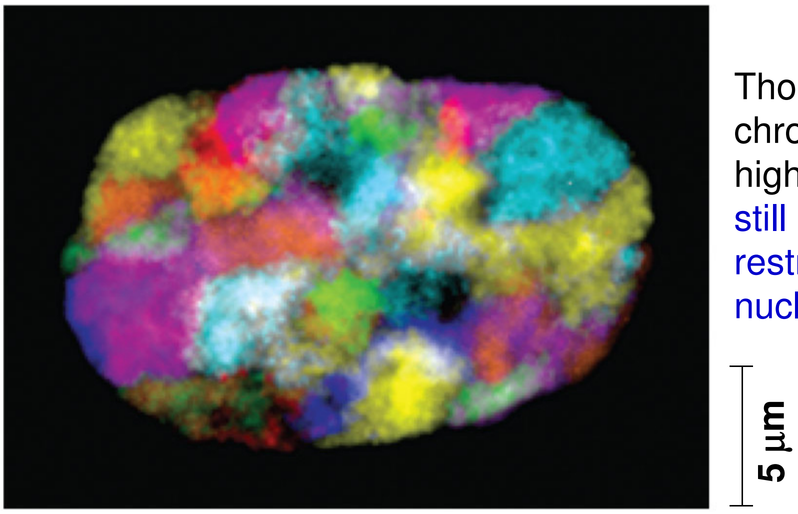
Figure 16.22b



- Chromatin undergoes changes in packing during the cell cycle
- At interphase, some chromatin is organized into a 10-nm fiber, but much is compacted into a 30-nm fiber, through folding and looping
- Though interphase chromosomes are not highly condensed, they still occupy specific restricted regions in the nucleus

Figure 16.23





Though interphase chromosomes are not highly condensed, they still occupy specific restricted regions in the nucleus

- Most chromatin is loosely packed in the nucleus during interphase and condenses prior to mitosis
- Loosely packed chromatin is called **euchromatin**
- During interphase a few regions of chromatin (centromeres and telomeres) are highly condensed into **heterochromatin**
- Dense packing of the heterochromatin makes it difficult for the cell to express genetic information coded in these regions

- Histones can undergo chemical modifications that result in changes in chromatin organization

(imprinting via methylation, etc.)