Chapter 14 Review Problems

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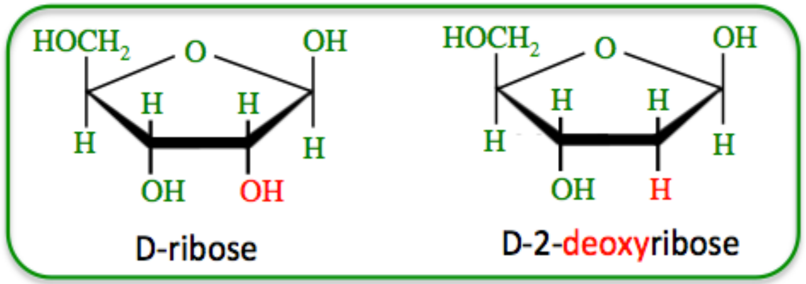
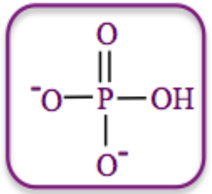
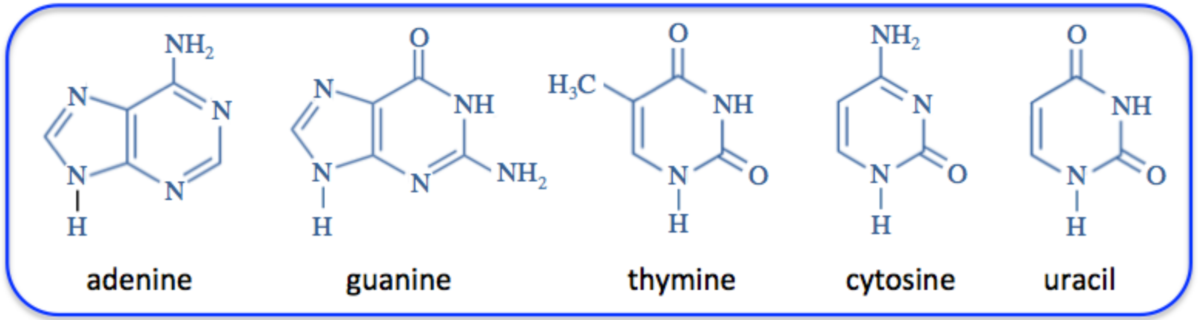
14.1) A nucleotide is formed from three chemical components: a *monosaccharide* (either ribose or deoxyribose), at least one *phosphate*, and one "*organic base*." The structures of these components are shown below.



nucleotides contain one of these monosaccharides



a phosphate
(hydrogen phosphate ion)



nucleotides contain one organic base
(the five most common organic bases are shown)

Draw the structure of the 5'-nucleotide that is made from deoxyribose, one phosphate, and cytosine.

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Click here to **check your answer**

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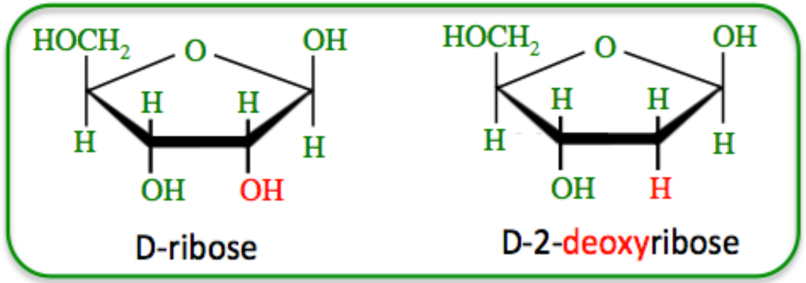
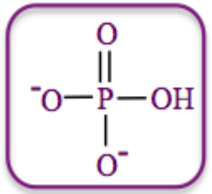


nucleotides contain one of these monosaccharides



a phosphate
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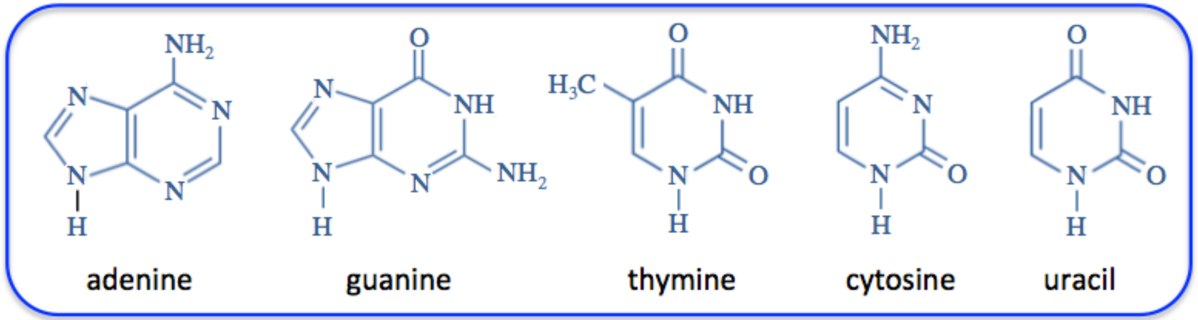

nucleotides contain one organic base
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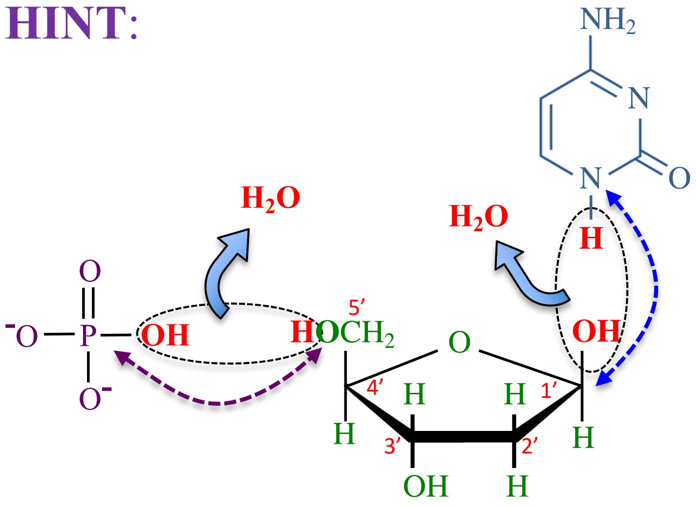
Draw the structure of the 5'-nucleotide that is made from deoxyribose, one phosphate, and cytosine.

HINT:



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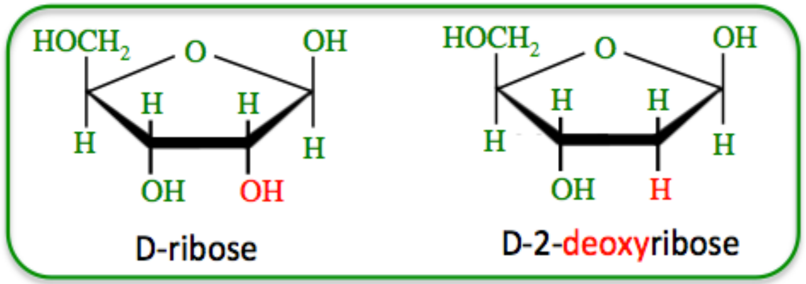
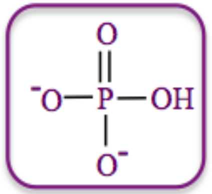


nucleotides contain one of these monosaccharides



a phosphate
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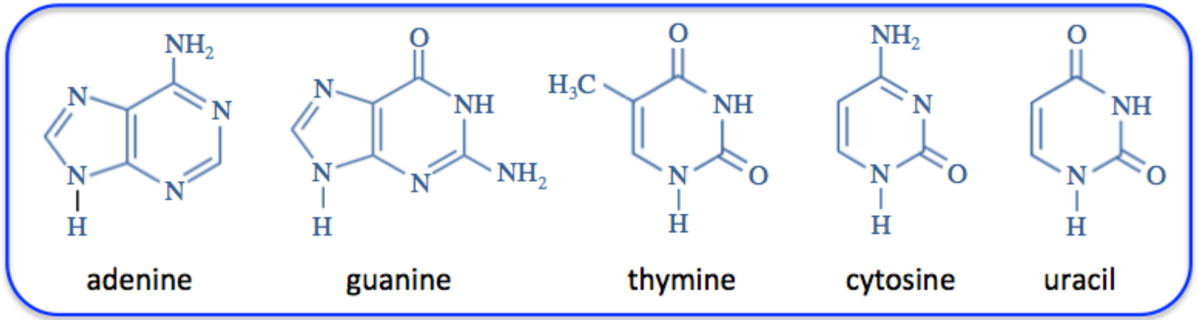

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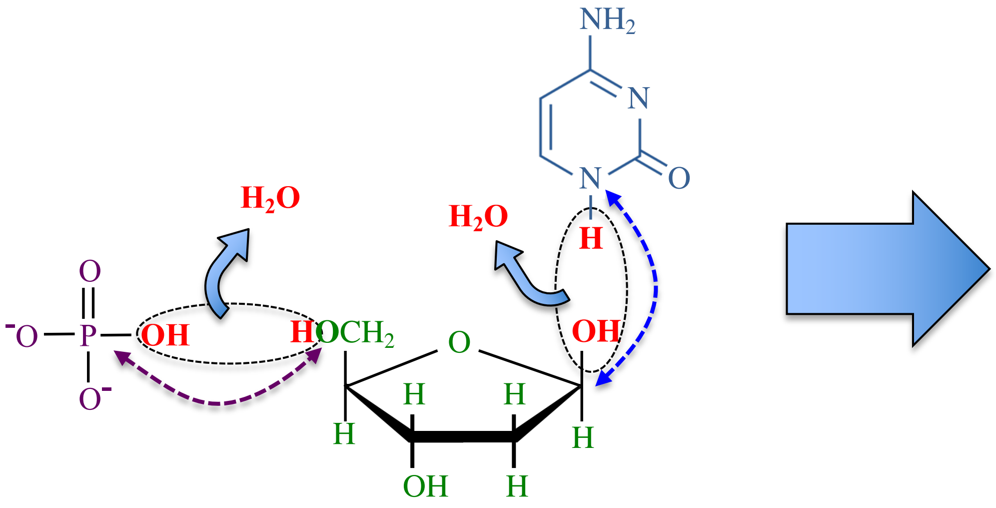
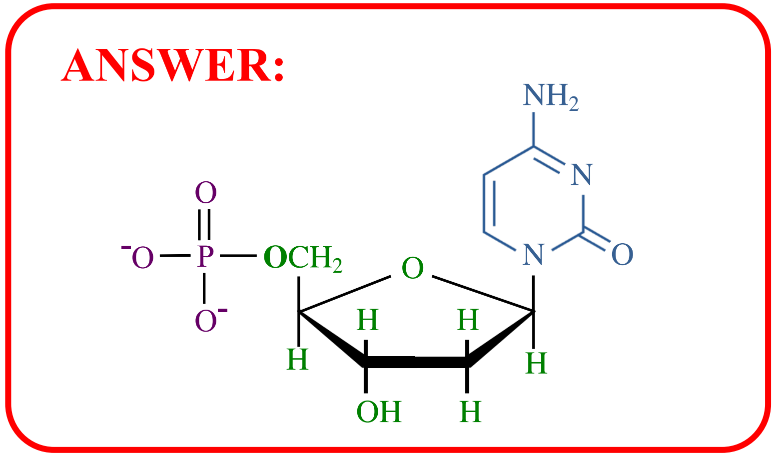
(the five most common organic bases are shown)

Draw the structure of the 5'-nucleotide that is made from deoxyribose, one phosphate, and cytosine.





a 5' nucleotide

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For more details: See chapter 14 part 1 video or chapter 14 section 2 in the textbook.

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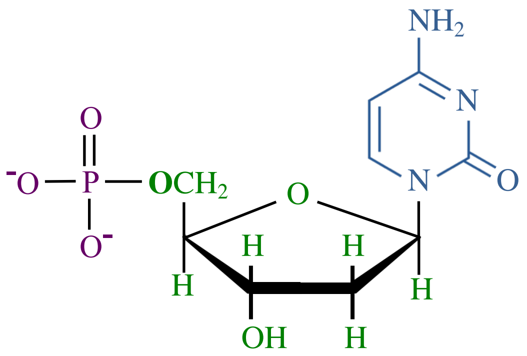
14.2) You drew the structure of a 5'-nucleotide (shown below) in the previous problem. Label the *phosphoester bonding pattern* and the *N-glycosidic bond* in your drawing.



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14.2) You drew the structure of a 5’-nucleotide (shown below) in the previous problem. Label the *phosphoester bonding pattern* and the *N-glycosidic bond* in your drawing.

HINT:

A ***phosphoester bonding pattern*** occurs when a monosaccharide bonds with the phosphate group.

An ***N-glycosidic bond*** is made when the monosaccharide bonds to a nitrogen in the organic base.

- N-glycosidic bonds should not be confused with the “standard” glycosidic bonds, which connect two carbohydrate residues.

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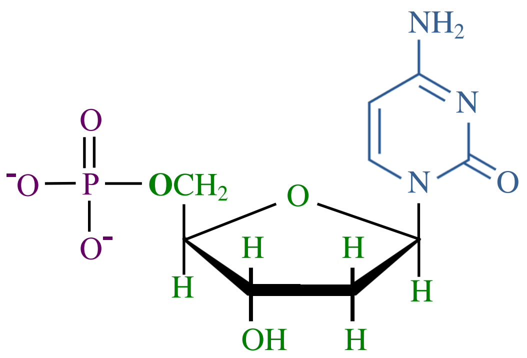

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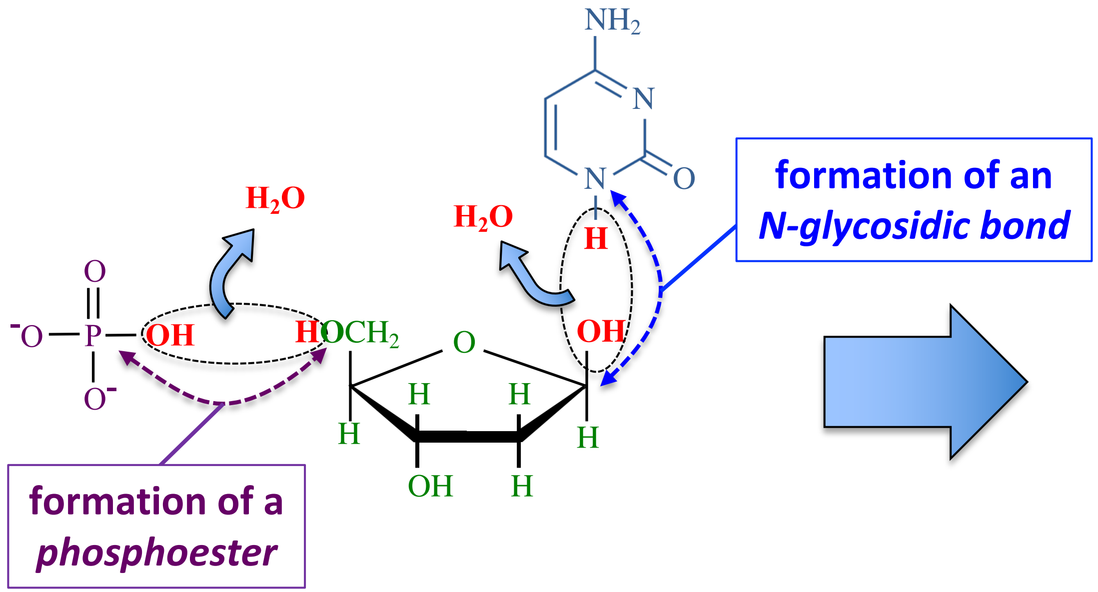
14.2) You drew the structure of a 5'-nucleotide (shown below) in the previous problem. Label the *phosphoester bonding pattern* and the *N-glycosidic bond* in your drawing.

EXPLANATION:

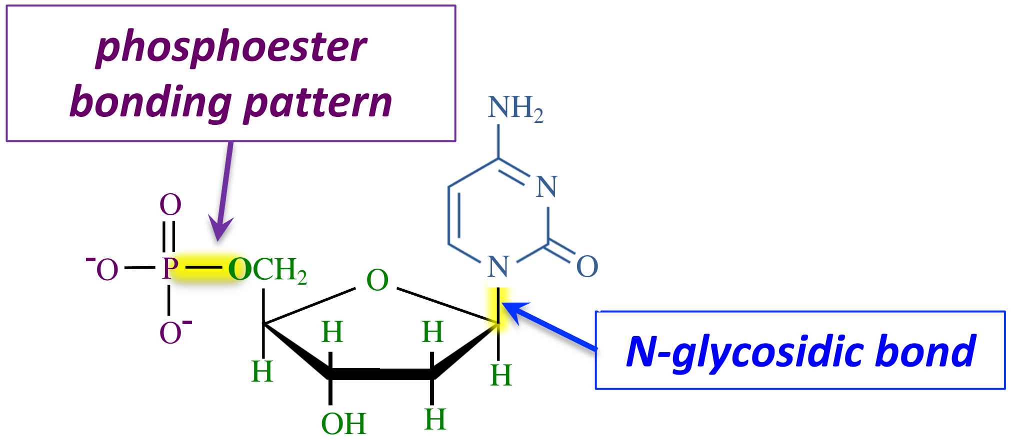
We see *a familiar bonding pattern* in the formation of nucleotides; the ***phosphoester bonding pattern*** occurs when a monosaccharide bonds with the phosphate group.

You saw a *new type of bonding pattern* in the formation of nucleotides; an ***N-glycosidic bond*** is made when the monosaccharide bonds to a nitrogen in the organic base.

- N-glycosidic bonds should not be confused with the "standard" glycosidic bonds, which connect two carbohydrate residues.



ANSWER:



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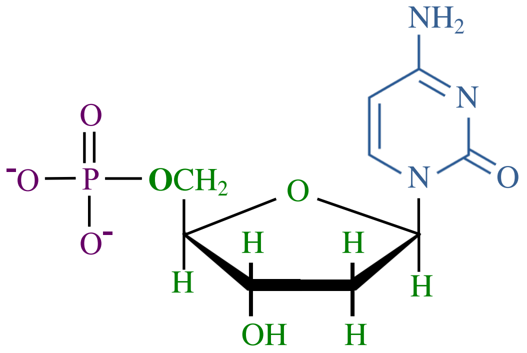
14.3) The 5'-nucleotide from the previous problems is shown below. Write the name of this nucleotide.



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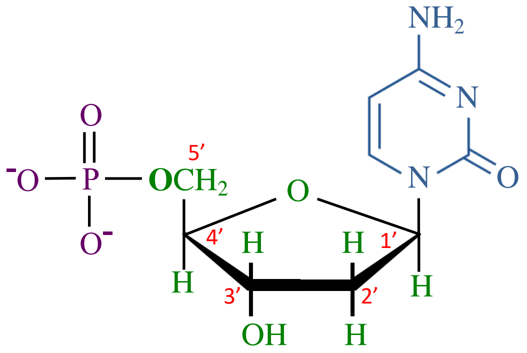
Go to next question

14.3) The 5'-nucleotide from the previous problems is shown below. Write the name of this nucleotide.

HINT:

When a ***cytosine*** organic base is present in a nucleotide, it is indicated by the term "***cytidine***" in the nucleotide name.

NAME: ________*cytidine* 5'-_______phosphate



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14.3) The 5’-nucleotide from the previous problems is shown below. Write the name of this nucleotide.

ANSWER: *deoxycytidine* 5’-monophosphate

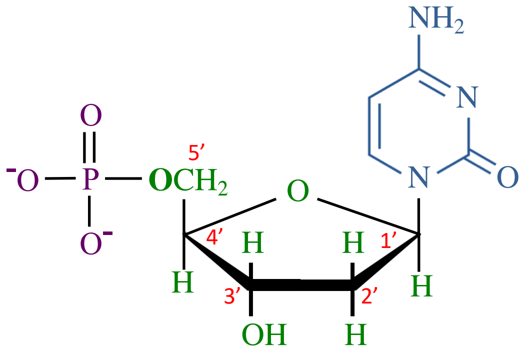
EXPLANATION:

This nucleotide was formed by bonding a phosphate to the carbon in position number **5’** of the monosaccharide ring. The position numbers of the monosaccharide ring are shown in the drawing below.

- Note that when assigning numbers to the *monosaccharide* ring positions, we use apostrophes in order to distinguish these positions from the *organic base* ring positions.

Because this nucleotide is formed from one *phosphate,* ***deoxy****ribose***,** and a *cytosine* organic base, we write its name as “***deoxy****cytidine* **5’**-monophosphate.” It is common to use abbreviations when naming nucleotides. In this case, we would abbreviate the name as “**5’** dCMP,” the lowercase “d” indicates “*deoxy*.”

For more details: See chapter 14 part 1 video or chapter 14 section 2 in the textbook.



***deoxycytidine* 5’-monophosphate**

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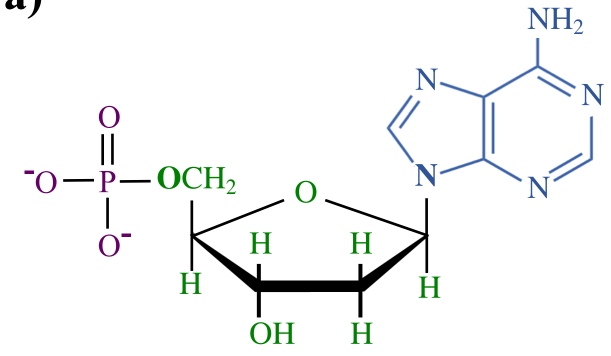
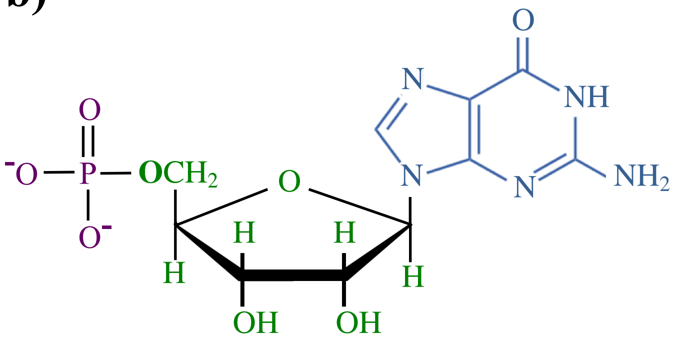
14.4) Classify each of the nucleotides shown below as either a **ribonucleotide** or a **deoxyribonucleotide**.

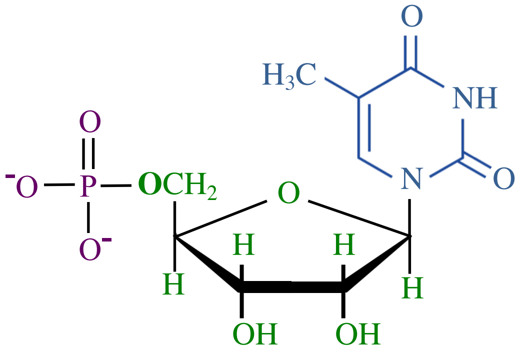
a)



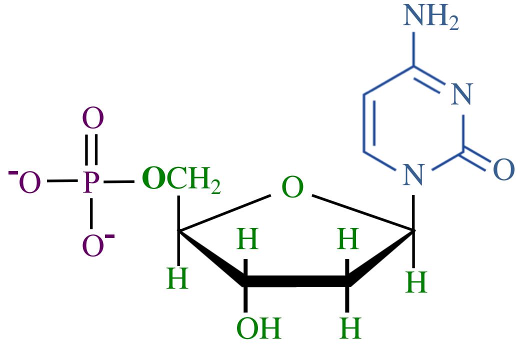
b)



c)



d)



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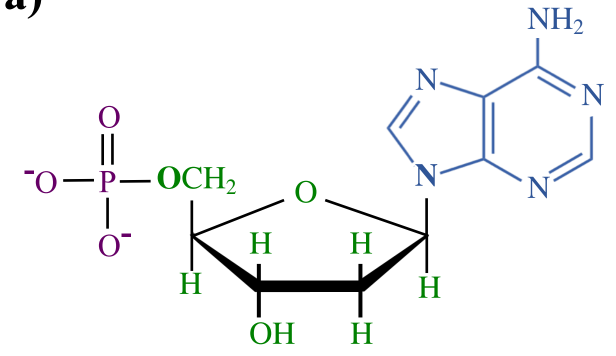
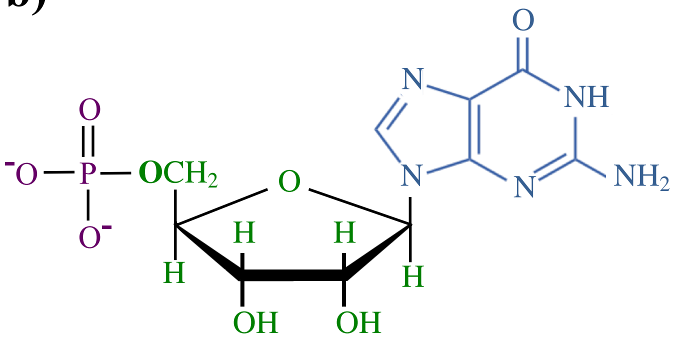
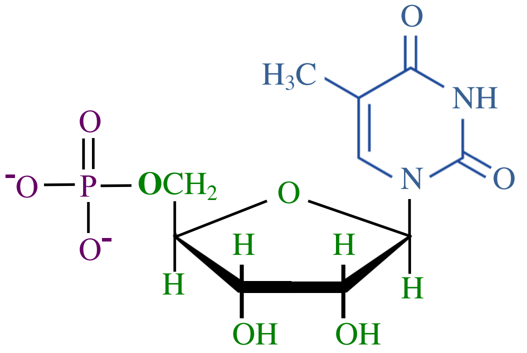
a)



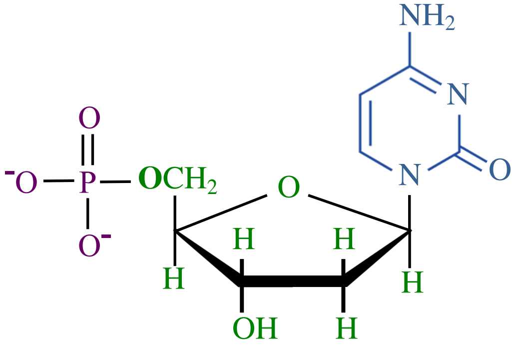
b)



c)



d)

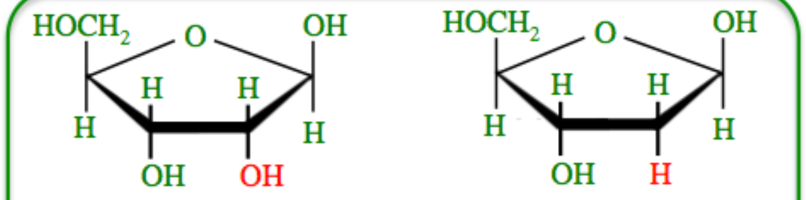


HINT:

A nucleotide is formed from three chemical components: a *monosaccharide* (either ribose or deoxyribose), at least one *phosphate*, and one "*organic base*."

- A nucleotide that contains a ***ribose residue*** is classified as a **ribonucleotide**.
- A nucleotide that contains a ***deoxyribose residue*** is classified as a **deoxyribonucleotide**.

Ribose and a deoxyribose are shown below.



D-ribose D-2-deoxyribose

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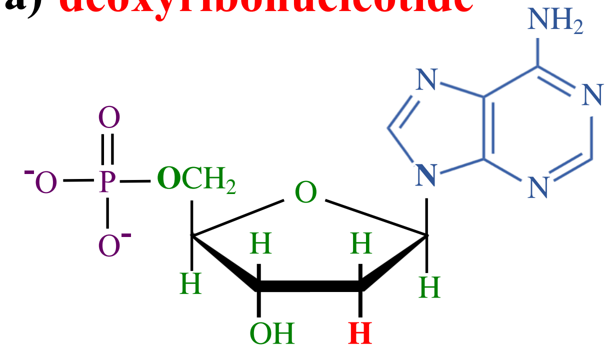
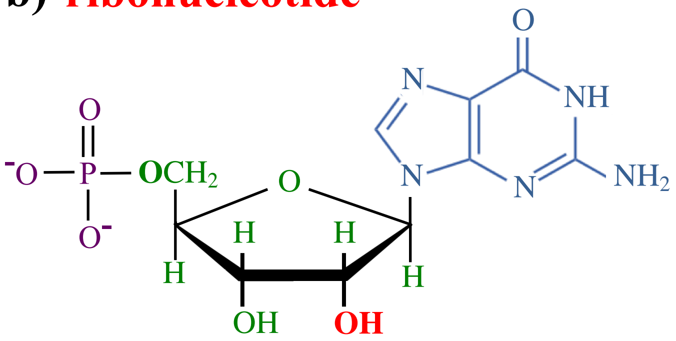
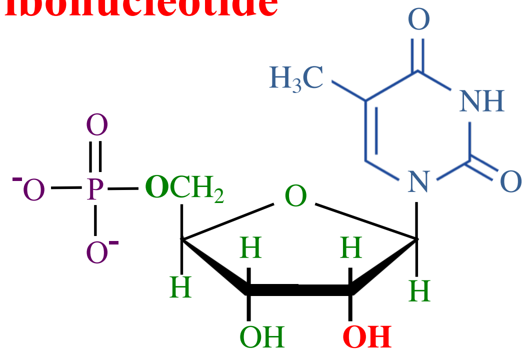


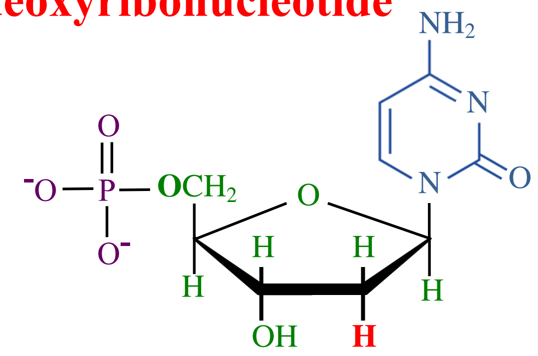
b) ribonucleotide



c) ribonucleotide



d) deoxyribonucleotide



EXPLANATION:

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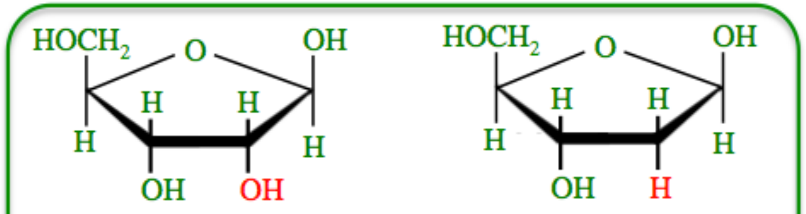

D-ribose D-2-deoxyribose

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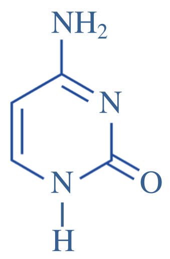
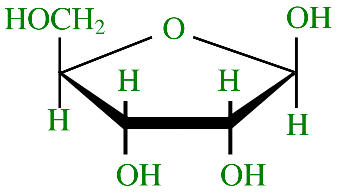
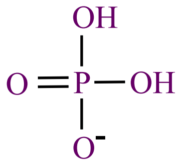
14.5) Cyclic cytidine monophosphate (cCMP) has been implicated in the control of cell growth and blood cell function. Draw the structural formula of cCMP by combining a cytosine organic base, ribose, and a phosphate. Make the phosphoester bonds to carbon number 3’ and carbon number 5’ of ribose.



cytosine
(an organic base)



ribose
(a monosaccharide)



phosphate

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Click here for a **hint**

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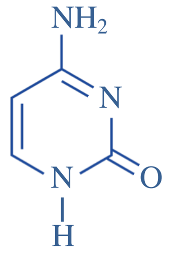

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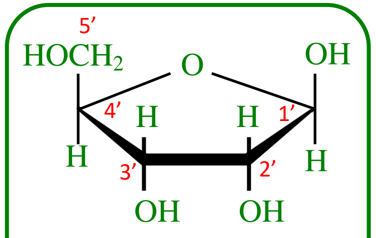

ribose
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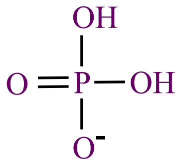

phosphate

HINT:
The carbon numbers are shown for ribose.

For more help: See chapter 14 part 1 video or chapter 14 section 2 in the textbook.

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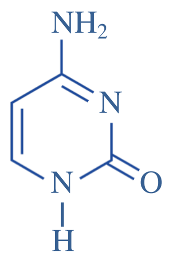

cytosine
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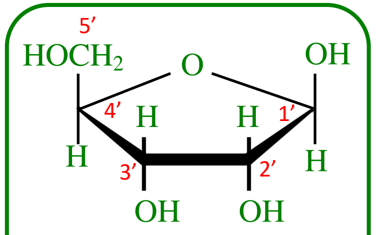

ribose
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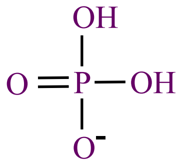
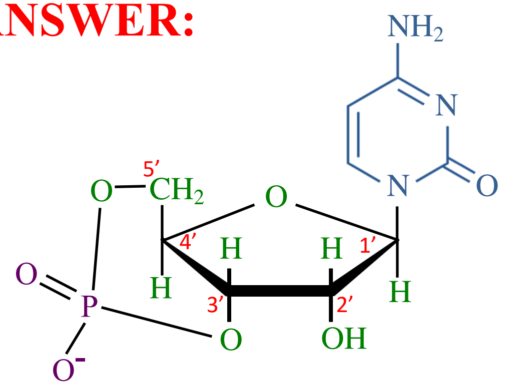


phosphate

ANSWER:



cyclic cytidine monophosphate (cCMP)

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For more details: See chapter 14 part 1 video or chapter 14 section 2 in the textbook.

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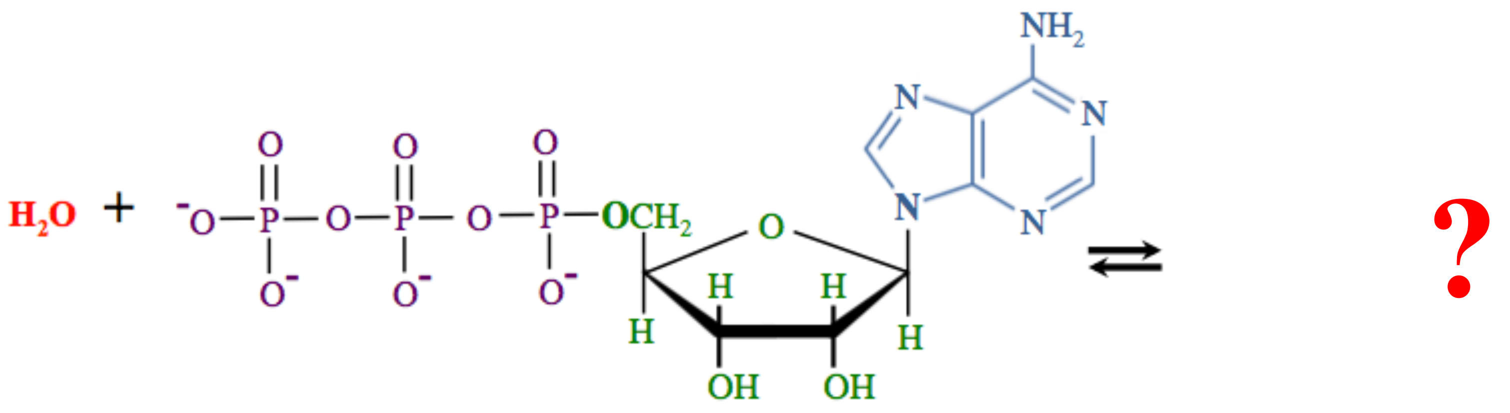
14.6) Nucleotides have biological roles other than forming DNA and RNA. One of these roles involves transferring energy. The two most important energy-transfer nucleotides are adenosine triphosphate (ATP) and adenosine diphosphate (ADP).

Energy is released from ATP when it is converted to ADP. Organisms can do mechanical work, or drive chemical reactions that require energy by converting ATP to ADP. Add the products to the chemical equation for the conversion of ATP to ADP.



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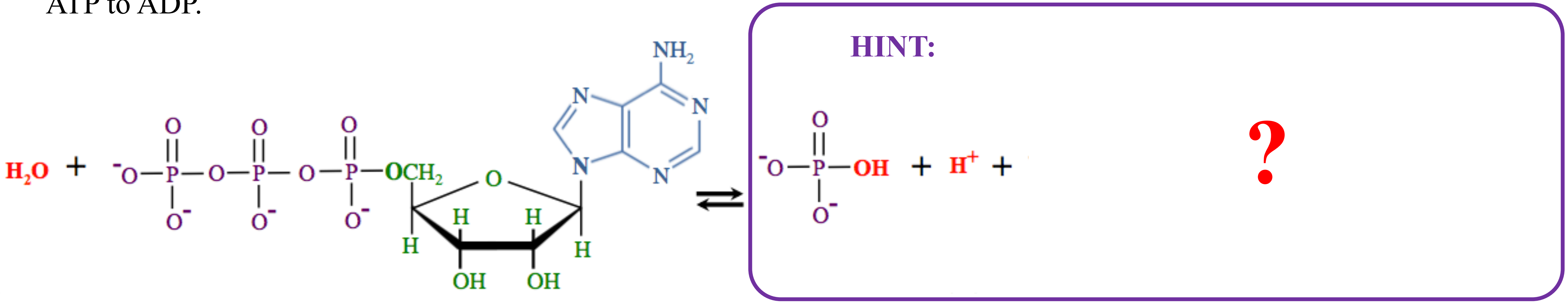

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Go to next question

14.6) Nucleotides have biological roles other than forming DNA and RNA. One of these roles involves transferring energy. The two most important energy-transfer nucleotides are adenosine triphosphate (ATP) and adenosine diphosphate (ADP).

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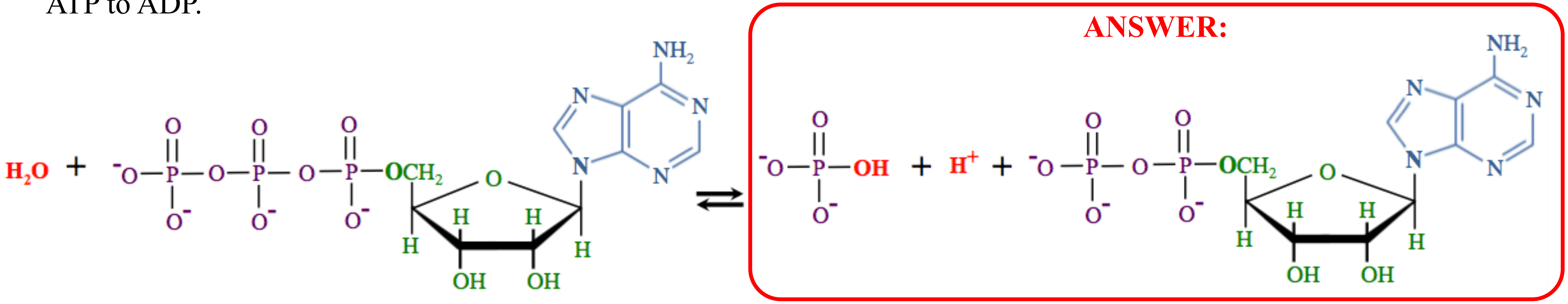

adenosine triphosphate (**ATP**) *hydrogen phosphate* (**P_i**) *adenosine diphosphate* (**ADP**)

EXPLANATION:

Energy can be released from **ATP** is by reacting it with **H_2O** to form **ADP**, hydrogen phosphate (abbreviated as P_i), and an **H^+** ion.

The chemical equation for this reaction is often written in an abbreviated form as shown below.

$$H_2O\,(l) + ATP\,(aq) \rightleftharpoons P_i\,(aq) + H^+ + ADP\,(aq)$$

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For more details: See chapter 14 part 1 video or chapter 14 section 2 in the textbook.

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14.7) A polynucleotide is a polymer made from nucleotide residues that are bonded to each other in a linear sequence.

i) A chain of covalently bonded nucleotides is referred to as _______________.

a) an oxy-deoxy chain
b) a strand
c) a chromosome
d) DNA polymerase

ii) In a polynucleotide, nucleotides are covalently bonded to each other by a phosphodiester bonding pattern between a 3' carbon on one monosaccharide and a ______________ on the other monosaccharide.

a) 5' carbon
b) 3' carbon
c) neither of the above

iii) In a polynucleotide, the nucleotides are connected to each other by covalent bonds between the monosaccharide residues and the ________________.

a) neighboring monosaccharide residues
b) organic base residues
c) phosphate residues

iv) The alternating monosaccharide and phosphate residues in a polynucleotide strand are referred to as the ____________.

a) glycophosphate backbone
b) sugar-phosphate backbone
c) glyphosate backbone

Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

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HINT:
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HINT:
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b) 3' carbon
~~c) neither of the above~~

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HINT:
a) neighboring monosaccharide residues
~~b) organic base residues~~
c) phosphate residues

iv) The alternating monosaccharide and phosphate residues in a polynucleotide strand are referred to as the _____________.

HINT:
a) glycophosphate backbone
b) sugar-phosphate backbone
~~c) glyphosate backbone~~

Go back

For more help: See chapter 14 part 2 video or chapter 14 section 3 in the textbook.

Click here to check your answer

Go to next question

14.7) A polynucleotide is a polymer made from nucleotide residues that are bonded to each other in a linear sequence.

i) A chain of covalently bonded nucleotides is referred to as ______________.

a) an oxy-deoxy chain
b) a strand
c) a chromosome
d) DNA polymerase

ii) In a polynucleotide, nucleotides are covalently bonded to each other by a phosphodiester bonding pattern between a 3' carbon on one monosaccharide and a ______________ on the other monosaccharide.

a) 5' carbon
b) 3' carbon
c) neither of the above

iii) In a polynucleotide, the nucleotides are connected to each other by covalent bonds between the monosaccharide residues and the ________________.

a) neighboring monosaccharide residues
b) organic base residues
c) phosphate residues

iv) The alternating monosaccharide and phosphate residues in a polynucleotide strand are referred to as the ____________.

a) glycophosphate backbone
b) sugar-phosphate backbone
c) glyphosate backbone

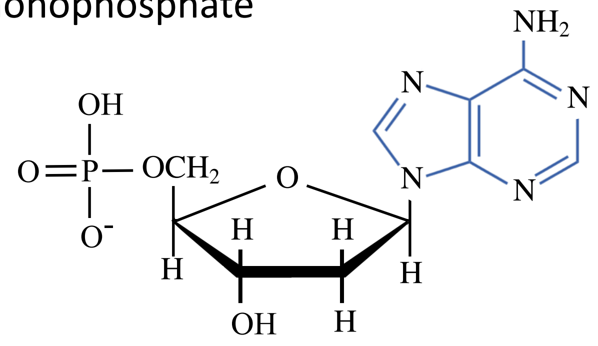
Go back

For more details: See chapter 14 part 2 video or chapter 14 section 3 in the textbook.

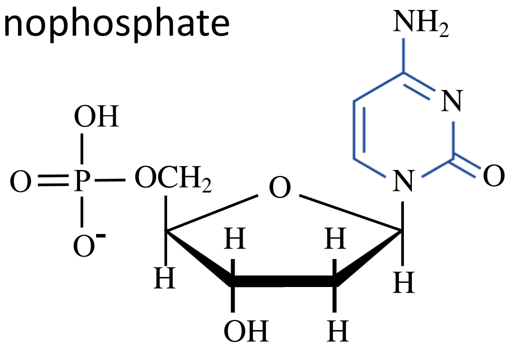
Go to next question

14.8) Draw the dinucleotide that is made by adding a *deoxyadenosine 5'-monophosphate* to the 3' carbon of a *deoxythymidine 5'-monophosphate* nucleotide residue.

deoxyadenosine 5'-monophosphate



deoxythymidine 5'-monophosphate



Go back

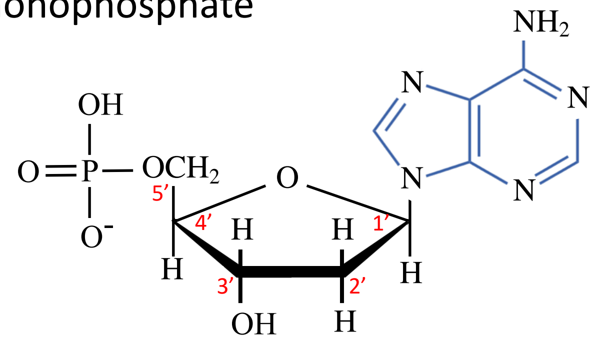
Click here for a **hint**

Click here to **check your answer**

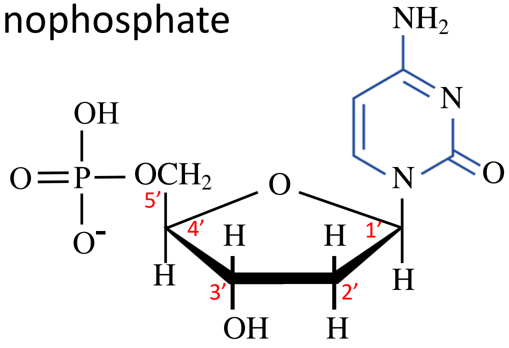
Go to next question

14.8) Draw the dinucleotide that is made by adding a *deoxyadenosine 5'-monophosphate* to the 3' carbon of a *deoxythymidine 5'-monophosphate* nucleotide residue.

deoxyadenosine 5'-monophosphate



deoxythymidine 5'-monophosphate



HINT:

Bond the two nucleotides to each other by a phosphodiester bonding pattern between the 3' carbon on one monosaccharide and the 5' carbon on the other monosaccharide.

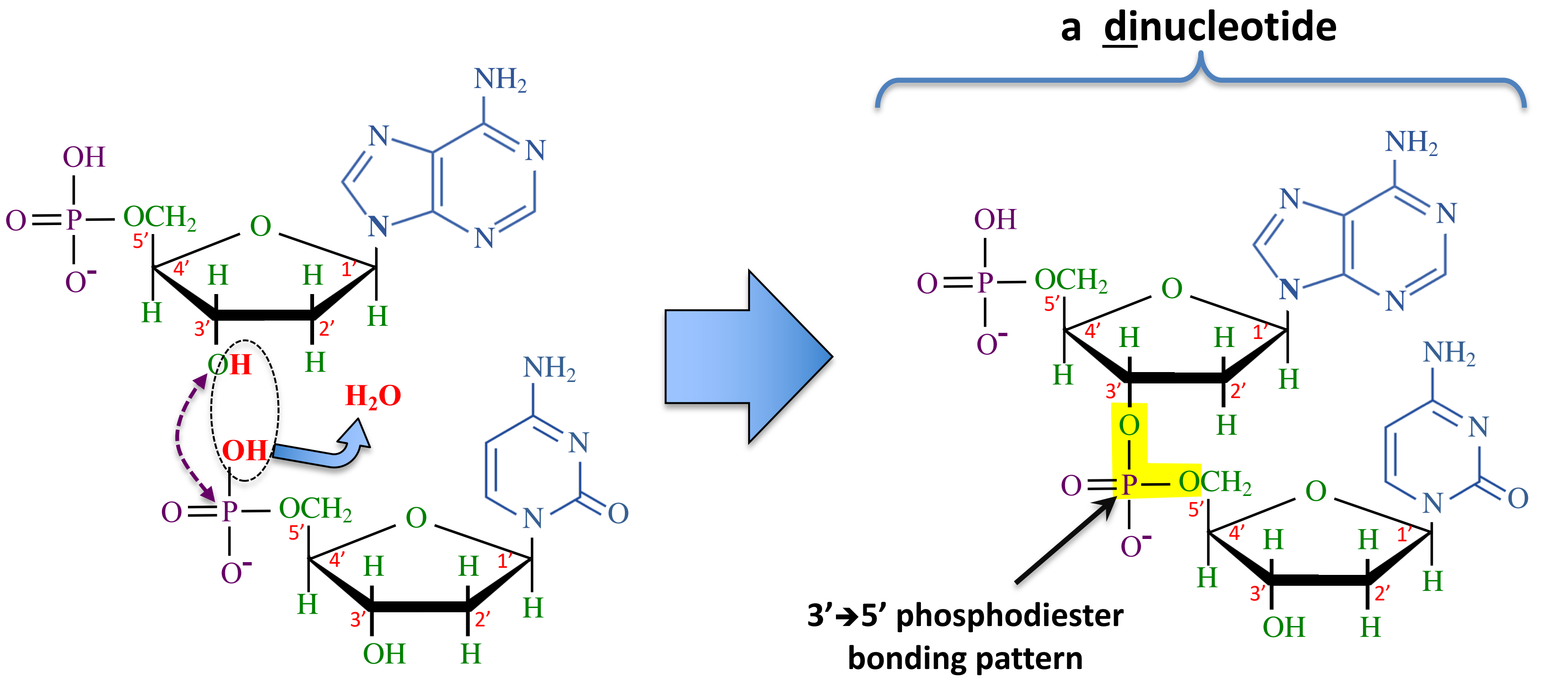
For more help: See chapter 14 part 2 video or chapter 14 section 3 in the textbook.

Go back

Click here to **check your answer**

Go to next question

14.8) Draw the dinucleotide that is made by adding a *deoxyadenosine 5'-monophosphate* to the 3' carbon of a *deoxythymidine 5'-monophosphate* nucleotide residue.



EXPLANATION:

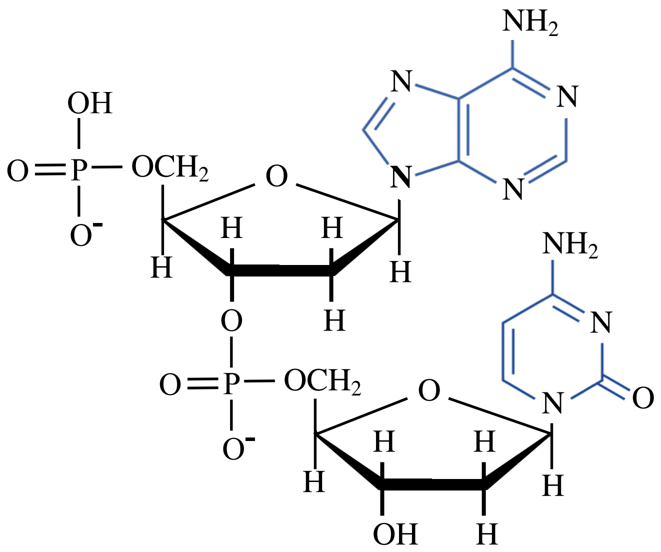
The two nucleotides are covalently bonded to each other by a phosphodiester bonding pattern between the 3' carbon on one monosaccharide and the 5' carbon on the other monosaccharide.

Go back

For more details: See chapter 14 part 2 video or chapter 14 section 3 in the textbook.

Go to next question

14.9) You drew the dinucleotide that is shown below in the previous problem. In that drawing, highlight (or circle) the phosphodiester bonding pattern.



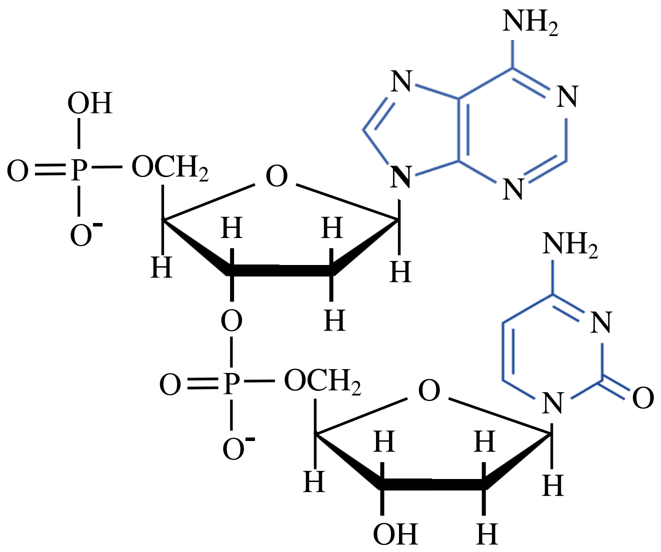
Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

14.9) You drew the dinucleotide that is shown below in the previous problem. In that drawing, highlight (or circle) the phosphodiester bonding pattern.



HINT:

A *phosphodiester bonding pattern* occurs when a phosphate group is bonded between two other groups of atoms.

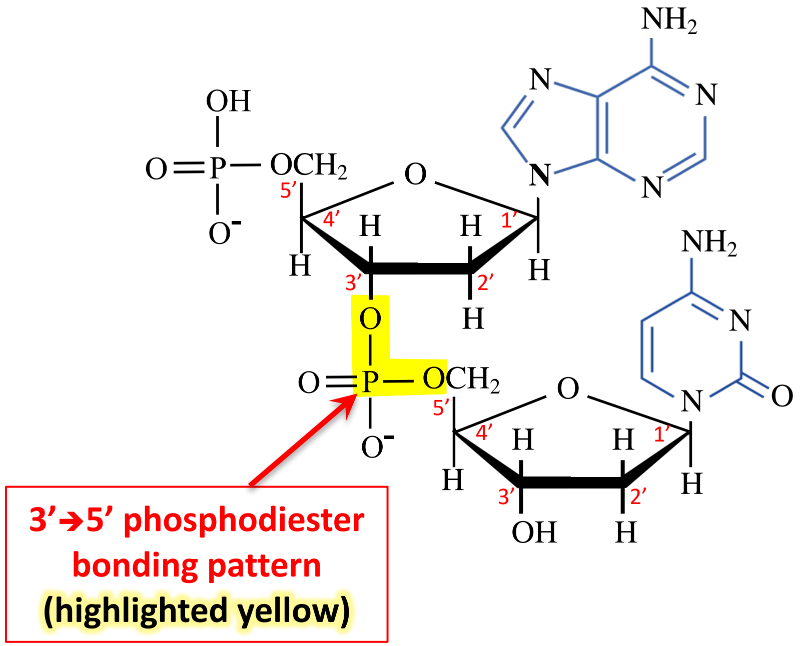
For more help: See chapter 14 part 2 video or chapter 14 section 3 in the textbook.

Go back

Click here to **check your answer**

Go to next question

14.9) You drew the dinucleotide that is shown below in the previous problem. In that drawing, highlight (or circle) the phosphodiester bonding pattern.



EXPLANATION:

In a dinucleotide, two nucleotides are covalently bonded to each other by a phosphodiester bonding pattern between a 3' carbon on one monosaccharide and a 5' carbon on the other monosaccharide.

A phosphodiester bonding pattern occurs when a phosphate group is bonded between two other groups of atoms.

In the case of polynucleotides, we call this bonding pattern a 3'→5' phosphodiester because the phosphate group is between the 3' and 5' carbons.

For more details: See chapter 14 part 2 video or chapter 14 section 3 in the textbook.

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Go to next question

14.10) DNA contains the "information" needed for life. This information enables cells to grow and divide. It is responsible for your physical characteristics, such as your height, skin tone, and eye color. Genetic information, the information used to make the various proteins and thereby enabling life, is contained in the sequence of nucleotides in DNA. DNA exists as a ***double helix***, which is made from **two** polynucleotide strands. Explain how the two strands are held together in DNA's double helix.

Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

14.10) DNA contains the "information" needed for life. This information enables cells to grow and divide. It is responsible for your physical characteristics, such as your height, skin tone, and eye color. Genetic information, the information used to make the various proteins and thereby enabling life, is contained in the sequence of nucleotides in DNA. DNA exists as a ***double helix***, which is made from **two** polynucleotide strands. Explain how the two strands are held together in DNA's double helix.

HINT:

Your answer should include the concept of **complementary base pairing** and you should mention type noncovalent interaction that is important in base pairing.

For more help: See chapter 14 part 2 video or chapter 14 section 3 in the textbook.

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Click here to **check your answer**

Go to next question

14.10) DNA contains the "information" needed for life. This information enables cells to grow and divide. It is responsible for your physical characteristics, such as your height, skin tone, and eye color. Genetic information, the information used to make the various proteins and thereby enabling life, is contained in the sequence of nucleotides in DNA. DNA exists as a ***double helix***, which is made from **two** polynucleotide strands. Explain how the two strands are held together in DNA's double helix.

YOUR ANSWER SHOULD BE SOMETHING LIKE THIS:

The two DNA strands are held together by especially strong hydrogen bonding between specific pairs of organic bases.

- Adenine (A) bases hydrogen bond with thymine (T) bases.
- Guanine (G) bases hydrogen bond with cytosine (C) bases.

The reason for the strong hydrogen bonding between these organic base pairs is that they have complementary shapes. The hydrogen bonding between these pairs of organic bases is referred to as **base pairing** or **complementary base pairing**. We say that the two polynucleotide strands in a double-stranded DNA particle are "complementary."

For more details: See chapter 14 part 2 video or chapter 14 section 3 in the textbook.

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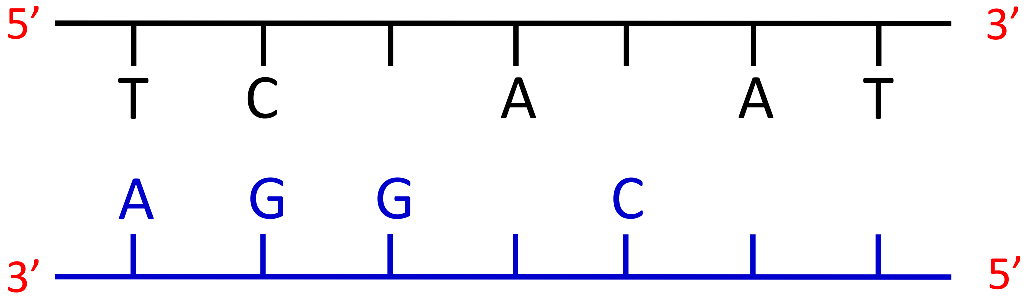
Go to next question

14.11) Fill in the missing one-letter abbreviations for the organic bases in the image below to show the correct DNA-DNA complementary base pairing.



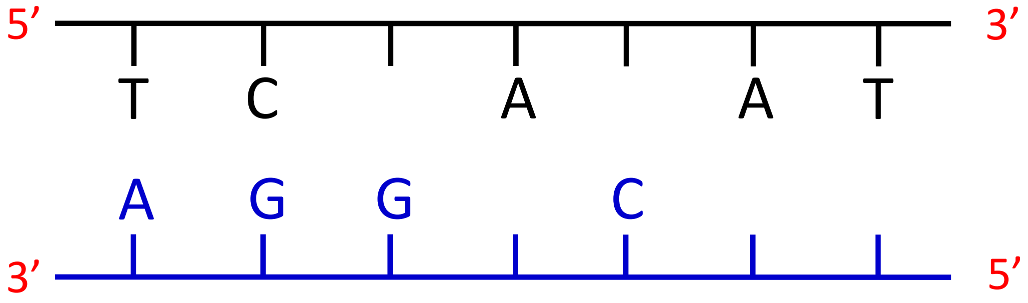
Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

14.11) Fill in the missing one-letter abbreviations for the organic bases in the image below to show the correct DNA-DNA complementary base pairing.



HINT:

G base pairs with C
A base pairs with T

For more help: See chapter 14 part 2 video or chapter 14 section 3 in the textbook.

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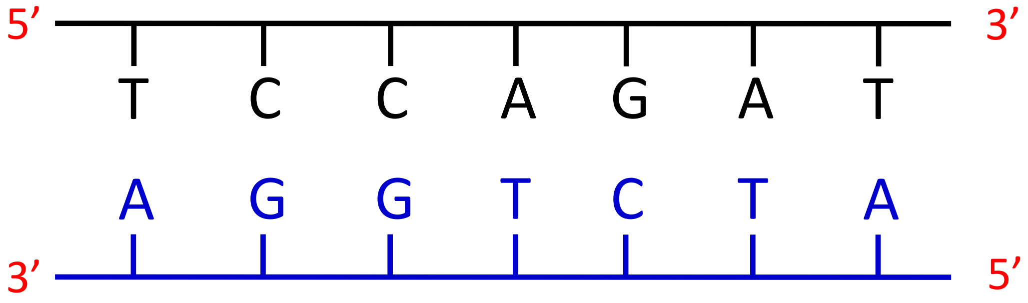
Click here to **check your answer**

Go to next question

14.11) Fill in the missing one-letter abbreviations for the organic bases in the image below to show the correct DNA-DNA complementary base pairing.



EXPLANATION:

G base pairs with C
A base pairs with T

For more details: See chapter 14 part 2 video or chapter 14 section 3 in the textbook.

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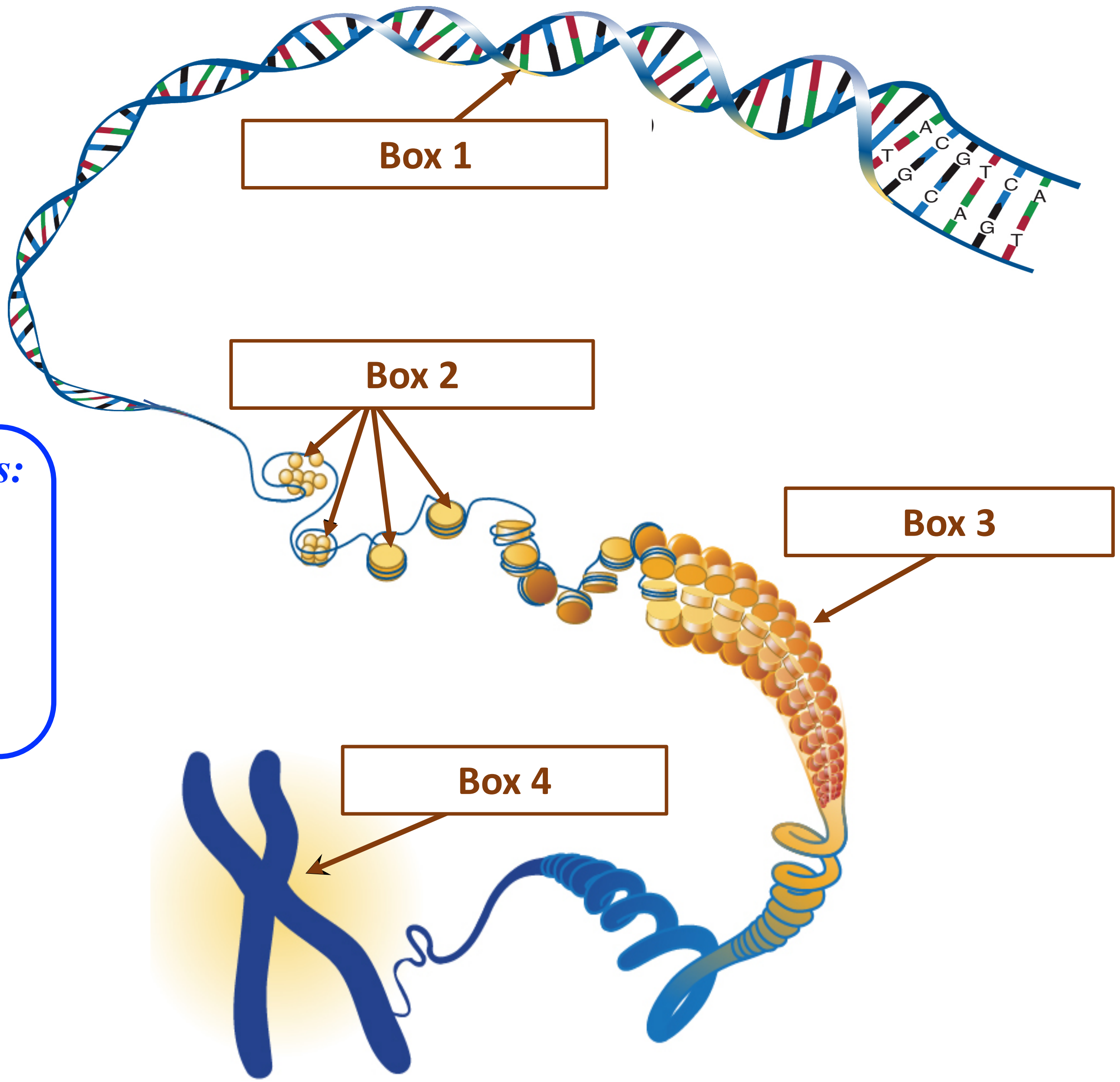
Go to next question

14.12) In eukaryotic organisms (plants, animals, and fungi), the DNA double helix coils into a more compact structure, as illustrated in the figure on the right. This coiling is necessary in order for the DNA to be contained in a cell's nucleus. In humans, if a typical DNA particle were uncoiled, it would be about six feet long.



Match each of the **boxes** in the figure with the ***type of structure*** that it represents.

a) **Box 1**: ___________________

b) **Box 2**: ___________________

c) **Box 3**: ___________________

d) **Box 4**: ___________________

type of structure choices:

a) **chromatin**
b) **DNA double helix**
c) **chromosome**
d) **histone protein**

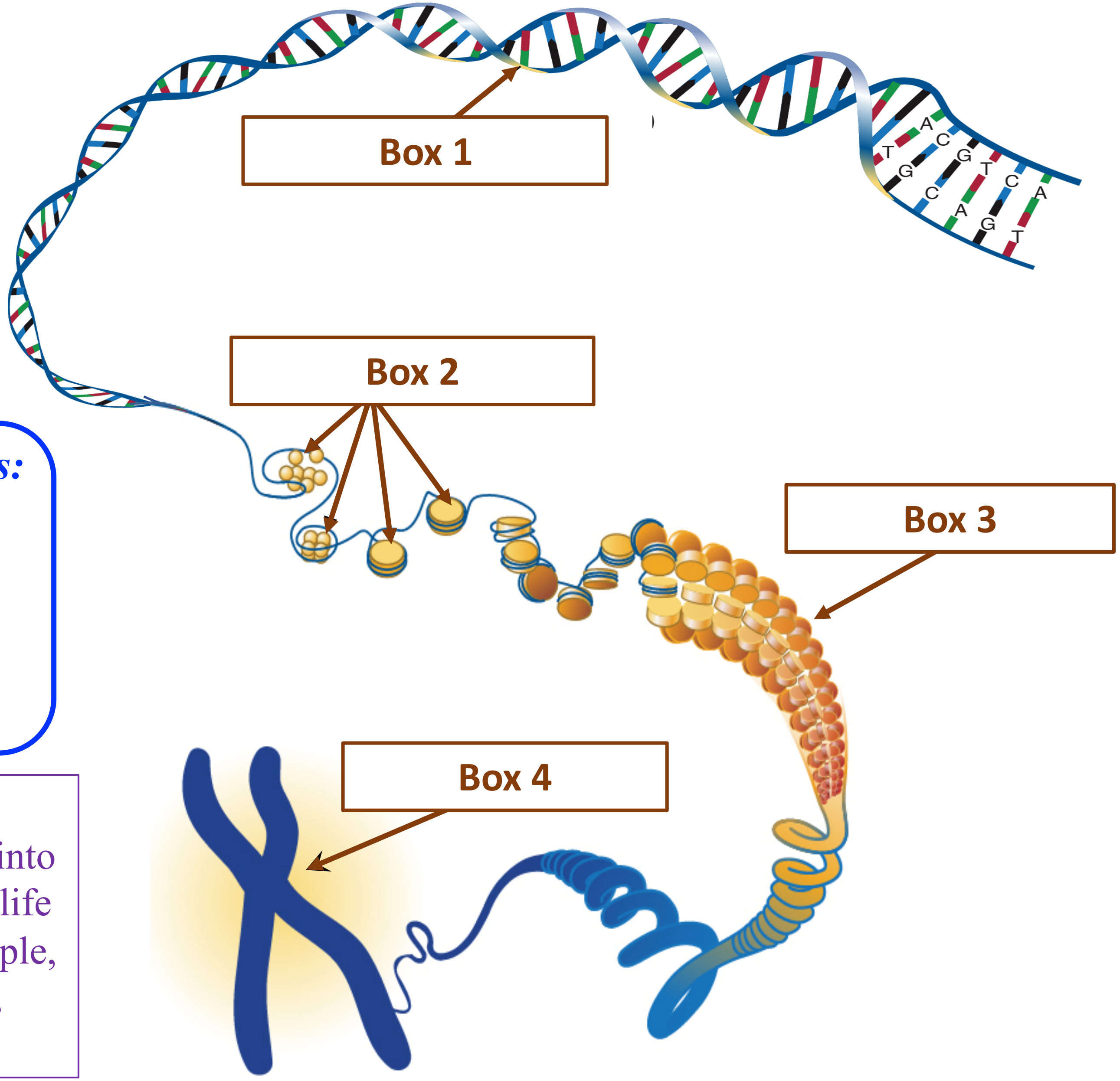
Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

14.12) In eukaryotic organisms (plants, animals, and fungi), the DNA double helix coils into a more compact structure, as illustrated in the figure on the right. This coiling is necessary in order for the DNA to be contained in a cell's nucleus. In humans, if a typical DNA particle were uncoiled, it would be about six feet long.



Match each of the **boxes** in the figure with the ***type of structure*** that it represents.

a) **Box 1**: ________________

b) **Box 2**: ________________

c) **Box 3**: ________________

d) **Box 4**: ________________

type of structure choices:

a) **chromatin**
b) **DNA double helix**
c) **chromosome**
d) **histone protein**

HINT: In the coiling process, the double helix wraps around **histone proteins**. The DNA/histone further condenses into a fiber that is called **chromatin**. Depending on the cell life cycle, chromatin can undergo further coiling. For example, before a cell divides chromatin is coiled into its tightest, most compact shape, which is called a **chromosome**.

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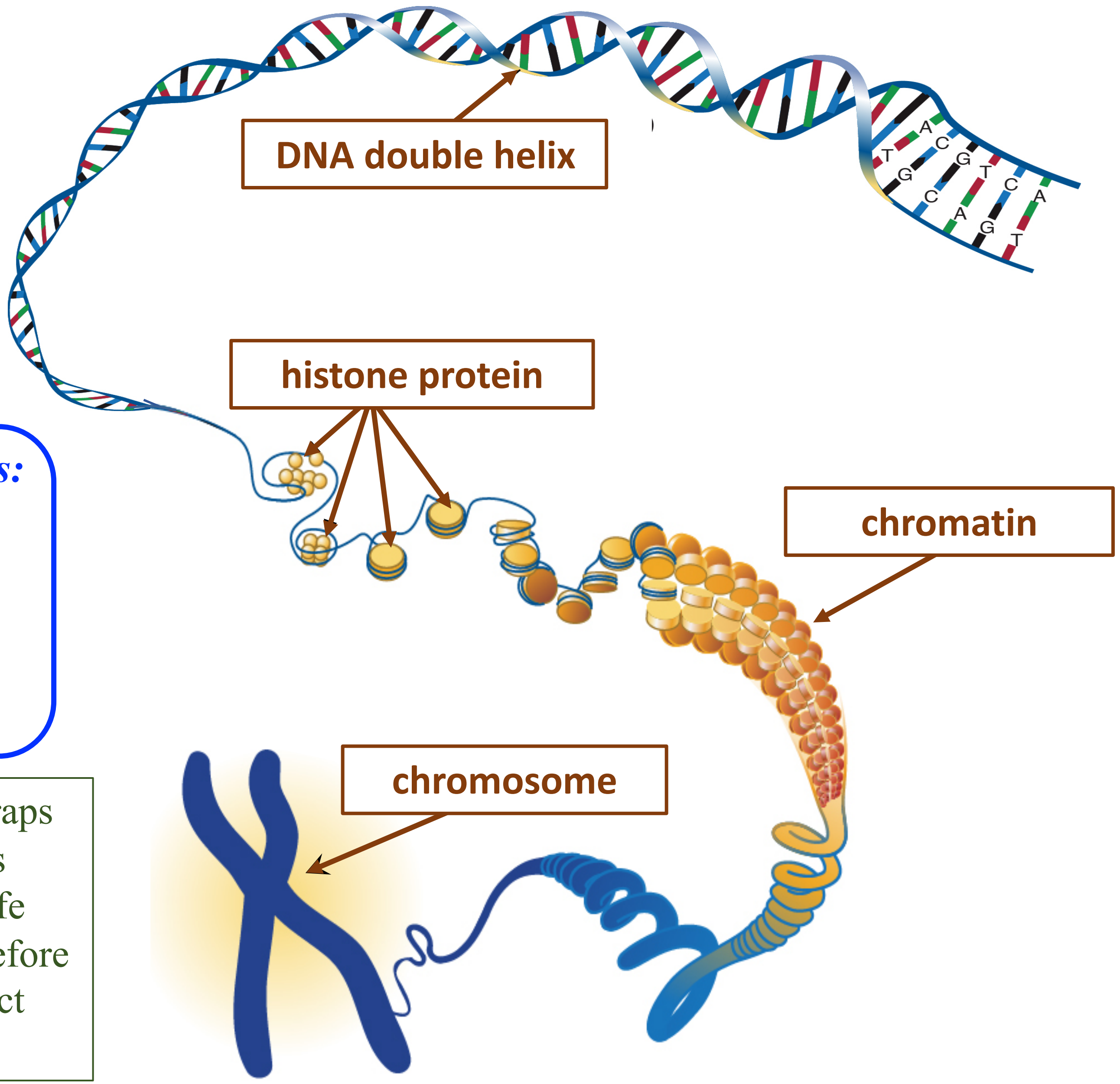
For more help: See chapter 14 part 3 video or chapter 14 section 3 in the textbook.

Click here to check your answer

Go to next question

14.12) In eukaryotic organisms (plants, animals, and fungi), the DNA double helix coils into a more compact structure, as illustrated in the figure on the right. This coiling is necessary in order for the DNA to be contained in a cell's nucleus. In humans, if a typical DNA particle were uncoiled, it would be about six feet long.



Match each of the **boxes** in the figure with the ***type of structure*** that it represents.

a) **Box 1**: (b) DNA double helix

b) **Box 2**: (d) histone protein

c) **Box 3**: (a) chromatin

d) **Box 4**: (c) chromosome

type of structure choices:

a) chromatin
b) DNA double helix
c) chromosome
d) histone protein

EXPLANATION: In the coiling process, the double helix wraps around **histone proteins**. The DNA/histone further condenses into a fiber that is called **chromatin**. Depending on the cell life cycle, chromatin can undergo further coiling. For example, before a cell divides chromatin is coiled into its tightest, most compact shape, which is called a **chromosome**.

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For more details: See chapter 14 part 3 video or chapter 14 section 3 in the textbook.

Go to next question

14.13) Determine whether each of the items shown below describe **DNA**, **RNA**, or **both DNA and RNA**.

a) nucleic acid

b) usually single-stranded

c) found in chromatin

d) found in chromosome

e) contains adenine

f) contains five-carbon monosaccharides

g) contains uracil

h) contains deoxyribose

i) contains ribose

Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

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d) found in chromosome

e) contains adenine

f) contains five-carbon monosaccharides

g) contains uracil

h) contains deoxyribose

i) contains ribose

HINT:

Review the video that discusses these topics (or read/re-read about them in the textbook, chapter 14, section 3).

Link to video: chapter 14 part 3 video

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Click here to **check your answer**

Go to next question

14.13) Determine whether each of the items shown below describe **DNA**, **RNA**, or **both DNA and RNA**.

a) nucleic acid **both DNA and RNA**

b) usually single-stranded **RNA**

c) found in chromatin **DNA**

d) found in chromosome **DNA**

e) contains adenine **both DNA and RNA**

f) contains five-carbon monosaccharides **both DNA and RNA**

g) contains uracil **RNA**

h) contains deoxyribose **DNA**

i) contains ribose **RNA**

For more details: See chapter 14 part 3 video or chapter 14 section 3 in the textbook.

Go back

Go to next question

14.14) Choose whether each of the following statements about DNA replication is **true** or **false**.

a) A double helix can be converted to two identical double helices.

b) If the sequence within a parent template strand is 5'-ATATGGC-3', then the sequence of its daughter strand would be 5'-TATACCG-3'.

c) One of the double helices produced in DNA replication contains the two parent strands, and the other double helix contains the two daughter strands.

d) The two parent strands are complementary to each other and therefore, the two daughter strands are complementary to each other.

e) DNA polymerase moves in the direction from 3' terminus of the parent (template) DNA strands toward the 5' terminus of the parent strands.

f) DNA polymerase catalyzes the addition of nucleotides to the 3' terminus of the growing daughter strand.

14.14) Choose whether each of the following statements about DNA replication is **true** or **false**.

a) A double helix can be converted to two identical double helices.
b) If the sequence within a parent template strand is 5’-ATATGGC-3’, then the sequence of its daughter strand would be 5’-TATACCG-3’.
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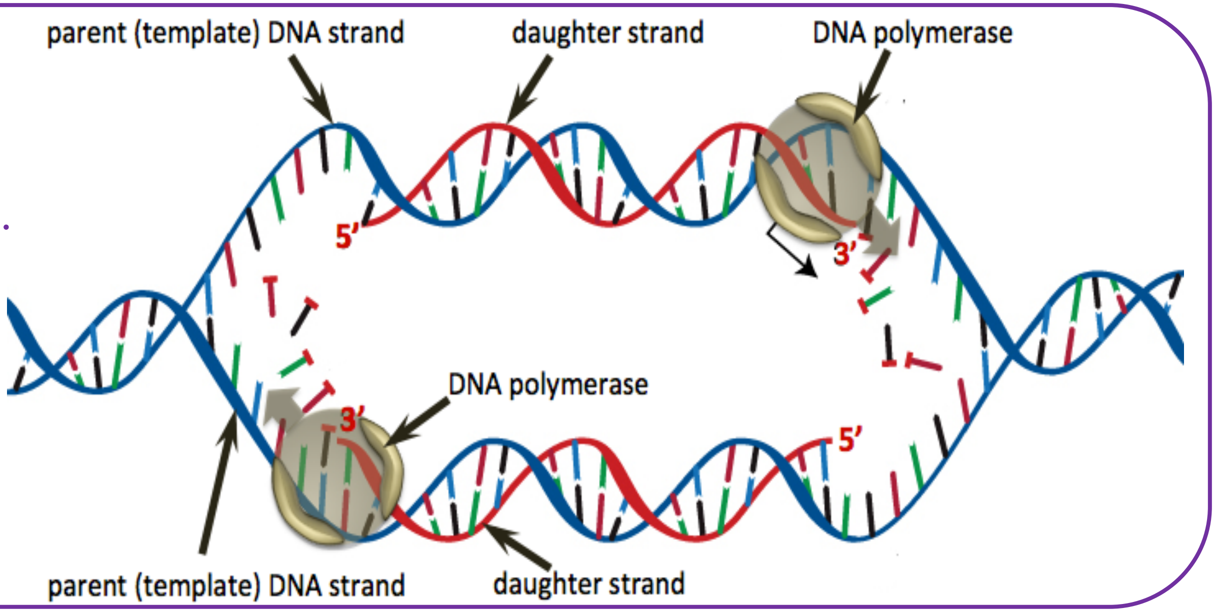
e) DNA polymerase moves in the direction from 3’ terminus of the parent (template) DNA strands toward the 5’ terminus of the parent strands.
f) DNA polymerase catalyzes the addition of nucleotides to the 3’ terminus of the growing daughter strand.

HINT: Use this figure to help you answer the question.



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For more help: See chapter 14 part 4 video or chapter 14 section 4 in the textbook.

Click here to check your answer

Go to next question

14.14) Choose whether each of the following statements about DNA replication is **true** or **false**.

a) A double helix can be converted to two identical double helices. **true**

b) If the sequence within a parent template strand is 5'-ATATGGC-3', then the sequence of its daughter strand would be 5'-TATACCG-3'. **false** - The sequence of its daughter strand would be 3'-TATACCG-5'.

c) One of the double helices produced in DNA replication contains the two parent strands, and the other double helix contains the two daughter strands. **false** - Each of the double helices produced in DNA replication contains the one parent strands and one daughter strand.

d) The two parent strands are complementary to each other and therefore, the two daughter strands are complementary to each other. **true**

e) DNA polymerase moves in the direction from 3' terminus of the parent (template) DNA strands toward the 5' terminus of the parent strands. **true** - DNA polymerase catalyzes the addition of nucleotides to the 3' terminus of the *growing daughter strand*. In order to do this, DNA polymerase moves along the parent (template) strand in the direction from 3' terminus to 5' terminus of the parent strand.

f) DNA polymerase catalyzes the addition of nucleotides to the 3' terminus of the growing daughter strand. **true**

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For more details: See chapter 14 part 4 video or chapter 14 section 4 in the textbook.

Go to next question

14.15) The information contained in the sequence of DNA nucleotides is used to generate proteins. This process is central to the existence of all known lifeforms because proteins are critical in directing and controlling cell growth and function, and in regulating an organism's metabolism. Define each of the following terms that are often used in discussing this process.

a) gene

b) gene expression

c) transcription

d) messenger RNA

e) translation

f) codon

Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

14.15) The information contained in the sequence of DNA nucleotides is used to generate proteins. This process is central to the existence of all known lifeforms because proteins are critical in directing and controlling cell growth and function, and in regulating an organism's metabolism. Define each of the following terms that are often used in discussing this process.

a) gene

b) gene expression

c) transcription

d) messenger RNA

e) translation

f) codon

HINT:

Review the videos that discuss these topics (or read/re-read about them in the textbook, chapter 14, section 5).

Videos links: chapter 14 part 5 and part 6

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Click here to **check your answer**

Go to next question

14.15) The information contained in the sequence of DNA nucleotides is used to generate proteins. This process is central to the existence of all known lifeforms because proteins are critical in directing and controlling cell growth and function, and in regulating an organism's metabolism. Define each of the following terms that are often used in discussing this process.

a) gene - A region of DNA that carries the information needed to produce a protein.

b) gene expression - The process of making proteins from the information in DNA.

c) transcription - The first step in protein synthesis is called **transcription**. In the transcription process, the information (sequence of nucleotides) in a gene is used to create a specific sequence of ribonucleotides in a single-stranded messenger RNA (mRNA) particle.

d) messenger RNA - a single-stranded RNA particle that is made in the transcription process. The genetic information (sequence of DNA nucleotides) that was in a gene is "transcribed" to the sequence of RNA nucleotides in **messenger RNA** (mRNA).

e) translation - Translation is the final step in protein synthesis. In the translation process, the genetic information that was transcribed to mRNA is used to construct the polypeptide chains that make up proteins.

f) codon - three-nucleotide mRNA sequences that directs the addition of a specific amino acid residue to a polypeptide that is being formed.

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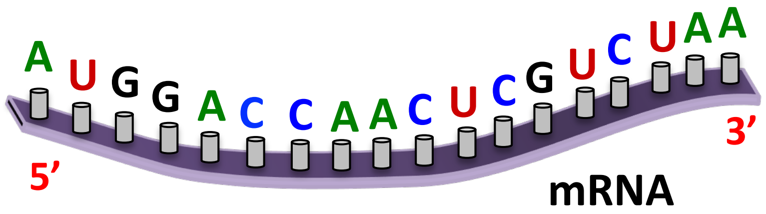
For more details: See chapter 14 part 5 and part 6 videos or chapter 14 section 5 in the textbook.

Go to next question

14.16) Write the three-letter abbreviations for the amino acid residues, in order from N-terminus to C-terminus, of the polypeptide that would be produced in the translation of the mRNA illustrated below. Recall that in translation, polypeptides are formed in the direction from their N-terminus to the C-terminus.



Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

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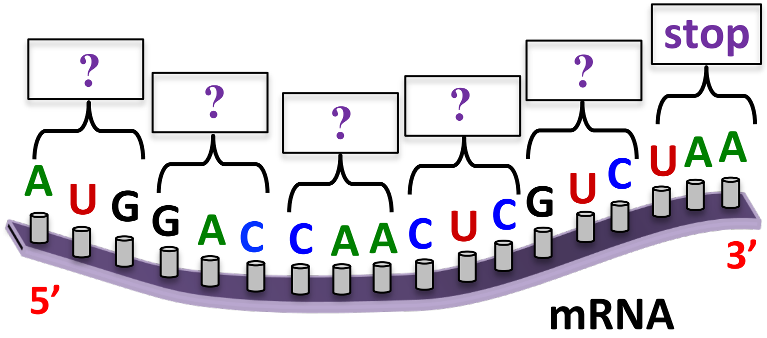

HINT:

In translation, the sequence of nucleotides in mRNA, is converted (translated) to a sequence of amino acid residues in a polypeptide. This is done using the **genetic code**. The genetic code is based on three-nucleotide sequences, called **codons**. A codon directs *the addition of a specific amino acid residue* to a polypeptide that is being formed. For example, the mRNA three-nucleotide sequence (codon) **GAU** codes for the addition of an aspartic acid (Asp) amino acid residue to a growing polypeptide chain. A genetic code table is in your lecture notes and textbook.

The "start" codon (**AUG**) determines the first amino acid residue to be used in the polypeptide. Peptides are synthesized in the direction from their **N**-terminus to their **C**-terminus. The "stop" codons determine the final amino acid to be added to the polypeptide.

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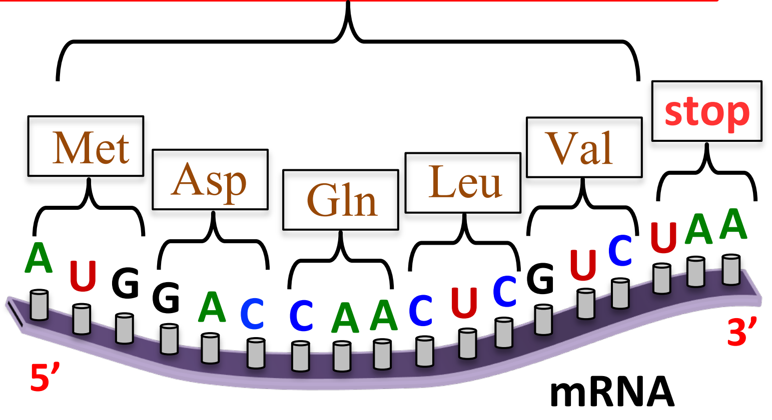
For more help: See chapter 14 part 5 and part 6 videos or chapter 14 section 5 in the textbook.

Click here to **check your answer**

Go to next question

14.16) Write the three-letter abbreviations for the amino acid residues, in order from N-terminus to C-terminus, of the polypeptide that would be produced in the translation of the mRNA illustrated below. Recall that in translation, polypeptides are formed in the direction from their N-terminus to the C-terminus.

ANSWER: Met-Asp-Gln-Leu-Val



EXPLANATION:

In translation, the sequence of nucleotides in mRNA, is converted (translated) to a sequence of amino acid residues in a polypeptide. This is done using the **genetic code**. The genetic code is based on three-nucleotide sequences, called **codons**. A codon directs *the addition of a specific amino acid residue* to a polypeptide that is being formed. A genetic code table is in your lecture notes and textbook.

The "start" codon (**AUG**) determines the first amino acid residue to be used in the polypeptide. Peptides are synthesized in the direction from their **N**-terminus to their **C**-terminus. The "stop" codons determine the final amino acid to be added to the polypeptide.

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For more details: See chapter 14 part 5 and part 6 videos or chapter 14 section 5 in the textbook.

Go to next question

14.17) In translation, the sequence of nucleotides in mRNA, is converted (translated) to a sequence of amino acid residues in a polypeptide. Translation involves ***three types of RNA***: transfer (tRNA), messenger RNA (mRNA), and ribosomal RNA (rRNA). Determine whether each of the items below are associated with **tRNA**, **mRNA**, or **rRNA**.

a) codon

b) anti-codon

c) combines with protein to form ribosomes

d) carries genetic information from nucleus to cytoplasm

e) transports amino acids

Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

14.17) In translation, the sequence of nucleotides in mRNA, is converted (translated) to a sequence of amino acid residues in a polypeptide. Translation involves ***three types of RNA***: transfer (tRNA), messenger RNA (mRNA), and ribosomal RNA (rRNA). Determine whether each of the items below are associated with **tRNA**, **mRNA**, or **rRNA**.

a) codon

b) anti-codon

c) combines with protein to form ribosomes

d) carries genetic information from nucleus to cytoplasm

e) transports amino acids

HINT:

Because translation is a fairly complicated process, it is often described by ***three steps***: **initiation**, **elongation**, and **termination**. These steps are discussed the textbook (chapter 14 section 5) and lecture notes. Review these three steps to recall how the various types of RNA are involved in translation.

Alternatively, review chapter 14 part 5 and part 6 videos.

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Click here to **check your answer**

Go to next question

14.17) In translation, the sequence of nucleotides in mRNA, is converted (translated) to a sequence of amino acid residues in a polypeptide. Translation involves ***three types of RNA***: transfer (tRNA), messenger RNA (mRNA), and ribosomal RNA (rRNA). Determine whether each of the items below are associated with **tRNA**, **mRNA**, or **rRNA**.

a) codon **mRNA** - mRNA produced in the transcription process contains the information (message) from a gene that is required to produce a protein. The information is in three-nucleotide mRNA sequences, called codons.

b) anti-codon **tRNA** - One region of tRNA has a site that attaches to an amino acid residue, and another region contains a three-nucleotide sequence called an *anticodon*. The particular amino acid that a tRNA carries depends on the three-nucleotide sequence in its anticodon. Anticodons are *complementary* to mRNA codons.

c) combines with protein to form ribosomes **rRNA**

d) carries genetic information from nucleus to cytoplasm **mRNA** - mRNA is produced in the nucleus during the transcription process. In eukaryotic cells, mRNA exits the nucleus through pores in the nuclear membrane and enters the cytoplasm where the protein synthesis process will be completed.

e) transports amino acids **tRNA** - The function of a tRNA particle is to carry and then transfer the amino acid that is specified by an mRNA codon to a growing peptide chain.

EXPLANATION:

Because translation is a fairly complicated process, it is often described by ***three steps***: **initiation**, **elongation**, and **termination**. These steps, that are discussed the textbook and lecture notes, describe how the various types of RNA are involved in translation.

For more details: See chapter 14 part 5 and part 6 videos or chapter 14 section 5 in the textbook.

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Go to next question

14.18) Write the three-letter abbreviations for the amino acid residues, in order from N-terminus to C-terminus, of the polypeptide that would be produced by the transcription and translation of DNA with a sequence of 3'-TACATATGGGGTACT-5'.

- CAUTION: In this question, you were given the sequence of DNA, not mRNA.

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Click here for a **hint**

Click here to **check your answer**

Go to next question

14.18) Write the three-letter abbreviations for the amino acid residues, in order from N-terminus to C-terminus, of the polypeptide that would be produced by the transcription and translation of DNA with a sequence of 3’-TACATATGGGGTACT-5’.

- CAUTION: In this question, you were given the sequence of DNA, not mRNA.

HINT:

STEP 1: Use the given sequence of DNA to determine the sequence of mRNA that would be made in the transcription process.

STEP 2: Use the sequence of mRNA from STEP 1 to determine the sequence of amino acids in the polypeptide that would be made during the translation process.

For more help: See chapter 14 part 5 and part 6 videos or chapter 14 section 5 in the textbook.

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Click here to **check your answer**

Go to next question

14.18) Write the three-letter abbreviations for the amino acid residues, in order from N-terminus to C-terminus, of the polypeptide that would be produced by the transcription and translation of DNA with a sequence of 3'-TACATATGGGTACT-5'.

- CAUTION: In this question, you were given the sequence of DNA, not mRNA.

ANSWER: Met-Tyr-Thr-Pro

EXPLANATION:

STEP 1: Use the given sequence of DNA to determine the sequence of mRNA that would be made in the transcription process.

DNA: 3'-TACATATGGGTACT-5'

This sequence of DNA would be transcribed to:

mRNA: 5'-AUGUAUACCCAUGA-3'

STEP 2: Use the sequence of mRNA from STEP 1 to determine the sequence of amino acids in the polypeptide that would be made during the translation process.

These five codons would be translated to the amino acid sequence:

(N-terminus) Met-Tyr-Thr-Pro (C-terminus)

For more details: See chapter 14 part 5 and part 6 videos or chapter 14 section 5 in the textbook.

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Go to next question

14.19) Determine whether each of the following statements refer to **DNA**, **RNA**, **both DNA and RNA**, or **neither DNA nor RNA**.

a) exists as double stranded

b) has sugar-phosphate backbone

c) uracil base pairs with adenine

d) has only one function

e) has several functions

f) involved in transcription

g) involved in translation

h) involved in replication

i) exists as single strand

j) is the product of translation

Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

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HINT:

Review the videos that discuss these topics (or read/re-read about them in the textbook, chapter 14, section 5).

Videos links: chapter 14 part 5 and part 6

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Click here to **check your answer**

Go to next question

14.19) Determine whether each of the following statements refer to **DNA**, **RNA**, **both DNA and RNA**, or **neither DNA nor RNA**.

a) exists as double stranded **DNA**

b) has sugar-phosphate backbone **both DNA and RNA**

c) uracil base pairs with adenine **RNA** - in DNA, thymine base pairs with adenine.

d) has only one function **DNA -** DNA has just one function: storing genetic information.

e) has several functions **RNA** – consider the function of mRNA, tRNA, and rRNA

f) involved in transcription **both DNA and RNA** – in transcription, the information in DNA is used to make mRNA.

g) involved in translation **RNA** – in translation, the information in mRNA is used to make a specific peptide/protein.

h) involved in replication **DNA** – in replication, daughter DNA strands are made from parent DNA templates.

i) exists as single strand **RNA** - DNA exists as double stranded

j) is the product of translation **neither DNA nor RNA** - in translation, a peptide/protein is produced.

For more details: See chapter 14 part 5 and part 6 videos or chapter 14 section 5 in the textbook.

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Go to next question

14.20) Determine whether each of the following items refer to **replication**, **transcription**, or **translation.**

a) DNA polymerase is involved

b) Both DNA strands of a double helix are duplicated

c) requires tRNA

d) RNA polymerase is involved

e) amino acids are added to a peptide chain

f) a single DNA strand is used to produce mRNA

g) a ribosome is involved

Go back

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Videos links: chapter 14 part 5 and part 6

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Go to next question

14.20) Determine whether each of the following items refer to **replication**, **transcription**, or **translation.**

a) DNA polymerase is involved **replication** - In replication, DNA polymerase catalyzes the addition of free deoxyribonucleotides, that are complementary to the DNA parent strand template, to the 3' end of a growing daughter DNA strand.

b) Both DNA strands of a double helix are duplicated **replication** - In replication, both DNA parent strands in a double helix are duplicated to produce two daughter DNA strands.

c) requires tRNA **translation** - In translation, tRNA carries and then transfer an amino acid that is specified by an mRNA codon to a growing peptide chain.

d) RNA polymerase is involved **transcription** - In transcription, RNA polymerase catalyzes the addition of free ribonucleotides, that are complementary to the DNA template, to the 3' end of a growing mRNA strand.

e) amino acids are added to a peptide chain **translation** - In translation, the information in mRNA is used to make a particular peptide by adding amino acid residues that are specified in mRNA codons to a growing peptide chain.

f) a single DNA strand is used to produce mRNA **transcription**

g) a ribosome is involved **translation** - The function of ribosomes is to provide a structure upon which polypeptides can be produced in the translation process.

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For more details: See chapter 14 part 5 and part 6 videos or chapter 14 section 5 in the textbook.

Go to next question

14.21) ***One way to control metabolic pathways***, or other conditions that involve proteins, is to **regulate the rate of production of a protein/enzyme**. This is called controlling ***gene expression*** (*gene expression* is another term used for *protein synthesis*). Because organisms have several thousand genes, it would be inefficient and harmful to *continually express* (continually make proteins from) all genes. Increasing the rate of gene expression is called **upregulation** of the gene; decreasing the rate of gene expression is called **downregulation** of the gene.

Determine whether each of the following conditions would result in the genes of the *lac operon* being **upregulated** or **downregulated**.

a) RNA polymerase is able to move move along the lac operon

b) Allolactose binds to the repressor protein

c) Lactose concentration within a cell is increased

d) Allolactose concentration within a cell is increased

e) Glucose is not available

f) Active repressor proteins are present in the absence of allolactose

Go back

Click here for a **hint**

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Go to next question

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HINT:

The ***regulation of gene expression*** may seem a bit complicated when you first consider it. It would be helpful to ***review*** the video that discusses this topic (or read/re-read about it in the textbook, chapter 14, end of section 5).

Link to video: chapter 14 part 7 video

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Click here to **check your answer**

Go to next question

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a) RNA polymerase is able to move move along the lac operon **upregulation**

b) Allolactose binds to the repressor protein **upregulation**

c) Lactose concentration within a cell is increased **upregulation**

d) Allolactose concentration within a cell is increased **upregulation**

e) Glucose is not available **upregulation**

f) Active repressor proteins are present in the absence of allolactose **downregulation**

EXPLANATION: The ***regulation of gene expression*** may seem a bit complicated when you first consider it. You may wish to ***review*** the video that discusses this topic (or read about it in the textbook, chapter 14, end of section 5).

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Go to next question

14.22)

i) Viruses are small particles that are not able to ____________________ on their own.

a) exist
b) reproduce
c) invade host cells

ii) All viruses have a ____________________ shell that encapsulates either DNA or RNA.

a) lipid
b) protein
c) polysaccharide
d) nucleic acid

iii) HIV is in a category of viruses called ____________________.

a) influenza viruses
b) host cell viruses
c) DNA viruses
d) retroviruses

iv) When taken into the host cell, the information in the retroviral RNA is converted to complementary DNA. This is called ____________________.

a) hosting
b) reverse translation
c) reverse transcription
d) reverse replication

Go back

Click here for a **hint**

Click here to **check your answer**

Go to next question

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i) Viruses are small particles that are not able to ____________________ on their own.

HINT: a) ~~exist~~
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c) polysaccharide
d) ~~nucleic acid~~

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HINT: a) ~~influenza viruses~~
b) host cell viruses
c) DNA viruses
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HINT: a) ~~hosting~~
b) reverse translation
c) reverse transcription
d) reverse replication

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For more help: See chapter 14 part 8 video or chapter 14 section 6 in the textbook.

Click here to check **your answer**

Go to next question

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For more details: See chapter 14 part 8 video or chapter 14 section 6 in the textbook.

Go to next question

14.23) All forms of life can have their cells invaded by viruses. When viruses take over plant or animal cells, we call this a viral infection. Several human infectious diseases, some of which are chronic diseases, are caused by viral infection. Using full sentences, explain how viruses infect cells and how the infection spreads to other cells in an organism.

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Click here for a **hint**

Click here to **check your answer**

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HINT:

Viruses infect cells by introducing their ________ or _________ and, in some cases, a few types of enzymes, into the host cell. This is done in various ways depending on the particular virus. Once the viral DNA or RNA is introduced to the host cell, enzymes, nucleic acids, and amino acids from the host cell are employed to make more viral DNA or viral RNA, and viral proteins. The viral DNA or RNA and viral proteins are reassembled into multiple, new virus particles within the host cell. These new viral particles cause the host cell to _________ or release the viral particles using the exocytosis process. The infection spreads as the new viruses infect other cells.

For more help: See chapter 14 part 8 video or chapter 14 section 6 in the textbook.

Go back

Click here to **check your answer**

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YOUR ANSWER SHOULD BE SOMETHING LIKE THIS:

Viruses infect cells by introducing their DNA or RNA and, in some cases, a few types of enzymes, into the host cell. This is done in various ways depending on the particular virus. Once the viral DNA or RNA is introduced to the host cell, enzymes, nucleic acids, and amino acids from the host cell are employed to make more viral DNA or viral RNA, and viral proteins. The viral DNA or RNA and viral proteins are reassembled into multiple, new virus particles within the host cell. These new viral particles cause the host cell to burst or release the viral particles using the exocytosis process. The infection spreads as the new viruses infect other cells.

For more details: See chapter 14 part 8 video or chapter 14 section 6 in the textbook.

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Go to next question

14.24) Genetics is the study of genes, variation in genes, and heredity. The terms that are listed below are often used in discussions and literature involving genetics. Define each of these terms.

a) genome

b) mutation

c) mutagen

d) tumor

e) genetic disease

f) gene therapy

g) recombinant DNA

Go back

Click here for a **hint**

Click here to **check your answer**

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a) genome

b) mutation

c) mutagen

d) tumor

e) genetic disease

f) gene therapy

g) recombinant DNA

HINT:

It would be helpful to ***review*** the videos on **genetics** that discusses these terms (or read/re-read about them in the textbook, chapter 14 section 7.

Links to videos: chapter 14 part 9 and part 10

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Click here to **check your answer**

Go to next question

14.24) Genetics is the study of genes, variation in genes, and heredity. The terms that are listed below are often used in discussions and literature involving genetics. Define each of these terms.

a) genome - The information contained in the DNA of an organism.

b) mutation - A mutation is a permanent change in the nucleotide sequence in an organism's genome.
- Changes in the nucleic acid sequence of a gene (a mutation) can result in changes in the amino acid sequence of the protein that is expressed, and can thereby give rise to partially or completely nonfunctional proteins.

c) mutagen - A chemical or physical agent that induces mutations.
- Examples of *physical mutagens* are ultraviolet light (UV) and x-rays. Examples of *chemical mutagens* are hydrogen peroxide, superoxide ion (O^{2-}), polyaromatic hydrocarbons (PAHs), benzene, and some metals.

d) tumor - Cancer is a disease that results from *somatic mutations* in genes that are responsible for cell growth or cell differentiation. Such mutations cause the formation of a mass of mutated cells (cancer cells) called a **tumor**.

e) genetic disease - When a *constitutional mutation* causes a negative health condition, it is referred to as a **genetic disease**. If a mutated *germ line cell* is passed to an offspring, then it results in a *constitutional mutation*, which is a mutation occurring in the nuclei of every cell of the offspring.

f) gene therapy - Some genetic diseases can be treated by **gene therapy**, which involves the delivery of functional (unmutated) genes to the cells of an individual who has a monogenic disease.

g) recombinant DNA - DNA made from two or more sources. This is done by extracting copies of a gene from one organism and then inserting that gene into another organism's genome.

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For more details: See chapter 14 part 9 and part 10 videos or chapter 14 section 7 in the textbook.

Go to next question

14.25) Mutations can be classified as ***small-scale*** or ***large-scale***, depending on the number of nucleotides involved in the mutation. Small-scale mutations involve a change in a small number of nucleotides (usually one to three nucleotides) within a single gene. Large-scale mutations, sometimes called chromosomal mutations, involve changes in large sections of chromosomes.

Determine whether each of the following small-scale mutations is a **point mutation**, **insertion mutation**, or **deletion mutation**.

a) The sequence of nucleotides in part of a gene is changed from **CCGATG** to **CCGGATG**.

b) The sequence of nucleotides in part of a gene is changed from **CCGATG** to **CCGAGG**.

c) The sequence of nucleotides in part of a gene is changed from **CCGGAG** to **CTGGAG**.

d) The sequence of nucleotides in part of a gene is changed from **CCGATG** to **CCGACTG**.

e) The sequence of nucleotides in part of a gene is changed from **CCAGATG** to **CCGATG**.

Go back

Click here for a **hint**

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e) The sequence of nucleotides in part of a gene is changed from **CCAGATG** to **CCGATG**.

HINT: Small-Scale Mutations

- **Point mutation**: A single, incorrect nucleotide takes the place of the original nucleotide.
- **Insertion mutation**: One or more extra nucleotides are inserted between two of the original nucleotides in a gene.
- **Deletion mutation**: A single nucleotide or a short sequence (usually 2 or 3 nucleotides) are removed from a gene.

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For more help: See chapter 14 part 9 video or chapter 14 section 7 in the textbook.

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a) The sequence of nucleotides in part of a gene is changed from **CCGATG** to **CCGGATG**. **insertion mutation**

b) The sequence of nucleotides in part of a gene is changed from **CCGATG** to **CCGAGG**. **point mutation**

c) The sequence of nucleotides in part of a gene is changed from **CCGGAG** to **CTGGAG**. **point mutation**

d) The sequence of nucleotides in part of a gene is changed from **CCGATG** to **CCGACTG**. **insertion mutation**

e) The sequence of nucleotides in part of a gene is changed from **CCAGATG** to **CCGATG**. **deletion mutation**

EXPLANATION: Small-Scale Mutations

- **Point mutation**: A single, incorrect nucleotide takes the place of the original nucleotide.
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For more details: See chapter 14 part 9 video or chapter 14 section 7 in the textbook.

Go to next question

14.26) The inheritance of one or more mutated genes can result in a **genetic disease**. Some genetic diseases involve a particular gene, others involve multiple genes.

Match each of the following **genetic disease descriptions/examples** with one of the ***disease type choices***.

i) One **or** both copies of a particular gene contains a harmful mutation.

ii) Monogenic diseases that occur when both copies of a gene are mutated.

iii) Monogenic diseases that occur when one copy of the gene is not mutated and one copy is mutated.

iv) One or both copies of multiple, different genes contain a harmful mutation.

v) Hypertension, coronary heart disease, and diabetes are examples of this type of disease. (choose either monogenic or polygenic disease)

vi) sickle cell disease (choose either monogenic or polygenic disease)

***disease type choices*:**

a) recessive disease

b) polygenic disease

c) monogenic disease

d) dominant disease

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Click here for a **hint**

Click here to **check your answer**

Go to next question

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vi) sickle cell disease (choose either monogenic or polygenic disease)

***disease type choices*:**

a) recessive disease

b) polygenic disease

c) monogenic disease

d) dominant disease

HINT: It would be helpful to ***review*** the video on **genetics** that discusses these ***genetic diseases*** (or read/re-read about them in the textbook, chapter 14 section 7.

Links to video: chapter 14 part 9

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Click here to **check your answer**

Go to next question

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Match each of the following **genetic disease descriptions/examples** with one of the ***disease type choices***.

disease type choices:

a) recessive disease

b) polygenic disease

c) monogenic disease

d) dominant disease

i) One **or** both copies of a particular gene contains a harmful mutation.
c) monogenic disease

ii) Monogenic diseases that occur when both copies of a gene are mutated.
d) dominant disease

iii) Monogenic diseases that occur when one copy of the gene is not mutated and one copy is mutated. **a) recessive disease**

iv) One or both copies of multiple, different genes contain a harmful mutation.
b) polygenic disease

v) Hypertension, coronary heart disease, and diabetes are examples of this type of disease. (choose either monogenic or polygenic disease)
b) polygenic disease

vi) sickle cell disease (choose either monogenic or polygenic disease)
c) monogenic disease

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For more details: See chapter 14 part 9 video or chapter 14 section 7 in the textbook.

Go to next question

14.27) This final question for chapter 14 is meant to help you review the processes of **translation**, **transcription**, **reverse transcription**, and **replication**.

Fill in the blanks in each of the statements below using the following choices: **DNA**, **RNA**, or **protein**.

a) In **translation**, the information in __________________ is used to make _______________.

b) In **transcription**, the information in __________________ is used to make _______________.

c) In **reverse transcription**, the information in __________________ is used to make _______________.

d) In **replication**, the information in __________________ is used to make _______________.

Go back

Click here for a **hint**

Click here to **check your answer**

This is the last question.

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b) In **transcription**, the information in ____________________ is used to make _________________.

c) In **reverse transcription**, the information in ____________________ is used to make _________________.

d) In **replication**, the information in ____________________ is used to make _________________.

HINT:

It could be helpful to ***review*** the videos and/or your lecture notes on these topics or read/re-read about them in the textbook.

- Reverse transcription is discussed in the section/video on viruses.

Go back

Click here to **check your answer**

This is the last question.

14.27) This final question for chapter 14 is meant to help you review the processes of **translation**, **transcription**, **reverse transcription**, and **replication**.

Fill in the blanks in each of the statements below using the following choices: **DNA**, **RNA**, or **protein**.

a) In **translation**, the information in ____**RNA**____ is used to make ____**protein**____.

b) In **transcription**, the information in ____**DNA**____ is used to make ____**RNA**____.

c) In **reverse transcription**, the information in ____**RNA**____ is used to make ____**DNA**____.

d) In **replication**, the information in ____**DNA**____ is used to make ____**DNA**____.

Go back

This is the last question.