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## **Molecular Biology: DNA Replication**

**Printable Flashcards — Pre-Med Biology**

Replication machinery, leading and lagging strands, Okazaki fragments, and the S phase of the cell cycle.

120 cards — Print double-sided, flip on long edge, then cut along dashed lines.

120 cards — Printable Flashcards

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1

DNA replication happens in which part of the cell cycle?

2

What is being duplicated in S phase: chromosomes or DNA?

3

DNA replication is semiconservative.  
Translate that into plain words.

4

DNA replication is **semiconservative**:  
each daughter DNA has **one old**  
strand and **one new** strand.

5

Does DNA replication happen from one end to the other in one direction?

6

What is an origin of replication?

7

Replication bubble: what is it?

8

Replication fork: what is it?



2

DNA is duplicated; chromosomes become duplicated (two sister chromatids).

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1

S phase (interphase).

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4

DNA replication is semiconservative: each daughter DNA has one old strand and one new strand.

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3

Each new DNA molecule has one old strand and one newly made strand.

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6

A DNA site where replication begins and forks form.

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5

No. It starts at origins and moves bidirectionally (two forks).

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8

The Y-shaped region where DNA is being unwound and copied.

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7

The opened-up region of DNA around an origin, with two replication forks.

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9

Does DNA polymerase start DNA synthesis by itself from nothing?

10

What is a primer in replication?

11

DNA polymerase adds nucleotides to which end of the growing strand?

12

New DNA strand is synthesized in which direction?

13

Template strand is read by DNA polymerase in which direction?

14

DNA polymerase reads the template  $\{c1::3' \rightarrow 5'\}$  and synthesizes the new strand  $\{c2::5' \rightarrow 3'\}$ .

15

Why can't DNA polymerase synthesize DNA  $3' \rightarrow 5'$ ?

16

Antiparallel means...



10

A short nucleic acid piece (usually RNA) that provides a free 3' OH for DNA polymerase.

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9

No. It needs a primer with a free 3' OH.

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12

5' -> 3'.

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11

The 3' end (adds to the 3' OH).

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14

DNA polymerase reads the template 3' -> 5' and synthesizes the new strand 5' -> 3'.

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13

3' -> 5'.

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16

The two DNA strands run in opposite directions (one 5' -> 3', the other 3' -> 5').

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15

Chemistry: it needs an incoming nucleotide to provide energy and it can only extend from a 3' OH.

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17

If you had to memorize ONE direction fact: what's the safest anchor?

18

Leading strand: continuous or discontinuous synthesis?

19

Lagging strand: continuous or discontinuous synthesis?

20

Okazaki fragments are found on which strand?

21

Why does the lagging strand need multiple primers?

22

Which strand gets made in the same direction the fork moves?

23

Common wrong idea: lagging strand is made 3'→5'. True or false?

24

Both leading and lagging strands are synthesized  $\{c1::5' \rightarrow 3'\}$ ; lagging is just  $\{c2::discontinuous\}$ .



18

Continuous.

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17

DNA polymerase adds to the 3' OH, so synthesis is 5'→3'.

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20

Lagging strand.

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19

Discontinuous (Okazaki fragments).

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22

Leading strand.

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21

Each Okazaki fragment needs its own primer because synthesis keeps restarting.

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24

Both leading and lagging strands are synthesized 5'→3'; lagging is just discontinuous.

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23

False. BOTH strands are synthesized 5'→3'.

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25

What connects Okazaki fragments into one continuous strand?

26

If a stem says 'seals a nick in the sugar-phosphate backbone,' that's which enzyme?

27

Helicase: what does it do?

28

Single-strand binding proteins (SSB): what do they do?

29

Primase: what does it do?

30

DNA polymerase main job (in one line)?

31

Topoisomerase: why does the fork need it?

32

DNA gyrase is a type of what enzyme (in bacteria)?



26

DNA ligase.

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25

DNA ligase.

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28

Keep the separated DNA strands apart and protect them.

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27

Unwinds the DNA double helix at the replication fork.

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30

Adds DNA nucleotides to extend the new strand from a primer (5'→3').

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29

Makes short RNA primers on the DNA template.

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32

Topoisomerase (type II) that relieves supercoiling.

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31

Unwinding creates supercoiling ahead of the fork; topoisomerase relieves that torsional stress.

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33

Sliding clamp: what is its purpose (concept)?

34

Clamp loader: what does it do?

35

DNA ligase uses what to seal DNA (energy)?

36

Proofreading: which enzyme activity removes a wrong base that was just added?

37

After RNA primers are laid down, do they stay in the final DNA?

38

Bacteria: which DNA polymerase removes RNA primers and replaces them with DNA?

39

Bacteria: which polymerase does most of the DNA synthesis?

40

What enzyme seals the final nick after primer removal and fill-in?



34

Loads the sliding clamp onto DNA (uses ATP).

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33

Keeps DNA polymerase attached to DNA so it can work fast without falling off.

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36

3'→5' exonuclease activity (in DNA polymerase).

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35

ATP (or NAD<sup>+</sup> in some bacteria).

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38

DNA polymerase I.

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37

No. Primers are removed and replaced with DNA.

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40

DNA ligase.

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39

DNA polymerase III.

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41

Eukaryotes: primers are RNA only or RNA+DNA?

42

Eukaryotes: which enzyme mainly removes RNA primers? (concept)

43

Prokaryotes usually have one origin per chromosome. Eukaryotes have...

44

Bacterial chromosomes are usually...

45

Eukaryotic nuclear chromosomes are usually...

46

Okazaki fragments: are they longer in bacteria or eukaryotes?

47

Replication happens in the nucleus for eukaryotic nuclear DNA. Where in bacteria?

48

Replication speed: bacteria or eukaryotes generally replicate faster per fork?



42

RNase H (plus other nucleases like FEN1)  
with polymerase fill-in, then ligase seals.

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41

Often a short RNA primer extended with a  
short stretch of DNA by DNA pol alpha.

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44

Circular.

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43

Many origins per chromosome.

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46

Longer in bacteria, shorter in eukaryotes.

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45

Linear.

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48

Bacteria (generally).

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47

In the cytoplasm (nucleoid region).

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49

Euk DNA is wrapped around what proteins that must be handled during replication?

50

End-replication problem: what's the issue in one line?

51

What are telomeres?

52

Telomerase: what does it do (one line)?

53

Telomerase is active mainly in which cells?

54

If a stem says 'enzyme with its own RNA template that extends chromosome ends', that's...

55

Telomerase is a {{c1::reverse transcriptase}} that uses an {{c2::RNA}} template to extend telomeres.

56

Replication is super accurate. What's the first 'quality control' layer?



50

After removing the last RNA primer on a linear chromosome, there's no 3' OH to fill the very end -> shortening.

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49

Histones (nucleosomes).

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52

Extends telomeres by adding DNA repeats to the 3' end using an RNA template.

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51

Repetitive DNA sequences at chromosome ends that protect coding DNA from being lost.

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54

Telomerase.

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53

Germ cells, stem cells, and many cancer cells (low in most somatic cells).

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56

DNA polymerase proofreading (3'→5' exonuclease).

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55

Telomerase is a reverse transcriptase that uses an RNA template to extend telomeres.

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57

Mismatch repair happens when?

58

If proofreading is 3'→5' exonuclease, what is 5'→3' exonuclease used for (classic in bacteria)?

59

Common confusion: ligase 'adds nucleotides'. True or false?

60

Common confusion: helicase relieves supercoiling. True or false?

61

Common confusion: primase makes DNA primers. True or false?

62

What is the 'replicative' polymerase in eukaryotes (concept)?

63

Replication pipeline in 6 steps?

64

Map this: unwind DNA at fork → which enzyme?



58

Removing RNA primers.

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57

After replication, fixing base-pair mismatches that escaped proofreading.

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60

False. Helicase unwinds strands; topoisomerase relieves supercoiling.

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59

False. Polymerase adds nucleotides; ligase seals the final bond between fragments.

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62

Mainly DNA pol delta and DNA pol epsilon.

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61

False. Primase makes RNA primers.

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64

Helicase.

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63

Unwind -> stabilize -> prime -> extend -> replace primers -> ligate.

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65

Map this: prevent single strands from re-annealing -> which proteins?

66

Map this: lay down a short starter so polymerase can begin -> which enzyme?

67

Map this: build the bulk of new DNA -> which enzyme family?

68

Map this: relieve twisting stress ahead of the fork -> which enzyme?

69

Map this: seal the last nick between fragments -> which enzyme?

70

Enzyme that unwinds DNA by breaking H-bonds:

71

Enzyme that relieves supercoiling by cutting/rejoining DNA:

72

Enzyme that makes an RNA primer:



66

Primase.

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65

Single-strand binding proteins (SSB).

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68

Topoisomerase (DNA gyrase in bacteria).

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67

DNA polymerases.

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70

Helicase.

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69

DNA ligase.

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72

Primase.

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71

Topoisomerase.

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73

Enzyme that seals nicks in DNA:

74

Activity that removes a wrong base during proofreading:

75

Activity that removes an RNA primer in bacteria (classic):

76

Clue check: a question says 'short DNA pieces later joined together.' What's it talking about?

77

Clue check: enzyme 'requires a free 3' OH'. Which enzyme is that hinting at?

78

Clue check: 'adds nucleotides to the 3' end' - what direction is synthesis?

79

Clue check: a drug targets bacterial gyrase. What process is it messing with?

80

Clue check: 'enzyme uses RNA template to add DNA repeats to chromosome ends' - what is it?



74

3'->5' exonuclease.

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73

DNA ligase.

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76

Okazaki fragments on the lagging strand.

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75

5'->3' exonuclease activity (DNA polymerase I).

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78

5'->3'.

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77

DNA polymerase.

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80

Telomerase.

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79

DNA replication (topology/supercoiling control).

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81

On a replication fork, is the leading strand template oriented 3'→5' or 5'→3' in the direction the fork moves?

82

Lagging strand template in the fork direction is oriented...

83

If the fork is moving right, which strand is synthesized continuously?

84

Mitochondria have their own DNA. Does it replicate during S phase only?

85

Endosymbiosis tie-in: mitochondria have circular DNA like...

86

Replication vs transcription: which one needs a primer?

87

Replication uses DNA polymerase. Transcription uses...

88

Replication uses dNTPs. Transcription uses...



82

5'→3' in the fork direction (so polymerase must work in fragments).

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81

Leading template is 3'→5' in the fork direction.

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84

Not strictly; mitochondrial DNA replication is regulated differently and can occur independent of nuclear S phase.

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83

The strand whose template is 3'→5' toward the right (leading).

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86

Replication needs a primer; transcription (RNA polymerase) can start de novo.

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85

Bacteria.

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88

NTPs (ribonucleotides).

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87

RNA polymerase.

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89

Why is 'replication happens once per cell cycle' important?

90

If a question says 'replication happens only once per cycle because of licensing,' what is the cell preventing?

91

If DNA is damaged during S phase, what should happen (big idea)?

92

Mini boss: You block primase. What step fails first?

93

Mini boss: You block ligase. What piles up?

94

Mini boss: You block helicase. What happens to the replication fork?

95

Mini boss: You block topoisomerase. What problem builds up?

96

Mini boss: a mutation kills proofreading. What's the consequence?



90

Re-replication (copying the same DNA segment twice).

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89

So DNA isn't over-copied (no genome chaos).

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92

Starting DNA synthesis (no primers -> polymerase can't begin).

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91

The cell activates checkpoints to pause the cycle and repair DNA before division.

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94

It can't open the DNA, so replication stops at the start.

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93

Unsealed nicks between Okazaki fragments on the lagging strand.

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96

More replication errors -> higher mutation rate.

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95

Extreme supercoiling/torsional stress ahead of the fork -> fork stalls/breaks.

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97

Mini boss: you remove SSB proteins. What likely happens?

98

If you answered 'ligase' for 'adds nucleotides', what did you mix up?

99

If you answered 'helicase' for 'relieves supercoiling', what did you mix up?

100

If you answered '3'->5"' for synthesis direction, what should you fix?

101

Enzyme that unwinds DNA at the replication fork?

102

Proteins that keep single-stranded DNA from snapping back together?

103

Enzyme that makes RNA primers?

104

Enzyme that seals nicks between Okazaki fragments?



98

Builder vs glue: DNA polymerase builds; ligase glues fragments.

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97

Single strands re-anneal or form weird structures -> replication slows/stalls.

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100

Synthesis is always 5'→3'.  
The template is read 3'→5'.

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99

Unzipping vs untwisting: helicase unzips, topoisomerase untwists.

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102

Single-strand binding proteins (SSB)

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101

Helicase

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104

DNA ligase

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103

Primase

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105

Enzyme that relieves supercoiling during replication?

106

Discontinuous DNA pieces on the lagging strand are called?

107

Enzyme that extends telomeres using an RNA template?

108

DNA polymerase can only add nucleotides to a free  $\{c1::3' OH\}$ .

109

The lagging strand is synthesized as  $\{c1::Okazaki fragments\}$  that are joined by  $\{c2::DNA ligase\}$ .

110

Helicase  $\{c1::unwinds\}$  DNA; topoisomerase  $\{c2::relieves supercoiling\}$ .

111

The leading strand is synthesized  $\{c1::continuously\}$ ; the lagging strand is synthesized  $\{c2::discontinuously\}$ .

112

In bacteria, the main replicative polymerase is  $\{c1::DNA pol III\}$ ; primer removal is mainly  $\{c2::DNA pol I\}$ .



106

Okazaki fragments

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105

Topoisomerase

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108

DNA polymerase can only add nucleotides to a free 3' OH.

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107

Telomerase

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110

Helicase unwinds DNA; topoisomerase relieves supercoiling.

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109

The lagging strand is synthesized as Okazaki fragments that are joined by DNA ligase.

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112

In bacteria, the main replicative polymerase is DNA pol III; primer removal is mainly DNA pol I.

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111

The leading strand is synthesized continuously; the lagging strand is synthesized discontinuously.

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113

Why is replication called 'semi-discontinuous'?

114

DNA polymerase needs a primer. Who provides the very first primer on the leading strand?

115

In eukaryotes, why are there many origins? Give the blunt reason.

116

If a stem says 'replication forks meet and fuse,' what stage of replication is that?

117

Circular bacterial DNA: what does replication look like on a diagram?

118

If they show a 'theta' replication diagram, what organism type is being hinted at?

119

Replication uses which base pairing rules?

120

If a question says 'new strand is complementary to template,' what does that mean practically?



114

Primase (via an RNA primer).

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113

Because one strand is continuous (leading) and the other is made in fragments (lagging).

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116

Termination (end of replication in that region).

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115

Linear chromosomes are huge, and replication forks move at a limited speed.

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118

Bacteria (prokaryotes) with circular DNA.

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117

A theta (  $\theta$  ) structure with two forks moving around the circle.

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120

A matches T, and G matches C (with antiparallel orientation).

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119

A-T and G-C complementary pairing.

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