NAME _____ DATE _____

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Comparing Amino Acid Sequences

Set A

Introduction

Some proteins are shared among all living things. Even though these proteins carry out the same function, their exact shape and size—which depends on the amino acids they are made up of—can be different from one organism to the next.

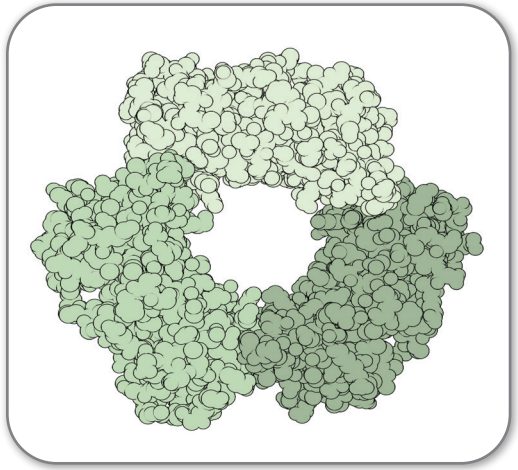
Yet if all living things are descended from a common ancestor, we would expect to find similarities in their protein sequences.

Are proteins that have the same job made up of similar sequences of amino acids?

What patterns are there in amino acid sequences from different organisms?

PCNA (Proliferating Cell Nuclear Antigen) Protein

When three of these proteins come together, they form a ring that wraps around a single strand of DNA. The ring acts as a clamp for DNA polymerase—the molecular machine that copies DNA—so it can "lock" onto the DNA template strand during DNA replication. Because copying DNA is essential for life, all types of living things make this protein.



Structure of PCNA protein (from *arabadopsis thaliana*). Three interconnected molecules of PCNA are pictured; DNA fits into the space in the center.

based on RCSD PDB reference 2zvw

Comparing Amino Acid Sequences

You will be comparing amino acid sequences of PCNA protein from several different organisms to PCNA protein from mouse. PCNA has about 260 amino acids in all. You're going to look at just the last 63 or so of them.

Instructions

1. Fold along the dotted line, below the mouse sequence.

MOUSE – PCNA amino acid sequence (partial):

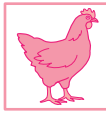
N E P V H L T F A L R Y L N F F T K A T P L S P T V T L S M S A D V P L V V E Y K I A D M G H L K Y Y L A P K I E D E E A S

NAME _____ DATE _____

2. Line up the mouse sequence with the sequence below, and mark matches and mismatches:
   - CIRCLE matches; SLASH mismatches
   - If both are dashes, don't count it at all

MOUSE – T L P - M S - - V P L E
SOYBEAN – T L P S M S - - K I A

◀ Example: 5 matches out of 10 = 50%



CHICKEN–PCNA amino acid sequence (partial):

N E P V Q L T F A L R Y L N F F T K A T P L S P T V T L S M S A D V P L V V E Y K I A D M G H L K Y Y L A P K I E D Q Q E G

4. Calculate the **percent of amino acids that are identical** between mouse and chicken: _____ (# that are the same) ÷ 62 = _____ %

5. Repeat for the other sequences:

FRUIT FLY – PCNA amino acid sequence (partial):

Q E P V T L T F A C R Y L N A F T K A T P L S T Q V Q L S M C A D V P L V V E Y A I K D L G H I R Y Y L A P K I E D N E T -

percent identical between mouse and fruit fly: _____ (# that are the same) ÷ 62 = _____ %

SOYBEAN – PCNA amino acid sequence (partial):

N E P V S L T F A L R Y M N S F T K A T P L S N T V T I S L S N E L P V V V E Y K I A E M G Y V R F Y L A P K I E E D E E D

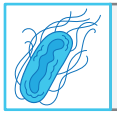
percent identical between mouse and soybean: _____ (# that are the same) ÷ 62 = _____ %

NAME _____ DATE _____

YEAST – PCNA amino acid sequence (partial):

D Q P V D L T F G A K Y L L D I I K G S S L S D R V G I R L S S E A P A L F Q F D L K - S G F L Q F F L A P K F N D E E - -

percent identical between mouse and yeast: _____ (# that are the same) ÷ 62 = _____ %



E. COLI — PCNA amino acid sequence (partial):

G A E M E I G F N V S Y V L D V L N A L K C E - N V R M M L T D S V S S - V Q I E D A A S Q S A A Y V V M P M R L - - - - -

percent identical between mouse and *E. coli*: _____ (# that are the same) ÷ 62 = _____ %

A

RANDOM amino acid sequence:

D K N Q H I S D P A T V Q L Y W L Q L W H G Q D H T V I P I R C V F W F N C A Y F Y F L M G R L T P T F A G L G C W G M K K

percent identical between mouse and the random sequence: _____ (# that are the same) ÷ 62 = _____ %

6. Fill in the boxes on the cards with the percent identical numbers. Make sure to write your numbers BIG. Cut the cards apart.

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Comparing Amino Acid Sequences

Set B

Introduction

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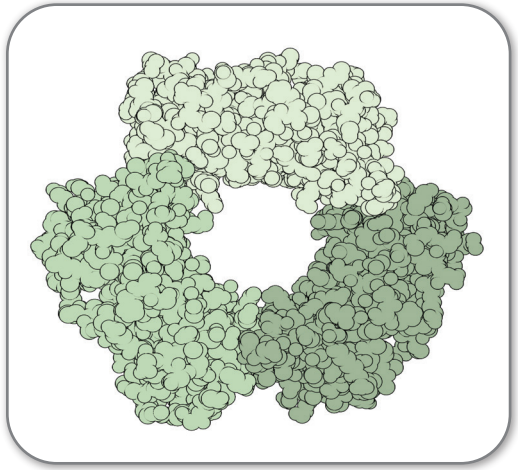
Are proteins that have the same job made up of similar sequences of amino acids?

What patterns are there in amino acid sequences from different organisms?



Structure of PCNA protein (from *arabadopsis thaliana*). Three interconnected molecules of PCNA are pictured; DNA fits into the space in the center.

based on RCSD PDB reference 2zvw

PCNA (Proliferating Cell Nuclear Antigen) Protein

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NAME _____ DATE _____

2. Line up the mouse sequence with the sequence below, and mark matches and mismatches:
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   - If both are dashes, don't count it at all

MOUSE – T L P - M S - - V P L E
SOYBEAN – T L P S M S - - K I A

◀ Example: 5 matches out of 10 = 50%

COW – PCNA amino acid sequence (partial):
N E P V Q L T F A L R Y L N F F T K A T P L S P T V T L S M S A D V P L V V E Y K I A D M G H L K Y Y L A P K I E D E E G S

4. Calculate the **percent of amino acids that are identical** between mouse and cow: _____ (# that are the same) ÷ 62 = _____ %

5. Repeat for the other sequences:

FROG – PCNA amino acid sequence (partial):
N E P V Q L T F A L R Y L N F F T K A T P L S P T V I L S M S A D I P L V V E Y K I A D M G H V K Y Y L A P K I E D E E A S

percent identical between mouse and frog: _____ (# that are the same) ÷ 62 = _____ %

NEMATODE – PCNA amino acid sequence (partial):
K D P V N V N F S I K Y M N Q F T K A T A L S D R V R L S L C N D V P V V V E Y P I E E N G Y L R F Y L A P K I D D D E N M

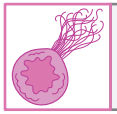
percent identical between mouse and nematode: _____ (# that are the same) ÷ 62 = _____ %

NAME _____ DATE _____

CORN – PCNA amino acid sequence (partial):

Q E P V S L T F A L R Y M N S F T K A S S L S E Q V T I S L S S E L P V V V E Y K I A E M G Y I R F Y L A P K I E D D E E M

percent identical between mouse and corn: _____ (# that are the same) ÷ 62 = _____ %



M. JANNASCHII — PCNA amino acid sequence (partial):

K E E A K S A F N L D Y L M D M V K G V S S G D I I K I Y L G N D M P L K L E Y S I A G - V N L T F L L A P R I E G - - - -

percent identical between mouse and M. janneschii: _____ (# that are the same) ÷ 62 = _____ %

B

RANDOM amino acid sequence:

P Q M Q K G A E M R W S H T R M S V S M Q L P F V A R G N E F L H P V I W K Y H I C K A C M E A M F N M H W G D G Y D D L G

percent identical between mouse and the random sequence: _____ (# that are the same) ÷ 62 = _____ %

6. Fill in the boxes on the cards with the percent identical numbers. Make sure to write your numbers BIG. Cut the cards apart.

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Comparing Amino Acid Sequences

Set C

Introduction

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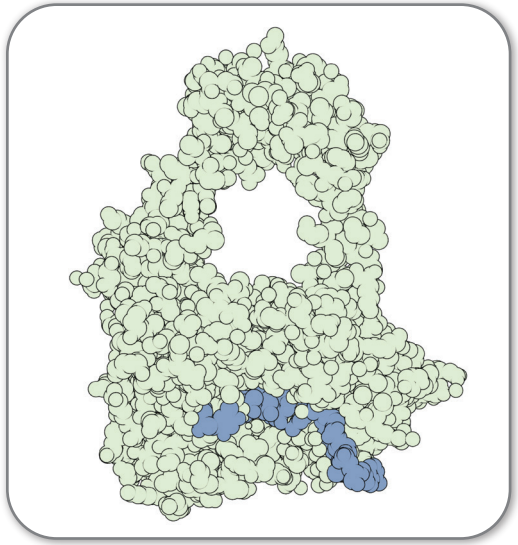
Are proteins that have the same job made up of similar sequences of amino acids?

What patterns are there in amino acid sequences from different organisms?



Structure of Topoisomerase I protein wrapped around a small piece of DNA.
based on RCSD PDB reference 3px7

Topoisomerase 1 Protein

As DNA is copied to make more DNA or RNA, it must unwind so that cellular machinery can access the sequences they need. Then it rewinds itself to stay compact.

Unwinding and rewinding adds twists and tension to DNA, much like a pair of tangled headphone wires. Topoisomerase 1 cuts one strand of DNA, allows it to untwist and relax, then puts the strand back together. Because managing DNA is essential for life, all types of living things make this protein.

Comparing Amino Acid Sequences

You will be comparing amino acid sequences of Topoisomerase protein from several different organisms to Topoisomerase protein from mouse. This protein has about 865 amino acids in all. You're going to look at about 60 of them.

Instructions

1. Fold along the dotted line, below the mouse sequence.

MOUSE – Topoisomerase 1 amino acid sequence (partial):

S S R I K G E K D W Q K Y E T A R – – – R L K K C V D K I R N Q Y R E D W K – – – – – – – S K E M K V R Q R A V A L Y F

NAME _____ DATE _____

2. Line up the mouse sequence with the sequence below, and mark matches and mismatches:
   - CIRCLE matches; SLASH mismatches
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MOUSE – T L P - M S - - V P L E
SOYBEAN – T L P S M S - - K I A F

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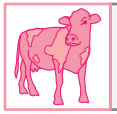
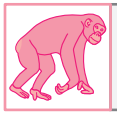


COW – Topoisomerase 1 amino acid sequence (partial):
S S R I K G E K D W Q K Y E T A R - - - R L K K C V D K I R N Q Y R E D W K - - - - - - - S K E M K V R Q R A V A L Y F

4. Calculate the **percent of amino acids that are identical** between mouse and cow: _____ (# that are the same) ÷ 50 = _____ %

5. Repeat for the other sequences:



CHIMP – Topoisomerase 1 amino acid sequence (partial):
S S R I K G E K D W Q K Y E T A R - - - R L K K C V D K I R N Q Y R E D W K - - - - - - - S K E M K V R Q R A V A L Y F

percent identical between mouse and chimp: _____ (# that are the same) ÷ 50 = _____ %

NEMATODE – Topoisomerase 1 amino acid sequence (partial):
S S K I K G E K D F E K Y E T A R - - - R L K K K I G G I R E R Y T D D F K - - - - - - - S K E M R V R Q R A T A L Y F

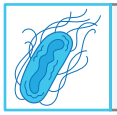
percent identical between mouse and nematode: _____ (# that are the same) ÷ 50 = _____ %

NAME _____ DATE _____

MOSS – Topoisomerase 1 amino acid sequence (partial):

A S K K V S E A K L S I G S V K K R L V R R N P L A P Y I T S T L Q Q D A S S K L G F G T T R T M S L A Q Q - - - L Y E

percent identical between mouse and moss: _____ (# that are the same) ÷ 60 = _____ %



E. COLI — Topoisomerase 1 amino acid sequence (partial):

A V S L L E K A R Y S V L E R E D K P T T S K P G A P F I T S T L Q Q A A S T R L G F G V K K T M M M A Q R - - - L Y E

percent identical between mouse and *E. coli*: _____ (# that are the same) ÷ 60 = _____ %

C

RANDOM amino acid sequence:

N M P F Q H I I K E A Y Y C L R G - - - S A C T T Q P Q G L H Y G W H W C W - - - - - - - F D S S Q A H Q H N K V K V T

percent identical between mouse and the random sequence: _____ (# that are the same) ÷ 50 = _____ %

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Comparing Amino Acid Sequences

Set D

Introduction

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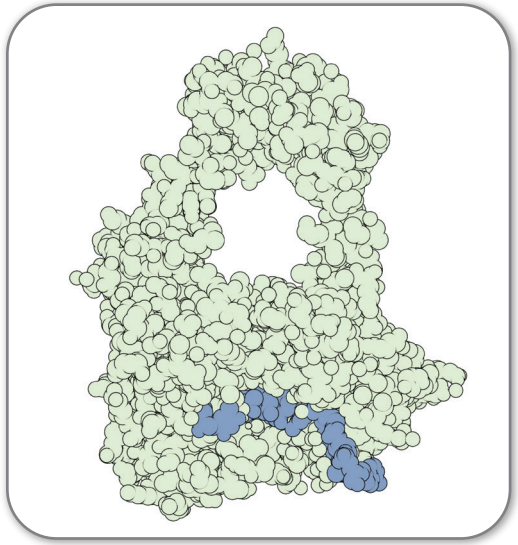

Structure of Topoisomerase I protein wrapped around a small piece of DNA.
based on RCSD PDB reference 3px7

Topoisomerase 1 Protein

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Comparing Amino Acid Sequences

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Instructions

1. Fold along the dotted line, below the mouse sequence.

MOUSE – Topoisomerase 1 amino acid sequence (partial):

S S R I K G E K D W Q K Y E T A R - - - R L K K C V D K I R N Q Y R E D W K - - - - - - - S K E M K V R Q R A V A L Y F

NAME _____ DATE _____

2. Line up the mouse sequence with the sequence below, and mark matches and mismatches:
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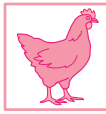
SOYBEAN – T L P S M S – – K I A

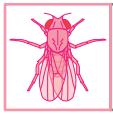
◀ Example: 5 matches out of 10 = 50%



CHICKEN – Topoisomerase 1 amino acid sequence (partial):
S S R I K G E K D W Q K Y E T A R – – – R L K K C V D K I R N Q Y R E D W K – – – – – – – S K E M K V R Q R A V A L Y F

4. Calculate the **percent of amino acids that are identical** between mouse and chicken: _____ (# that are the same) ÷ 50 = _____ %

5. Repeat for the other sequences:



FRUIT FLY – Topoisomerase 1 amino acid sequence (partial):
S S K L K G E K D H I K Y E T A R – – – R L D K V I D K I R A T Y R D E W K – – – – – – – S K E M R V R Q R A V A L Y F

percent identical between mouse and fruit fly: _____ (# that are the same) ÷ 50 = _____ %

YEAST – Topoisomerase 1 amino acid sequence (partial):
N S S L K G Q S D Y K K F E K A R – – – Q L K S Y I D A I R R D Y T R N L K – – – – – – – S K V M L E R Q K A V A I Y L

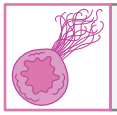
percent identical between mouse and yeast: _____ (# that are the same) ÷ 50 = _____ %

NAME _____ DATE _____

MOSS – Topoisomerase 1 amino acid sequence (partial):

A S K K V S E A K L S I G S V K K R L V R R N P L A P Y I T S T L Q Q D A S S K L G F G T T R T M S L A Q Q - - - L Y E

percent identical between mouse and moss: _____ (# that are the same) ÷ 60 = _____ %



M. JANNASCHII — Topoisomerase 1 amino acid sequence (partial):

Y E K I K D E K S A K V V E I K K T K R K L K P L P P F D L G T L Q R E A Y S Y F K I S P K E T Q E I A Q K - - - L Y E

percent identical between mouse and M. janneschii: _____ (# that are the same) ÷ 60 = _____ %

D

RANDOM amino acid sequence:

R D L W S K A E Q M Q A P N C H N - - - T T R C F C G L F W I S F T L S F M - - - - - - - D S Q I E A I L Y Q H T T W Y

percent identical between mouse and the random sequence: _____ (# that are the same) ÷ 50 = _____ %

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Comparing Amino Acid Sequences

Set E

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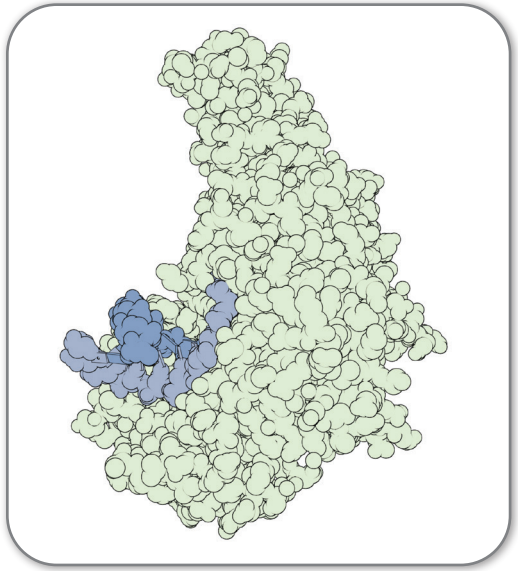
Are proteins that have the same job made up of similar sequences of amino acids?

What patterns are there in amino acid sequences from different organisms?

DNA Polymerase 1 Protein

DNA Polymerase is a molecular machine that copies DNA. It moves along one strand of DNA, adding one building block (nucleotide) at a time to make a new, complementary DNA strand. Because copying DNA is essential for life, all types of living things make this protein.



Structure of DNA polymerase protein, shown with a small piece of DNA.
based on RCSD PDB reference 4q5v

Comparing Amino Acid Sequences

You will be comparing amino acid sequences of DNA Polymerase 1 protein from several different organisms to DNA Polymerase 1 protein from mouse. DNA Polymerase 1 is a very large protein, up to about 1,465 amino acids in size. You're going to look at about 54 amino acids.

Instructions

1. Fold along the dotted line, below the mouse sequence.

MOUSE – DNA Polymerase 1 amino acid sequence (partial):

L I E I G E N V L N G S V P V S Q F E I N K A L T K D P Q D Y P D R K S L P H V H V A L W I N S Q G G

NAME _____ DATE _____

2. Line up the mouse sequence with the sequence below, and mark matches and mismatches:
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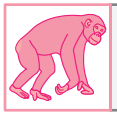


CHIMP — DNA Polymerase 1 amino acid sequence (partial):

L I E I G E N V L N G S V P V S Q F E I N K A L T K D P Q D Y P D K K S L P H V H V A L W I N S Q G G

4. Calculate the **percent of amino acids that are identical** between mouse and chimp: _____ (# that are the same) ÷ 51 = _____ %

5. Repeat for the other sequences:

ZEBRAFISH — DNA Polymerase 1 amino acid sequence (partial):

L I E I G E K V A N G N I P L N M F E I H K S L T K E P Q D Y P D K K S L P H V H V A L W I N S Q G G

percent identical between mouse and zebrafish: _____ (# that are the same) ÷ 51 = _____ %

NEMATODE — DNA Polymerase 1 amino acid sequence (partial):

L R E I R A K L D S G T V P L E M F Q I S K Q L T R N P E Q Y A D V K A Q C H A A V A Q R L N K S G K

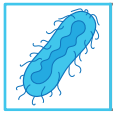
percent identical between mouse and nematode: _____ (# that are the same) ÷ 51 = _____ %

NAME _____ DATE _____

PLASMODIUM — DNA Polymerase 1 amino acid sequence (partial):

L R T I N Q R I Q N D E F D L D Y Y I I T K K L T K N V H E Y Q D K N S L G H V L V A E R M I K D – G

percent identical between mouse and plasmodium: _____ (# that are the same) ÷ 51 = _____ %



Y. PESTIS — DNA Polymerase 1 amino acid sequence (partial):

V R D Y V A R T L N G E L D E Q – L V Y R K R L R R R L D D Y Q R N – V P P H A R A A D E F N R K L G

percent identical between mouse and Y. pestis: _____ (# that are the same) ÷ 51 = _____ %

E

RANDOM amino acid sequence:

E T Q W F M G A N E C R A T V Q K S K F K Y N R P F D G A F I Y L K Q K H A Y Q Y Y N A L Q T H W Q D

percent identical between mouse and the random sequence: _____ (# that are the same) ÷ 51 = _____ %

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Comparing Amino Acid Sequences

Set F

Introduction

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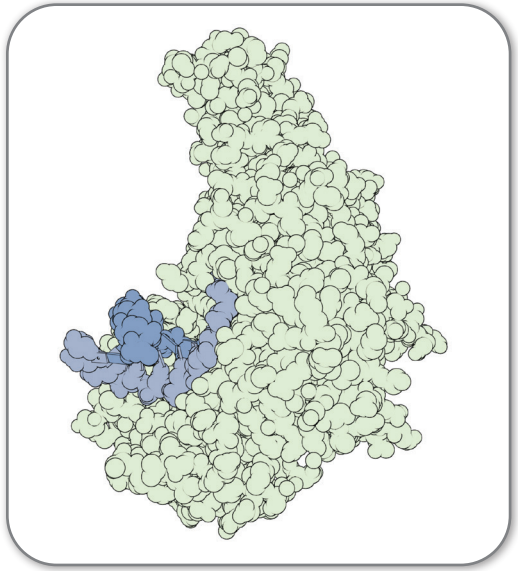
Yet if all living things are descended from a common ancestor, we would expect to find similarities in their protein sequences.

Are proteins that have the same job made up of similar sequences of amino acids?

What patterns are there in amino acid sequences from different organisms?



Structure of DNA polymerase protein, shown with a small piece of DNA.
based on RCSD PDB reference 4q5v

DNA Polymerase 1 Protein

DNA Polymerase is a molecular machine that copies DNA. It moves along one strand of DNA, adding one building block (nucleotide) at a time to make a new, complementary DNA strand. Because copying DNA is essential for life, all types of living things make this protein.

Comparing Amino Acid Sequences

You will be comparing amino acid sequences of DNA Polymerase 1 protein from several different organisms to DNA Polymerase 1 protein from mouse. DNA Polymerase 1 is a very large protein, up to about 1,465 amino acids in size. You're going to look at about 54 amino acids.

Instructions

1. Fold along the dotted line, below the mouse sequence.

MOUSE – DNA Polymerase 1 amino acid sequence (partial):

L I E I G E N V L N G S V P V S Q F E I N K A L T K D P Q D Y P D R K S L P H V H V A L W I N S Q G G

NAME _____ DATE _____

2. Line up the mouse sequence with the sequence below, and mark matches and mismatches:
   - CIRCLE matches; SLASH mismatches
   - If both are dashes, don't count it at all

MOUSE – T L P – M S – – V P L E
SOYBEAN – T L P S M S – – K I A F

◀ Example: 5 matches out of 10 = 50%

COW – DNA Polymerase 1 amino acid sequence (partial):
L I E I G E N V L N G S V P V S Q F E I N K A L T K D P Q D Y P D K K S L P H V H V A L W I N S Q G G

4. Calculate the **percent of amino acids that are identical** between mouse and cow: _____ (# that are the same) ÷ 51 = _____ %

5. Repeat for the other sequences:

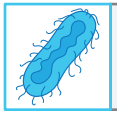
FRUIT FLY – DNA Polymerase 1 amino acid sequence (partial):
L E K I K T Q I A E G V V P L P L F V I T K Q L T R T P Q E Y A N S A S L P H V Q V A L R M N R E R N

percent identical between mouse and fruit fly: _____ (# that are the same) ÷ 51 = _____ %

YEAST – DNA Polymerase 1 amino acid sequence (partial):
L E D I R I K V E T N N I R I D K Y K I N M K L S K D P K A Y P G G K N M P A V Q V A L R M R K A – G

percent identical between mouse and yeast: _____ (# that are the same) ÷ 51 = _____ %

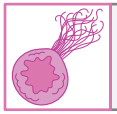
NAME _____ DATE _____



Y. PESTIS – DNA Polymerase 1 amino acid sequence (partial):

V R D Y V A R T L N G E L D E Q – L V Y R K R L R R R L D D Y Q R N – V P P H A R A A D E F N R K L G

percent identical between mouse and Y. pestis: _____ (# that are the same) ÷ 51 = _____ %



M. JANNASCHII — DNA Polymerase I amino acid sequence (partial):

I Q D V I K D L R E K K I K K E D L I I Y T Q L T K D P K E Y K T – – T A P H V E I A K K L M R E – G

percent identical between mouse and M. janneschii: _____ (# that are the same) ÷ 51 = _____ %

F

RANDOM amino acid sequence:

W V F N T Y L T T T N A N W N G D M R G W A N M I T M M H G R A M W S F H Y I C K V L H P M C P V A G

percent identical between mouse and the random sequence: _____ (# that are the same) ÷ 51 = _____ %

6. Fill in the boxes on the cards with the percent identical numbers. Make sure to write your numbers BIG. Cut the cards apart.

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Comparing Amino Acid Sequences

Set G

Introduction

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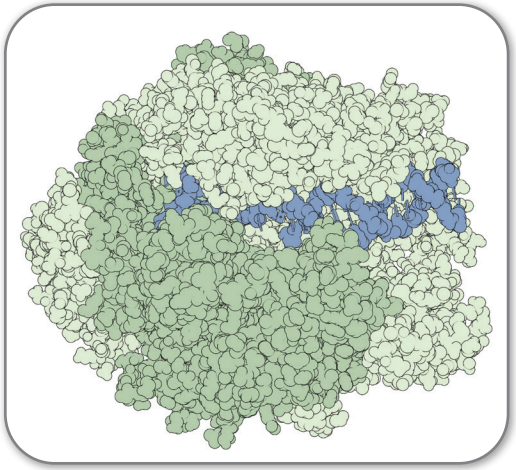


Structure of RNA polymerase protein complex, shown attached to a small piece of DNA. Subunit B is shown in a darker shade.

based on RCSD PDB reference 2e2i

RNA Polymerase 2 Protein

RNA Polymerase is made up of several proteins that work together (in yeast, there are 10). RNA Polymerase transcribes DNA: it moves along one strand and builds a complementary strand of RNA. Because transcribing the information from DNA to make RNA is essential for life, all types of living things make RNA Polymerase.

Comparing Amino Acid Sequences

You will be comparing amino acid sequences of RNA Polymerase 2 protein subunits from several different organisms to the Subunit B protein from mouse. This protein has about 1,255 amino acids in all. You're going to look at just 60 of them.

Instructions

1. Fold along the dotted line, below the mouse sequence.

MOUSE – RNA Polymerase 2 amino acid sequence (partial):

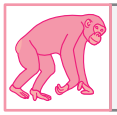
Y H L R G N E V L Y N G F T G R K I T S Q I F I G P T Y Y Q R L K H M V D D K I H S R A R G P I Q I L N R Q P M E G R S

NAME _____ DATE _____

2. Line up the mouse sequence with the sequence below, and mark matches and mismatches:
   - CIRCLE matches; SLASH mismatches
   - If both are dashes, don't count it at all

MOUSE – T L P - M S - - V P L E
SOYBEAN – (T)(L)(P) $ (M)(S) - - K I A

◀ Example: 5 matches out of 10 = 50%



CHIMP — RNA Polymerase 2 amino acid sequence (partial):

Y H L R G N E V L Y N G F T G R K I T S Q I F I G P T Y Y Q R L K H M V D D K I H S R A R G P I Q I L N R Q P M E G R S

4. Calculate the **percent of amino acids that are identical** between mouse and chimp: _____ (# that are the same) ÷ 60 = _____ %

5. Repeat for the other sequences:

FRUIT FLY — RNA Polymerase 2 amino acid sequence (partial):

Y H L R G N E V M Y N G H T G R K I N A Q V F L G P T Y Y Q R L K H M V D D K I H S R A R G P V Q I L V R Q P M E G R A

percent identical between mouse and fruit fly: _____ (# that are the same) ÷ 60 = _____ %

YEAST — RNA Polymerase 2 amino acid sequence (partial):

Y Q S R G F E V M Y N G H T G K K L M A Q I F F G P T Y Y Q R L R H M V D D K I H A R A R G P M Q V L T R Q P V E G R S

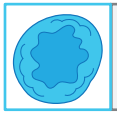
percent identical between mouse and yeast: _____ (# that are the same) ÷ 60 = _____ %

NAME _____ DATE _____

CORN — RNA Polymerase 2 amino acid sequence (partial):

P E Y P G K S R I F D G R T G D P F E Q P V L I G K S Y I L K L I H Q V D E K I H G R S T G P Y S L V T Q Q P V R G R A

percent identical between mouse and corn: _____ (# that are the same) ÷ 60 = _____ %



S. AUREUS — RNA Polymerase 2 amino acid sequence (partial):

M A R D G K T V L Y D G R T G E P F D N R I S V G V M Y M L K L A H M V D D K L H A R S T G P Y S L V T Q Q P L G G K A

percent identical between mouse and S. aureus: _____ (# that are the same) ÷ 60 = _____ %

G

RANDOM amino acid sequence:

Y W F M L S W A F P V C Q L L F F Q A W M A N C F K K D Q T L E H N L R R G V C S I Y G E I I G K K H N R C E Q R M T C

percent identical between mouse and the random sequence: _____ (# that are the same) ÷ 60 = _____ %

6. Fill in the boxes on the cards with the percent identical numbers. Make sure to write your numbers BIG. Cut the cards apart.

NAME _____ DATE _____

Comparing Amino Acid Sequences

Set H

Introduction

Some proteins are shared among all living things. Even though these proteins carry out the same function, their exact shape and size—which depends on the amino acids they are made up of—can be different from one organism to the next.

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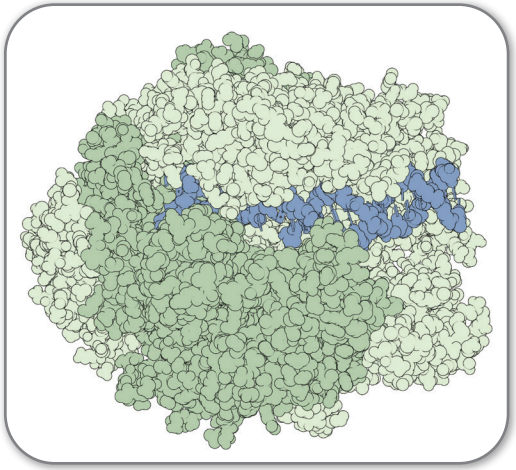
What patterns are there in amino acid sequences from different organisms?



Structure of RNA polymerase protein complex, shown attached to a small piece of DNA. Subunit B is shown in a darker shade.

based on RCSD PDB reference 2e2i

RNA Polymerase 2 Protein

RNA Polymerase is made up of several protein subunits (in yeast, there are 12) that work together. RNA Polymerase transcribes DNA: it moves along one strand and builds a complementary strand of RNA. Because transcribing the information from DNA to make RNA is essential for life, all types of living things make RNA Polymerase.

Comparing Amino Acid Sequences

You will be comparing amino acid sequences of RNA Polymerase 2 protein subunits from several different organisms to the Subunit B protein from mouse. This protein has about 1,255 amino acids in all. You're going to look at just 60 of them.

Instructions

1. Fold along the dotted line, below the mouse sequence.

MOUSE – RNA Polymerase 2 amino acid sequence (partial):

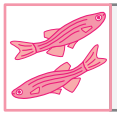
Y H L R G N E V L Y N G F T G R K I T S Q I F I G P T Y Y Q R L K H M V D D K I H S R A R G P I Q I L N R Q P M E G R S

NAME _____ DATE _____

2. Line up the mouse sequence with the sequence below, and mark matches and mismatches:
   - CIRCLE matches; SLASH mismatches
   - If both are dashes, don't count it at all

MOUSE – T L P – M S – – V P L E
SOYBEAN – T L P $ M S – – K I A

◀ Example: 5 matches out of 10 = 50%



ZEBRAFISH – RNA Polymerase 2 amino acid sequence (partial):
Y H L R G N E V L Y N G F T G R K L T S Q I F V G P T Y Y Q R L K H M V D D K I H S R A R G P V Q I L N R Q P M E G R S

4. Calculate the **percent of amino acids that are identical** between mouse and zebrafish: _____ (# that are the same) ÷ 60 = _____ %

5. Repeat for the other sequences:

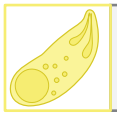
MOSS – RNA Polymerase 2 amino acid sequence (partial):
Y Q M R G F E V M Y N G H T G R R L T A H I F L G P T Y Y Q R L K H M V D D K I H S R G R G P V Q I L T R Q P A E G R S

percent identical between mouse and moss: _____ (# that are the same) ÷ 60 = _____ %

PENICILLIUM – RNA Polymerase 2 amino acid sequence (partial):
Y Q S R G F E V M F N G H T G R K L V A Q V F L G P T Y Y Q R L R H M V D D K I H A R A R G P T Q I L T R Q P V E G R A

percent identical between mouse and mold: _____ (# that are the same) ÷ 60 = _____ %

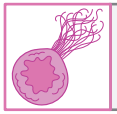
NAME _____ DATE _____



PLASMODIUM – RNA Polymerase 2 amino acid sequence (partial):

S Y N Y N K Y Y L K N P F T G N M I N N S I C L N N I Y Y Y K L I H M I K D K F R Y R F I G L Y S E L T Q Q P I K G N T

percent identical between mouse and plasmodium: _____ (# that are the same) ÷ 60 = _____ %



M. JANNASCHII — RNA Polymerase 2 amino acid sequence (partial):

F K H H G K E V M Y D G K T G K K F E V E I Y I G I A Y Y Q K L H H L V A G K I H A R S R G P V Q V L T R Q P T E G R A

percent identical between mouse and M. janneschii: _____ (# that are the same) ÷ 60 = _____ %

H

RANDOM amino acid sequence:

P G E H S E Y C S D W R S E T C F C H S E T L T M K A N T Y H I I Q E K E N G I P M R L H W L C I E T G Q F F E G G E N

percent identical between mouse and the random sequence: _____ (# that are the same) ÷ 60 = _____ %

6. Fill in the boxes on the cards with the percent identical numbers. Make sure to write your numbers BIG. Cut the cards apart.

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Comparing Amino Acid Sequences

Set J

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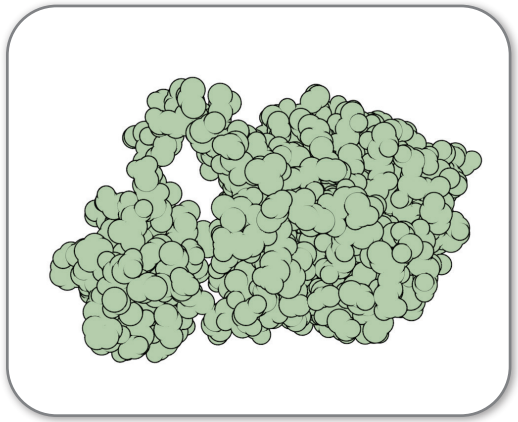

Structure of RadA protein from the archaeal species *Methanococcus maripaludis*.
based on RCSD PDB reference 3etl

Recombination Protein RecA

This protein has different names in different species, including RecA, RadA, and Rad51. Whatever the name, this protein helps cells repair damage to their DNA. RadA binds to single-stranded DNA and recruits other proteins needed to repair broken DNA strands. Because maintaining and repairing DNA are essential for life, all types of living things make this protein.

Comparing Amino Acid Sequences

You will be comparing amino acid sequences of RecA-related proteins from several different organisms to RecA protein from mouse. RecA has about 352 amino acids in all. You're going to look at about 60 of them.

Instructions

1. Fold along the dotted line, below the mouse sequence.

MOUSE – RecA amino acid sequence (partial):

N I K G I S E A K A D K I L T E A A K L V P M G F T T A T E F - - - H Q R R S E I I Q I T T G S K E L D K L L Q - G G I

NAME _____ DATE _____

2. Line up the mouse sequence with the sequence below, and mark matches and mismatches:
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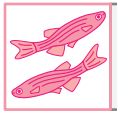
MOUSE – T L P – M S – – V P L E
SOYBEAN – T L P $ M S – – K I A

◀ Example: 5 matches out of 10 = 50%



ZEBRAFISH — RecA amino acid sequence (partial):

N I K G I S E A K A D K I L T E A A K M V P M G F T T A T E F – – – H Q R R A E I I Q I S T G S K E L D K L L Q – G G I

4. Calculate the **percent of amino acids that are identical** between mouse and zebrafish: _____ (# that are the same) ÷ 56 = _____ %

5. Repeat for the other sequences:

NEMATODE — RecA amino acid sequence (partial):

N V K G I S D Q K A E K I M K E A M K F V Q M G F T T G A E V – – – H V K R S Q L V Q I R T G S A S L D R L L G – G G I

percent identical between mouse and nematode: _____ (# that are the same) ÷ 56 = _____ %

MOSS — RecA amino acid sequence (partial):

L I K G L S D A K V D K I I E A A T K L V P M G F T S A K Q M – – – H E Q R A E L I Q I T T G A K E F D N I L E – G G I

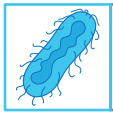
percent identical between mouse and moss: _____ (# that are the same) ÷ 56 = _____ %

NAME _____ DATE _____

PLASMODIUM — RecA amino acid sequence (partial):

A I K G I S E Q K A E K L K K A C K E L C N S G F C N A I D Y - - - H D A R Q N L I K F T T G S K Q L D A L L K - G G I

percent identical between mouse and plasmodium: _____ (# that are the same) ÷ 56 = _____ %



Y. PESTIS — RecA amino acid sequence (partial):

- - M A I D E N K Q - K A L A A A L G Q I E K Q F G K G S I M R L G E D R S M D V E T I S T G S L S L D I A L G A G G L

percent identical between mouse and Y. pestis: _____ (# that are the same) ÷ 60 = _____ %

J

RANDOM amino acid sequence:

M L E T K L Y L M D W S R R C P K I E H L T I K L T G A E Y N - - - W H F S P A W G T N I G R Y H G A K M Y L K - S Y D

percent identical between mouse and the random sequence: _____ (# that are the same) ÷ 56 = _____ %

6. Fill in the boxes on the cards with the percent identical numbers. Make sure to write your numbers BIG. Cut the cards apart.

NAME _____ DATE _____

Comparing Amino Acid Sequences

Set K

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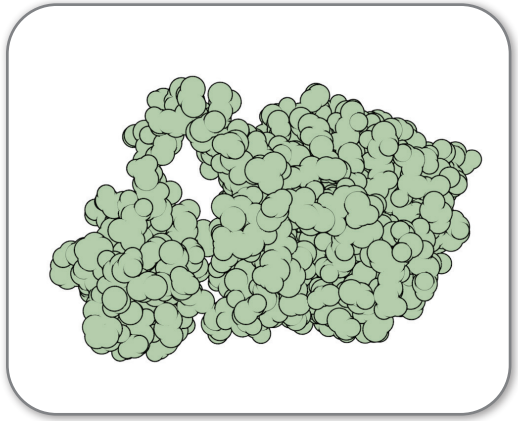

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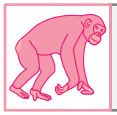
NAME _____ DATE _____

2. Line up the mouse sequence with the sequence below, and mark matches and mismatches:
   - CIRCLE matches; SLASH mismatches
   - If both are dashes, don't count it at all

MOUSE – T L P - M S - - V P L E
SOYBEAN – T L P S M S - - K I A

◀ Example: 5 matches out of 10 = 50%



CHIMP — RecA amino acid sequence (partial):

N I K G I S E A K A D K I L A E A A K L V P M G F T T A T E F - - - H Q R R S E I I Q I T T G S K E L D K L L Q - G G I

4. Calculate the **percent of amino acids that are identical** between mouse and chimp: _____ (# that are the same) ÷ 56 = _____ %

5. Repeat for the other sequences:

YEAST — RecA amino acid sequence (partial):

E I K G I S E A K A D K L L N E A A R L V P M G F V T A A D F - - - H M R R S E L I C L T T G S K N L D T L L G - G G V

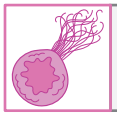
percent identical between mouse and yeast: _____ (# that are the same) ÷ 56 = _____ %

CORN — RecA amino acid sequence (partial):

Q I K G I S E A K A D K I I E A A S K I V P L G F T S A S Q L - - - H A Q R L E I I Q V T T G S R E L D K I L E - G G I

percent identical between mouse and corn: _____ (# that are the same) ÷ 56 = _____ %

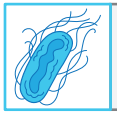
NAME _____ DATE _____



M. JANNASCHII — RecA amino acid sequence (partial):

E I D G I S E K A A A R I I E A A R E L C N L G F K S G T E V - - - L S Q R K N I W K L S T G S K N L D E I L G - G G L

percent identical between mouse and m. janneschii: _____ (# that are the same) ÷ 56 = _____ %



E. COLI — RecA amino acid sequence (partial):

- - M A I D E N K Q - K A L A A A L G Q I E K Q F G K G S I M R L G E D R S M D V E T I S T G S L S L D I A L G A G G L

percent identical between mouse and *E. coli*: _____ (# that are the same) ÷ 60 = _____ %

K

RANDOM amino acid sequence:

W S V E H W F N C F P G V N T A K N S M Y I I T K V C M P Q R - - - F Y I Y A I T F Q Q D G C Y F A P Y D I T W - Q P L

percent identical between mouse and the random sequence: _____ (# that are the same) ÷ 56 = _____ %

6. Fill in the boxes on the cards with the percent identical numbers. Make sure to write your numbers BIG. Cut the cards apart.