Two DNA strands, two names

For a particular gene, RNA polymerase uses one DNA strand as its template. The strand names describe their roles in transcription, not two different kinds of DNA.

TEMPLATE

Also: transcribed strand

The strand read by RNA polymerase. Its bases determine the RNA sequence by complementary pairing.

NON-TEMPLATE

Also: non-transcribed / coding

The other DNA strand. It is not the template for this gene. Its sequence matches the RNA apart from T/U.

1. COMPARE CORRESPONDING POSITIONS

Non-template DNA	5'	A	T	G	C	C	T	3'
Template DNA	3'	T	A	C	G	G	A	5'
RNA product	5'	A	U	G	C	C	U	3'

The RNA row is aligned for comparison; it is not a third DNA strand. These six bases are an illustrative segment, not an entire gene.

2. COMPLEMENTARY TO ONE, SIMILAR TO THE OTHER

The two DNA strands are complementary and antiparallel. The RNA is complementary to the template and runs in the opposite direction. When both are written 5' to 3', RNA matches the non-template sequence, with U replacing T.

RNA polymerase reads the template 3' to 5' while building RNA 5' to 3'. Neither DNA strand is removed or converted into RNA.

Strand relationships: OpenStax Biology 2e, section 15.2.
Complementarity and RNA synthesis: Alberts et al., From DNA to RNA (NCBI).

Scope: Cambridge Biology 9700 syllabus, section 6.2, outcome 4, p. 25.

Choose the rule before copying bases

First identify the named strand and its direction. Write your final RNA answer 5' to 3'. Use U in RNA, never T. These examples are short sequence fragments.

1. GIVEN THE TEMPLATE: USE COMPLEMENTARY BASES

Template DNA	**3' - T A C G G A - 5'**
RNA answer	**5' - A U G C C U - 3'**

Match each template base with an RNA base: T with A, A with U, C with G, and G with C. Keep opposite ends aligned. Simply changing T to U on the template would give the wrong sequence.

2. GIVEN THE NON-TEMPLATE: KEEP ORDER, T BECOMES U

Non-template DNA	**5' - A T G C C T - 3'**
RNA answer	**5' - A U G C C U - 3'**

Both sequences above run 5' to 3'. Do not complement the coding strand.

3. IF THE TEMPLATE IS WRITTEN THE OTHER WAY

Template as supplied	**5' - A G G C A T - 3'**
Aligned RNA complement	**3' - U C C G U A - 5'**
RNA written 5' to 3'	**5' - A U G C C U - 3'**

Example 3 is the same template as example 1, shown in reverse orientation. Reverse the aligned RNA to report it 5' to 3'; do not complement it a second time. Strand labels matter more than whether a strand is drawn above or below.

Strand relationships: OpenStax Biology 2e, section 15.2.
Complementarity and RNA synthesis: Alberts et al., From DNA to RNA (NCBI).

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