**Student questions of the day…**

Q: Does splicing involve DNA or RNA?
A: Splicing refers to processing of the primary RNA.

Q: Is information lost from RNA during splicing?
A: Yes. introns and some exons are permanently lost.

Q: Does RNA really break and rejoin during splicing?
A: Yes, the process involves cutting and religation.

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**Molecular Biology III**
*(RNA processing, translation and genetic code)*

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**Gene expression: can be regulated at any point**

gene (dsDNA) → transcription → RNA splicing → export to cytoplasm → translation → protein trafficking/ modification

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1. RNA processing
Splicing (conclusion)

See Purves 14.11
Gene includes exons and introns
Introns = in primary RNA/ non-coding
Exons = in primary and mature mRNA/ protein coding

Alternate splicing events: any join between splice donor ○ and splice acceptor ■ sites

Splicing = introns removed

Different protein products from alternately spliced RNAs

The Dscam gene can yield 38,000 different spliced mRNAs!!

Schmucker et al, 2000
1. RNA processing

Cap/poly A tail addition to mRNAs

UTR = "untranslated region"

2. Translation

Code
### See Purves 12.5: genetic code

<table>
<thead>
<tr>
<th>First letter</th>
<th>Second letter</th>
<th>Third letter</th>
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</tr>
</tbody>
</table>

**DNA template**

```
3' ACCAAACCGAGT 5'
```

**transcription**

```
codon
UGG UUUGGCUCA
```

**RNA**

```
5' UGG UUUGGCUCA 3'
```

**translation**

```
Protein
```

```
NH2 trp phe gly ser COOH
```

**Direction of translation**

H. Sive MIT 2007

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### 4. From DNA to protein/ the “genetic code”

- **DNA template**
  - 3’ ACCAAACCGAGT 5’

- **transcription**
  - codon UGG UUUGGCUCA

- **RNA**
  - 5’ UGG UUUGGCUCA 3’

- **translation**
  - Protein
    - NH2 trp phe gly ser COOH

- **2. Translation interpreter is tRNA**
Amino acid covalently attaches to 3’ CCA

Anticodon (triplet) recognizes complementary triplet on mRNA

2. Translation factory is the ribosome

Ribosome structure/RNA (gold) and proteins (colors)
Translation

Ribosome recognition

Initiation codon: AUG

Termination codon:

5' MeG RNA

5' A U G C U U A G U U A 'A

Met

Leu

5' U A C

U A G

U A A

Met

Leu

3' UAC = anticodon

Peptide bond formation

H. Sive MIT 2007

Translation elongation

5' A U G C U A G U U A U A A

RNA

NH$_2$Met

Leu

Ser

U A C

U A C

U A A

NH$_2$Met

Leu

Ser COOH

Peptide released

H. Sive MIT 2007

Translation termination

5' A U G C U U A G U U A A

RNA

Stop codon

No matching tRNA

U C A

tRNA

Uncharged tRNA-Ser

NH$_2$Met

Leu

Ser COOH

Peptide released

H. Sive MIT 2007

Translation animation
PolyA tail brings initiation factors to cap

3. From genotype to phenotype

giantism

MicroRNAs are small regulators of gene expression
Mutations can change the amount or sequence of protein produced

Wild type gene, protein sequence

Wild type gene, protein sequence
frameshift mutation: changes >1 amino acid

DNA: 5'ATGTGGCTCCTGGATTA
template TACACCAGGACCTAATT

mRNA: 5'AUGUGGCUCUGGAUUA
protein: mettrpleuproasp

silent mutation: does not change protein

DNA: 5'ATGTGCCCTCCTGGATTA
template TACAGCGAGGACCTAATT

mRNA: AUGUAGCUCCUGGAUAA
protein: mettrpleuproasp

missense mutation: changes single amino acid

DNA: 5'ATGTCCGTCCCTGGATTA
template TACAGCGAGGACCTAATT

mRNA: AUGUAGCUCCUGGAUUA
protein: mettrpleuproval

frameshift mutation: changes >1 amino acid
insertion

DNA: ATGTGGACTCCTGGATTA
template TACACCAGGACCTAATT

mRNA: AUGUAGACUCUGGUUUA
protein: mettrpthrprolysglu..