1. You do complementation analyses to determine if the *unc* mutants listed below belong to the same complementation group as the *unc* 23 gene. You obtained the following results for the F$_1$ generation from your crosses:

<table>
<thead>
<tr>
<th>Mutation</th>
<th>F$_1$</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>unc A</em></td>
<td>all +</td>
</tr>
<tr>
<td><em>unc B</em></td>
<td>all unc</td>
</tr>
<tr>
<td><em>unc C</em></td>
<td>all unc</td>
</tr>
<tr>
<td><em>unc D</em></td>
<td>all +</td>
</tr>
</tbody>
</table>

Based on the results above, which mutant(s) belong to the same complementation group as *unc* 23?

*unc B and C*

Which mutant(s) demonstrated complementation?

*unc A and D*

Explain what is meant by complementation.

**Complementation refers to the ability of one mutant to ‘fix’ a mutation in another gene and vice versa when two individuals are mated. If the mutation in each parent is in a different gene then each parent should carry a good copy of the other gene and these good copies will make up for the bad copies present in the other individual. If complementation occurs the result is that all the offspring should have wild type phenotypes.**
2. Indicate whether each of the following descriptions is true of microtubules (MT), microfilaments (MF), both (B) or none of these (N).

  - **MF**: involved in muscle contraction
  - **MT**: involved in the movement of cilia and flagella
  - **MF**: made of actin
  - **B**: provide support as part of the cell's cytoskeleton
  - **MT**: important for chromosome movements
  - **B**: can be detected by immunofluorescence
  - **MT**: can be disrupted by colchicine
  - **MT**: can interact with dynein to produce movement

3. What are the two mechanisms by which both microfilaments and microtubules produce movement?

   By interacting with motor proteins
   Polymerization and depolymerization

4. What does it mean to say that two genes are in the same linkage group? How many linkage groups does *C. elegans* have?

   A linkage group is a group of genes on a single chromosome that are inherited together. *C. elegans* has 6 linkage groups corresponding to the 5 somatic chromosomes and the X chromosome.
5. The diagram below represents a portion of a striated skeletal muscle:

a) Which region of the diagram (give letter) is a sarcomere? __e__
b) Which region consists only of myosin filaments? __d__
c) Which region consists of both actin and myosin filaments? __b__
d) Which region(s) gets smaller as muscle contracts? __d, f, e__
e) Which region(s) would bind an antibody to myosin? __b__

6. What is the chemical signal within the sarcomere, which the action potential triggers, that initiates muscle contraction?

**Calcium ions**

Where does the chemical come from and how is it removed so that contraction can cease?

*The calcium comes from the sarcoplasmic reticulum*
*It is removed by the action of the calcium ATPase*

Why do muscles become rigid (rigor mortis) upon death?

*Upon death calcium ions leak out of the sarcoplasmic reticulum triggering contraction of the muscle or rigor mortis. The myosin heads are locked into place on the actin filaments unless ATP is available to break the bond between them. ATP in not being made by a dead organism so it is not available to break the links.*