Mitochondria

- Mitochondria are tiny organelles within a cell, each one being about one hundredth the width of a single hair.

- Mitochondria come in many shapes and sizes. They can be small and round or can fuse together to become long and thin.

- Mitochondria are known as the powerhouses of the cell, because they convert energy from the food we eat into a form that cells can use.

- The shape of the mitochondria is important for this job. The energy-generating reaction takes place on the inner membrane, so it folds to form fingers inside the cell. This creates more space for energy to be made.

- Each cell can contain between 1 and 2000 mitochondria. Cells that need more energy contain more mitochondria, for example muscle cells need lots of mitochondria to make energy to move.
Mitochondrial DNA

- It is thought that millions of years ago mitochondria were once separate bacteria-like organisms that were swallowed up by cells and used to help them produce energy.
- Probably because they were once separate organisms, Mitochondria are the only organelles to contain their own DNA, a completely separate set of instructions from the DNA in the nucleus.
- Mitochondria are passed on from the mother’s egg cell but not the father’s sperm, so mitochondrial DNA can be used to trace where our female ancestors came from.
- Mutations in mitochondrial DNA can happen as we age and if mutations are passed on to children they can develop mitochondrial diseases.
- There are more than 50 known mitochondrial diseases that cause effects such as muscle weakness, diabetes, heart disease, hearing loss and dementia.

Meet the Researcher
Hansong Ma - Ma Lab

In my lab we study mitochondrial DNA. We are interested in how mutations in mitochondrial DNA are passed on to children, and what decides whether mutations are passed on or not. This will help us to understand how mitochondrial diseases progress as we age and how they are inherited from mother to child.

We are also interested in how differences between the mitochondrial DNA of different people can affect things like health, ageing and fertility. We use fruit flies to study ideas, because they also have mitochondria and mitochondrial DNA.

Recently the ‘three-parent babies’ technique was approved for treating mitochondrial diseases in the UK. In this case the nuclear DNA of a mother with a mitochondrial disease is combined the mitochondria of a donor without the disease. This prevents the mother from passing on mitochondrial diseases to her children. It is therefore extremely important to learn more about how mitochondrial DNA impacts individuals’ health and wellbeing. Watch my research video or take a look at our website to find out more!
Instructions Part 3: Mitochondria

QUICK GUIDE

COLOUR 1
Row 1: ch 2, ch 1 to turn  
Row 2: dc 2 in second stitch from hook, dc 2 in next stitch, ch 1 to turn  
Row 3: dc 2 in first dc, dc 1 in each of the next 2 stitches, dc 2 in last dc, ch 1 to turn  
Row 4-7: (dc 6, ch 1 to turn) x 4  
Row 8: dc2tog, dc 1 in each of the next two stitches, dc2tog, ch 1 to turn  
Row 9: dc2tog x2, finish off

COLOUR 2
Step 1: Stitch the mitochondria to your cell by running a row of dcs around the edge, attaching it to the cytoplasm in whatever position you prefer (see illustrated instructions Step 13 for more details)  
Step 2: Cut a 20cm tail of yarn  
Step 3: Pull the tail of yarn through to the back of the fabric  
Step 4: Pull the yarn through to the front of the fabric, near the edge of the mitochondria  
Step 5: Run a line of slip stitches vertically across three quarters of the surface of the mitochondria (see illustrated instructions Step 17 for more details)  
Step 6: Repeat Steps 3-5 several times to make your cristae  
Step 7: Pull yarn through to the back of the fabric and tie off

1. START WITH A SLIP KNOT THEN MAKE THREE CHAIN STITCHES (ch 3)

Working in the same colour as the cell body, or a new colour, make a slip knot on your hook (as in Cytoplasm Step 1), then make make three chain stitches

2. MAKE TWO DOUBLE CROCHETS IN THE SECOND STITCH FROM THE HOOK (dc 2 in same stitch)

Make two double crochets (as in Cytoplasm Step 5) in the second stitch from the hook (green)

3. MAKE TWO DOUBLE CROCHETS IN THE NEXT STITCH, THEN ONE CHAIN STITCH (dc 2 in the same stitch, ch 1)

Make two double crochet stitches in the next stitch (green), then one chain stitch to turn (as in Cytoplasm Step 3). Filp the fabric ready to start the next row

4. MAKE TWO DOUBLE CROCHETS IN THE SECOND STITCH FROM THE HOOK (dc 2 in same stitch)

Make two double crochet stitches in the second stitch from the hook (green)

5. MAKE ONE DOUBLE CROCHET IN EACH OF THE NEXT TWO STITCHES ((dc 1) x2)

Make one double crochet in each of the next two stitches (green)

6. MAKE TWO DOUBLE CROCHETS IN THE FINAL STITCH, THEN MAKE ONE CHAIN STITCH (dc 2 in same stitch, ch 1)

Make two double crochets in the final stitch (green), then make one chain stitch to turn. Filp the fabric ready to start the next row
7. MAKE SIX DOUBLE CROCHETS, THEN ONE CHAIN STITCH. REPEAT 3 MORE TIMES ((dc 6, ch 1) x4)

8. DOUBLE CROCHET TWO TOGETHER (dc2tog)

Make six double crochets running back along the fabric, then one chain stitch to turn at the end. Repeat three more times

Place your hook through the front loops of the first two stitches (green). Complete the stitch as you would a double crochet, i.e. yarn over, pull through the first two loops on the hook, yarn over again, and pull through the next two loops

9. MAKE ONE DOUBLE CROCHET IN EACH OF THE NEXT TWO STITCHES (dc 2)

10. DOUBLE CROCHET TWO TOGETHER, THEN MAKE ONE CHAIN STITCH (dc2tog, ch 1)

11. DOUBLE CROCHET TWO TOGETHER TWICE (dc2tog x2) FINISH OFF

Repeat Step 8 with the final two stitches. Make one chain stitch to turn

Double crochet two together (as in Step 8), then repeat for the final two stitches. Finish off (as in Cytoplasm, Step 9)

13. MAKE A DOUBLE CROCHET ATTACHING THE MITCHONDRIA TO THE CELL BODY

Working in the same colour as the plasma membrane, or a new colour, make a slip knot on your hook and insert first through the fabric of cell body (light green), then through a loop on the outside of the fabric (dark green). Yarn over, then pull through both the mitochondria and the cell body. Yarn over again and then pull through the final loop on your hook. This completes the double crochet
17. MAKE 2-4 SLIP STITCHES ACROSS THE FABRIC (ss 2-4)

Keeping the working end of the yarn on the right, place your hook through the fabric (green) and back up. Yarn over and pull through the fabric (green). This completes the first slip stitch. Repeat, this time pulling through both the fabric (light green) and the loop on your hook (dark green). This completes the second slip stitch. Repeat if desired, making a line of 2-4 slip stitches in total. At the end, pull the yarn through to the front of the fabric.

14. REPEAT STEP 13 WORKING AROUND THE EDGE AND JOIN WITH A SLIP STITCH

Working around the edge of the mitochondria, repeat Step 13 as many times as necessary to work back round to the beginning. Then join with a slip stitch (as in Plasma Membrane Step 9).

15. CUT A 20 CM TAIL OF YARN AND PULL THROUGH TO BACK OF FABRIC

Cut the yarn leaving a tail approximately 20 cm long. Use your hook to pull this tail through to the back of the fabric.

16. PULL YARN TO FRONT OF FABRIC IN DESIRED LOCATION

Use hook to pull yarn through to the front of the fabric in desired location along the inside edge of the mitochondria.

18. REPEAT STEPS 21 AND 22 MAKING HORIZONTAL LINES ACROSS THE FABRIC ((ss 2-4) x 3-5)

Repeat Steps 16-17 to make horizontal lines of slip stitches across the surface from both sides - these are your cristae! Finish by pulling yarn through to back of fabric and finish off.

Congratulations! You have completed your mitochondria!

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