Sophia Chen (2019), *Synchronized Swimming Under The Microscope,* The International Society for Optics and Photonics

The article can be accessed at this link.

You can also download the Cornell notes template for this paper (which includes the same questions) as a Word Document or PDF. Teachers, feel free to download this and forward it on to your students.

This week we're looking at a popular article again, but one that touches upon a further type of scientific writing that's especially important when you embark upon a new direction of research or learning – that is the review article. Review articles are used throughout academia as a way to bring together the major pieces of work within a field and give some form of commentary on them. Review articles might be used to give context to a field, show the progress made within a field, or to try to understand the truth within fields where seemingly opposing ideas have been suggested. In the case of this article, it is to provide an update on the recent progress made within one small part of the realm of biophysics. This article brings together ten pieces of modern research, and some additional quotes and thoughts of scientists, to show the current state of our abilities to manipulate 'microswimmers'.

Your task this week is to:

- Read the article
- Come up with some **skim-read questions** and answer them
- Answer our comprehension questions
- Answer our three summary questions

We'd then like you to go further and:

- Choose ***one*** of the articles that are linked within the piece to read (there are ten links, but only eight of them are open-access so choose one of those).
- Summarise that one article in a short paragraph.

There are no sections, so we'll simply list the summary questions rather than presenting them in a Cornell-notes style. Do try to make use of Cornell notes in your own note-taking though – there does seem to be some benefit in *note-taking by hand* as described in this piece by the Learning Scientists.

COMPREHENSION QUESTIONS

1. What is a microswimmer?

2. What are the advantages to using light to direct microswimmers over something like electric or magnetic fields?

3. How does Jinyao Tang use light to steer microswimmers?

4. How does Jinyao Tang use light to power microswimmers?

5. Why is swimming at the microscale different to the macroscale?

6. What are the advantages of using 'chassis from nature' and starting with biological cells?

7. "Some algae, for example, can move more than ten times their body length per second, which is more than a speeding car can do on the highway." Find values and perform calculations to prove/disprove this statement.

8. What is phototaxis? Give examples.

9. How do *Chlamydomonas* manage to respond to light?

10. What unanswered questions are there surrounding microswimmers and their eventual use within the human body?

11. Describe the process behind the movement of Celia Lozano's spheres.

12. "To make a microscopic particle respond to light, it just needs to be asymmetrical in some way." Analyse the truth behind this statement using example microswimmers from the article.

SUMMARY QUESTIONS (submit these, along with your own SKIM-READ questions and answers to thomas.millichamp@warwick.ac.uk)

What different methods have scientists used so far to manipulate the motion of microbots and bacteria? What do you think are the positives and negatives of these methods?

How could synthetic microbots and hijacked biological cells be used? Are there differences between them?

What issues can you foresee within the field of microswimmers?

Your additional summary question is to summarise one of the linked articles from the piece in a short paragraph. Please ensure you say which article you are summarising – preferably in a Harvard Referencing style (to give you practice at working out what this looks like).

FURTHER READING

There is a famous lecture by Richard Feynman entitled Plenty of Room at the Bottom which discusses the early ideas around miniaturisation. You can see a version of the lecture here can access a transcript of a slightly different version of the lecture here.