

# SMART SYSTEMS ENGINEERING

WITH PROFESSOR PRASAD YARLAGADDA

## Talking points

### KNOWLEDGE

1. What is a nanostructure?
2. What is a pathogen?

### COMPREHENSION

3. Why do some insects have antibacterial nanostructures on their wings?
4. How does hydrothermal synthesis work?

### APPLICATION

5. Why do you think Prasad's team is interested in understanding the molecular changes that happen when pathogens meet nanostructures?
6. What do you think might be some practical implications of Prasad's team's findings on nanostructures and SARS-CoV-2?

### ANALYSIS

7. Why do you think Prasad's team used several different methods to test the efficacy of their nanostructures?

8. Prasad's team also looked at cicada wings, which involve nanostructures that can be duplicated using a complex process called electron beam lithography. Why do you think the team might have since decided to focus more on hydrothermal synthesis?

### SYNTHESIS

9. Prasad mentions smart systems engineers can work with sectors ranging from "aviation to food, to mining". How do you think each of these sectors could benefit from smart systems engineering research and application?

### EVALUATION

10. Healthcare is already expensive. How do you think Prasad's team could present their findings to persuade hospital administrators to take on the extra cost of coating medical equipment in nanostructures?
11. Antibiotics resistance in pathogens is on the rise, which may make infections much harder to treat in the future. To what extent do you think Prasad's work could help fight this trend?

## Activity

1. Nanomaterials are becoming increasingly prevalent throughout society, as methods for manufacturing them at scale become more efficient. Use the internet to research the following.

Nanomaterial	Special structural properties	Uses in society
Graphene		
Silver nanowires		
Carbon nanotubes		
Nano-titanium dioxide		
Drug delivery nanoparticles		

2. Engineers often take inspiration from structures found in the natural world. Design a poster aimed at 8- to 11-year-old children that explores some of these, using engaging illustrations and accessible language. To get started, research how engineers have been inspired by the following:

- Waterproof insect wings
- Spider silk
- Any others that you find that interest you
- Geckos' toes
- Shark skin

When you are finished, compare your poster with those of your classmates. What interesting sources of inspiration did they come across?

## More resources

- This article from SciTechDaily gives a quick additional insight into how nanomaterials can destroy bacteria: [scitechdaily.com/new-nanomaterials-inspired-by-insect-wings-destroy-super-bacteria-by-stretching-slicing-or-tearing-them-apart](https://scitechdaily.com/new-nanomaterials-inspired-by-insect-wings-destroy-super-bacteria-by-stretching-slicing-or-tearing-them-apart)
- This video from CrashCourse provides an 8-minute overview of nanomaterials and their unique properties:  
[www.youtube.com/watch?v=IkYimZBzguw](https://www.youtube.com/watch?v=IkYimZBzguw)