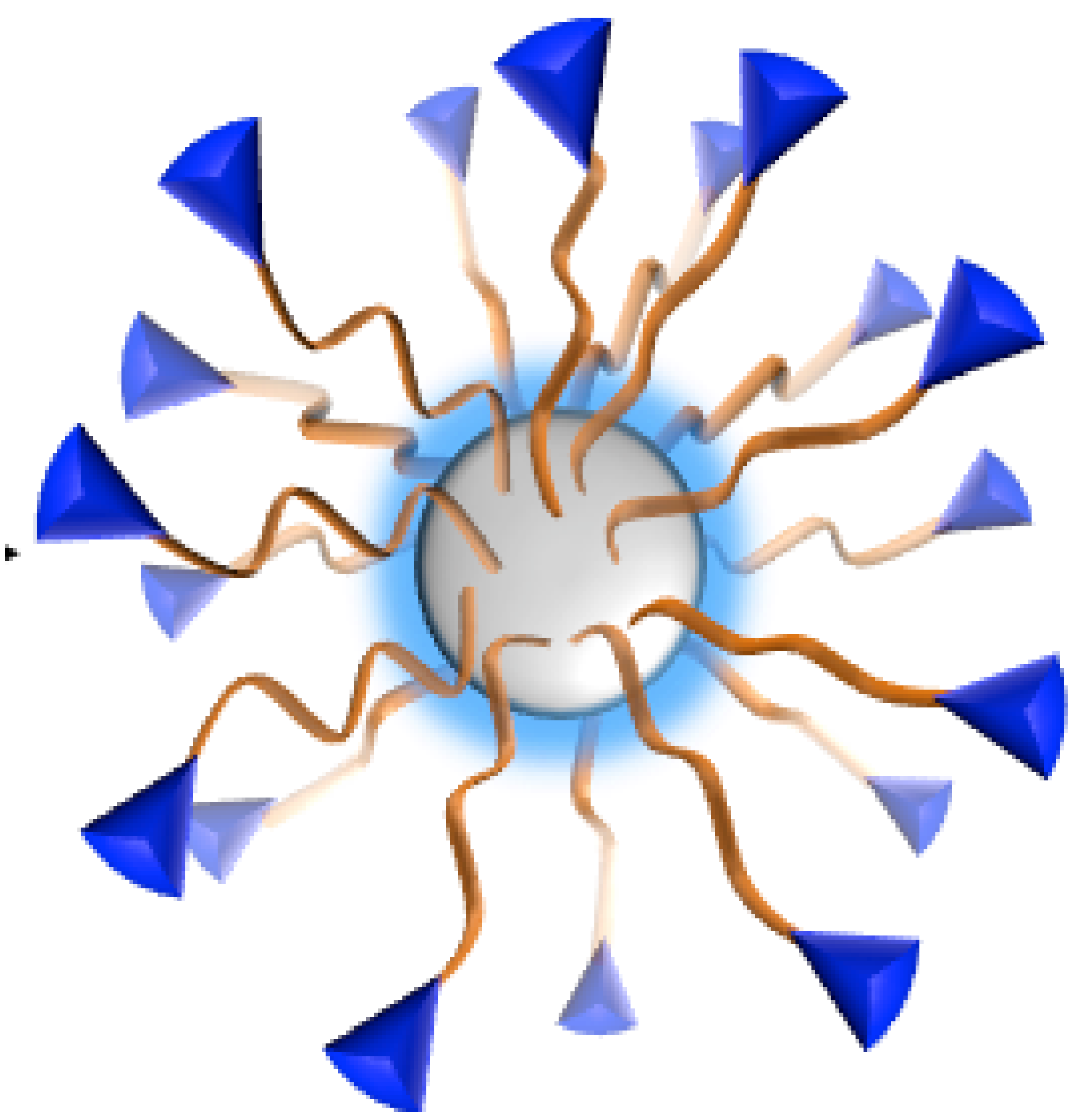


# TOXICITY ASSESSMENT OF NOVEL NANOPARTICLES ENGINEERED TO DISPERSE CRUDE OIL MONITORED USING A GENE EXPRESSION BIOMARKER IN FATHEAD MINNOW JUVENILES

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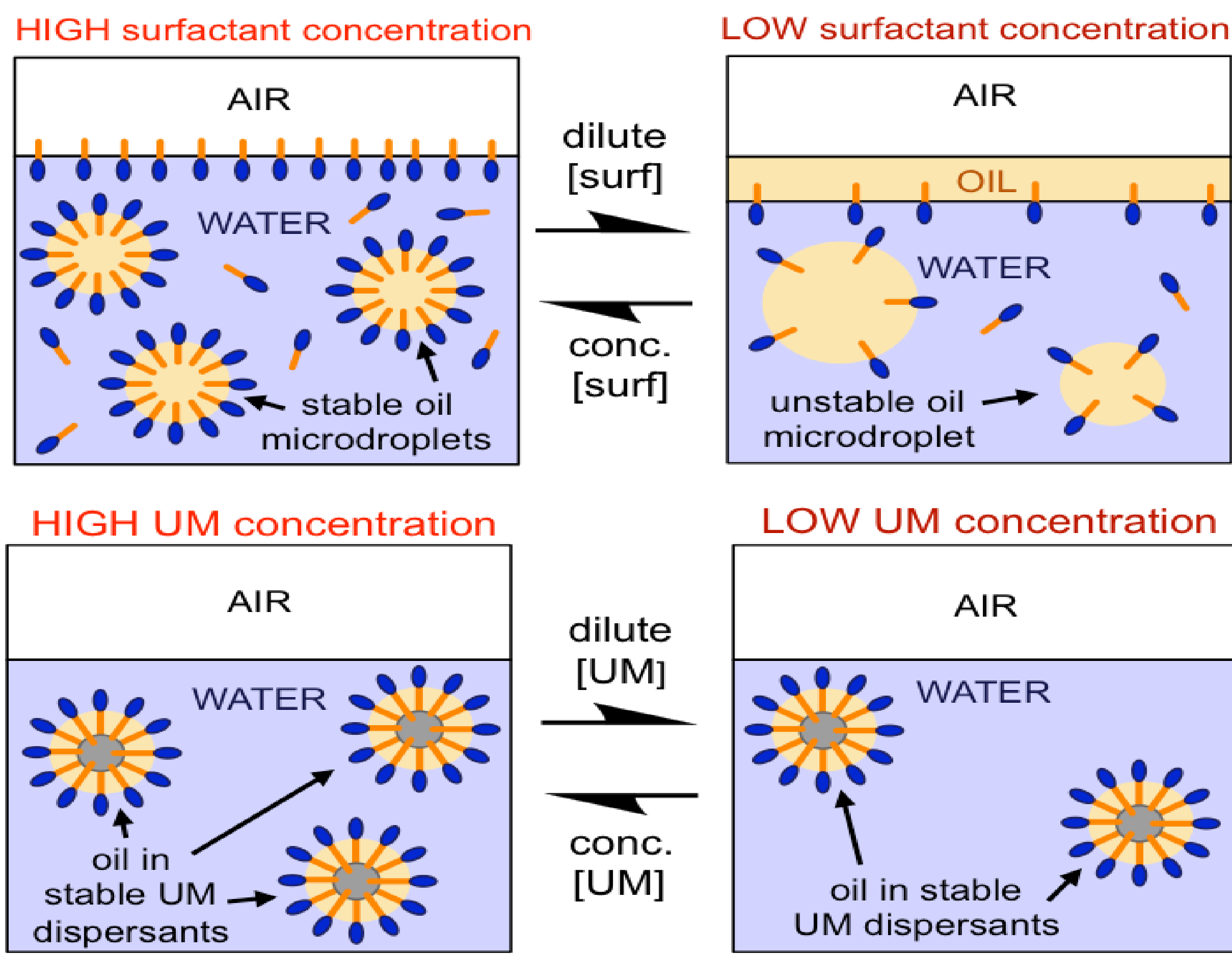
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## UNIMOLECULAR MICELLE NANOPARTICLE

“Next-generation oil dispersants with superior uptake and stability”

- Core of Silica Nanoparticle (SiO<sub>2</sub>-NPs)
- Branches of amphiphilic copolymers composed of hyperbranched poly(glycidol) (HPG)
- No need of Critical Micellar Concentration (CMC)



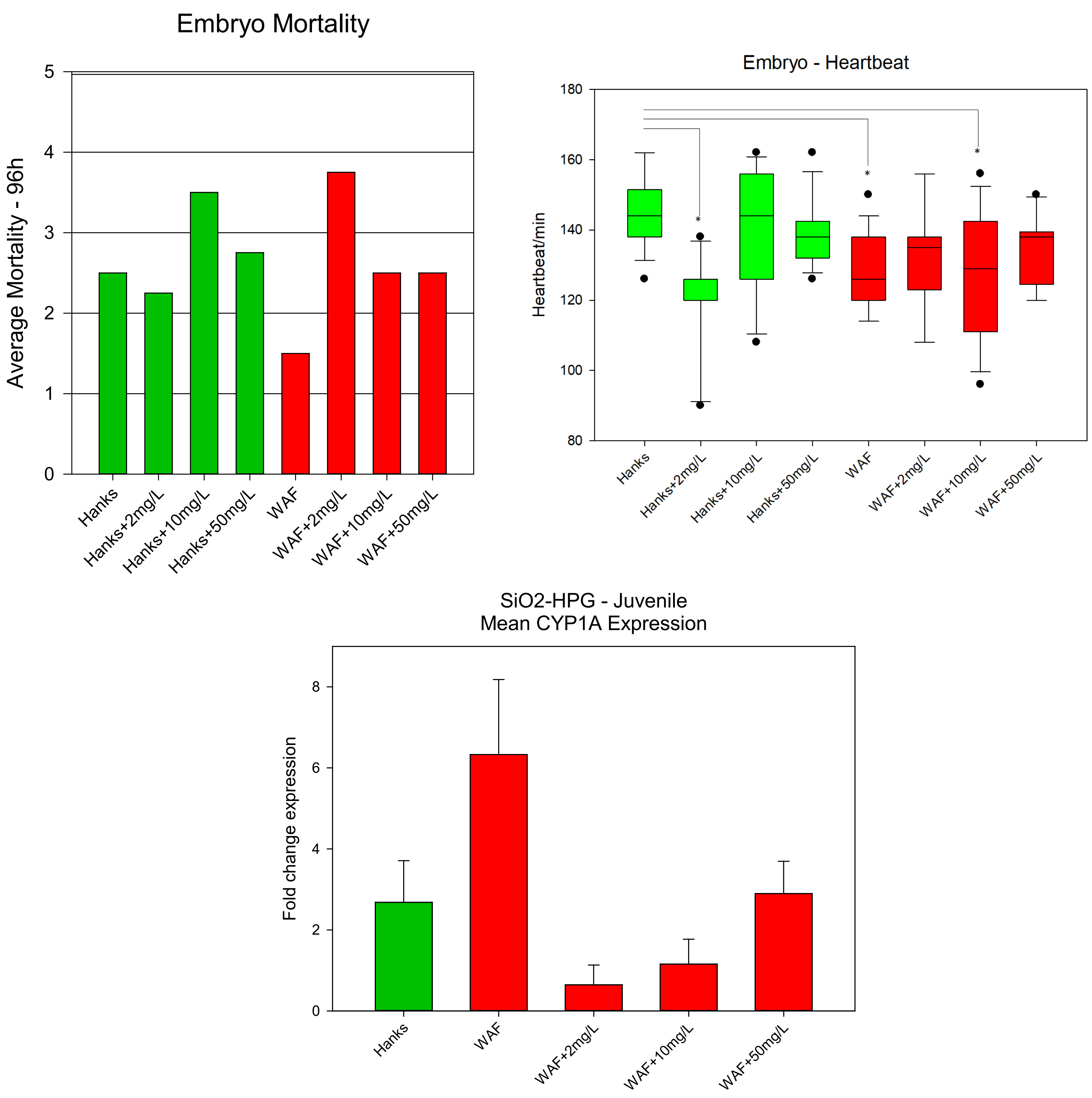
## BACKGROUND

Petroleum is the primary traded energy source in the world, and projections suggest it will remain the principal fuel for many decades to come.

- Uncontrolled oil releases during its extraction or shipping happen
- The environmental impact of such events can be devastating
- Dispersants have been used in remediating oil spills
- Toxic effect still in debate



## RESULTS AND DISCUSSION



- SiO<sub>2</sub>-HPG nanoparticles were used in these experiments. No visible agglomeration was observed throughout exposure.
- Mortality:
  - After 96h, embryo mortality was similar in all treatments with no statistical differences.
  - After 96h, no juvenile mortality was observed.
- Embryo Heartbeat
  - A significant reduction in heartbeat was observed with Hanks+2mg/L NP
  - A significant reduction with WAF alone and WAF+10mg/L NP were observed as well.
- Juvenile *cyp1a* gene expression
  - Juveniles exposed to WAF alone increased the expression of *cyp1a* by more than 3-fold as expected
  - After the addition of NP, the fold expression decreased in all treatment, although the differences were not significant.
- PAH detection
  - Naphthalene could be detected in Hanks solution, indicating a possible laboratory contamination.
  - 5 PAH could be detected in WAF solution and 3 could be quantified
  - 7 PAH could be detected in WAF+NP solution where 6 were quantified

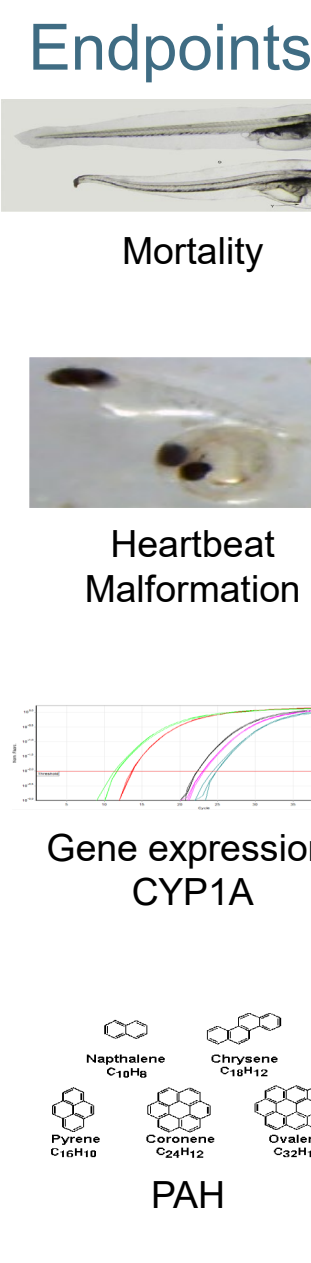
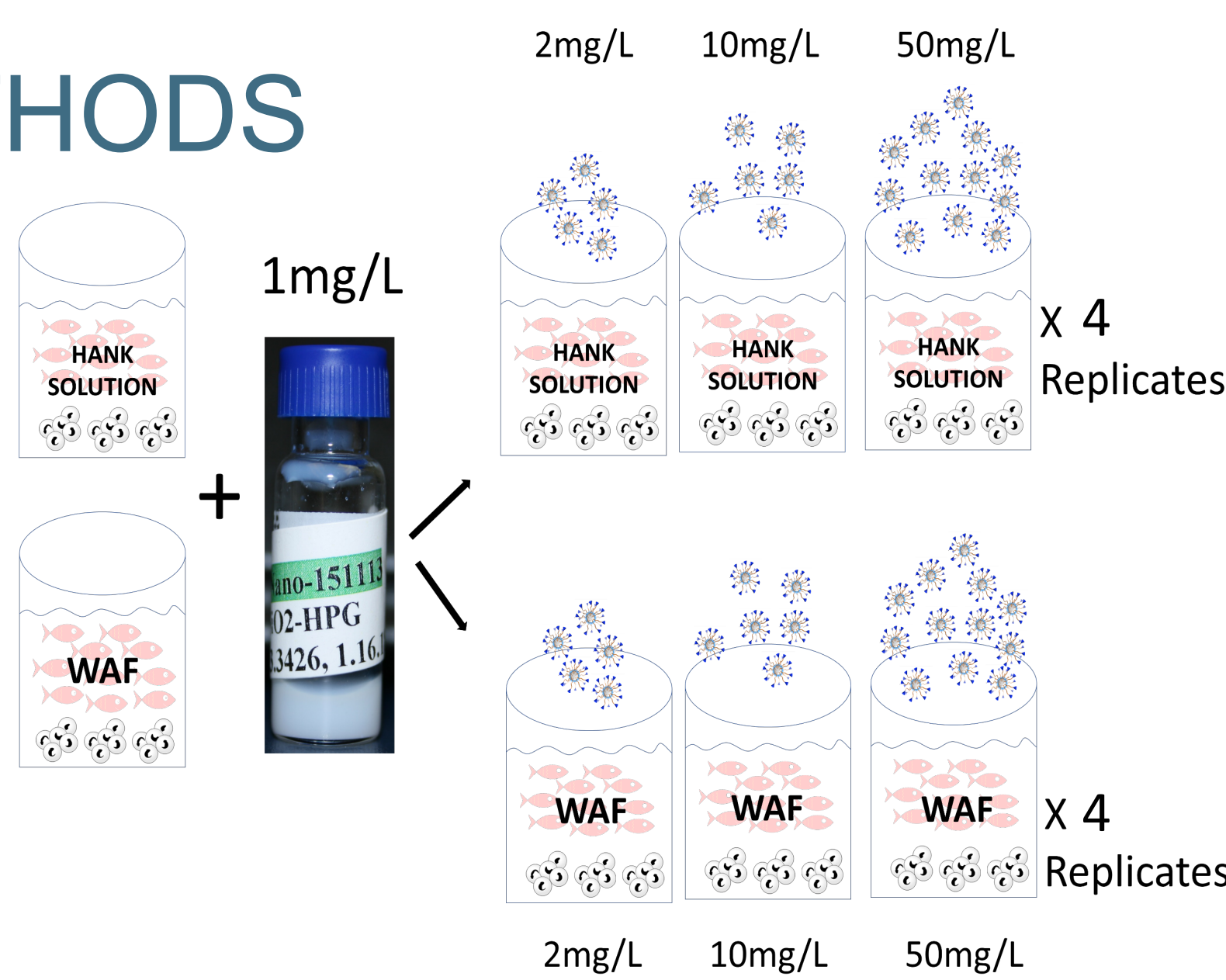
## OBJECTIVE

- Determine the toxicity of unimolecular functionalized silica nanoparticles exposed to fathead minnow embryos and juveniles

## HYPOTHESIS

- Engineered NPs uptake the oil components thus prevent the expression of biomarker of exposure in fathead minnow juveniles when co-exposed with the water-accommodated fraction of the oil

## METHODS



	sample limits		Hanks	WAF	WAF + NP
	LOD	LOQ			
naphthalene	0.05	0.125	0.13	0.48	10.48
acenaphthylene	0.025	0.025	<LOD	0.03	0.07
acenaphthene	0.05	0.125	nd	nd	0.11
fluorene	0.05	0.125	<LOQ	<LOQ	1.67
phenanthrene	0.05	0.125	<LOQ	0.13	0.99
anthracene	0.05	0.05	<LOD	<LOD	0.06
fluoranthene	0.05	0.125	<LOD	<LOQ	<LOD
pyrene	0.05	0.125	<LOD	<LOD	<LOQ
chrysene	0.05	0.125	nd	nd	nd
benz[a]anthracene	0.05	0.125	nd	nd	nd
benzo[b]fluoranthene	0.05	0.125	nd	nd	nd
benzo[k]fluoranthene	0.05	0.125	nd	nd	nd
benzo[a]pyrene	0.125	0.5	nd	nd	nd
indeno[1,2,3-c,d]pyrene	0.125	0.5	nd	nd	nd
dibenz[a,h]anthracene	0.125	0.125	nd	nd	nd
benzo[g,h,i]perylene	0.125	0.5	nd	nd	nd
Σ16 PAH (ng/mL)			0.13	0.64	13.38

## CONSLUSION AND ONGOING EXPERIMENTS

- Under the tested condition, the SiO<sub>2</sub>-HPG showed no toxic effect when exposed acutely to fathead minnow embryos and juveniles. Moreover, the NP reduced the bioavailability of PAH to juveniles, lowering the expression of *cyp1a*, with the 2mg/L NP was the most effective. Since heartbeat was altered by Hanks treatment alone, we cannot draw any conclusions with this endpoint about the performance of NP at the present time.
- Measurement of PAH in the media confirm the presence of oil components in WAF and WAF+NP; thus, the effects observed in embryonic and juvenile stages can be attributable to the presence of oil components.
- Currently EROD assay is performed to measure the enzymatic activity of the CYP1A, using whole embryo exposed during 24h to WAF. With this, we will have different scale of biomarkers of exposure: one at gene expression level and the actual effect on the organism.

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