***Experimental Outlook: Testing Relational Order in Living Systems** The hypothesis that life sustains quantum-like relational order can now be approached empirically. We are not chasing "quantum consciousness," but asking whether living systems preserve or recruit nonclassical coherence under conditions where it should vanish – and whether this order co-varies with adaptive organization. Each test thus pairs two readouts: a physical witness of coherence and a functional measure of adaptation.

Molecular level. Ultrafast two-dimensional spectroscopy of pigment-protein complexes or tunnelling-mediated enzymes can reveal whether coherence lifetimes or tunnelling probabilities shift with ecological perturbations in step with functional yield. The key prediction is a context-dependent optimum: perturbing protein scaffolds or hydration shells that alter vibronic couplings should move coherence and performance together. Denatured or mutant controls falsify the link if function changes independently of the coherence signature.

Mesoscopic level. Radical-pair magnetoreception offers model-based tests. Express cryptochrome constructs with functional reporters and apply weak, orientation-controlled magnetic fields at resonance frequencies predicted to disrupt singlet-triplet conversion. If relational order matters, both spin-correlation signals and downstream pathway efficacy will decline within the same narrow spectral window, vanishing under shielding or in mutants that break the radical-pair channel.

Network and organismal levels. Coherence-sensitive probes such as NV-diamond magnetometry or pump-probe microscopy can monitor spin or charge coherence in living cell networks while adaptation metrics (growth under noise, chemotaxis, metabolic reorganization) are tracked. At larger scales, simple organisms showing stimulus-response optimization can be tested under environmental contexts that subtly modulate coherence conditions–temperature, hydration, structured light–and correlated with non-invasive coherence proxies like fluorescence lifetimes or optical coherence tomography.

Across all tiers, information-theoretic analyses–transfer entropy, multi-scale entropy, or participation ratio–can quantify how relational order aligns with adaptive stability. A consistent co-variation between physical coherence and functional efficiency would support the view that life maintains order through contextual participation; persistent decoupling would challenge it.

Finally, the methodology itself should reflect the thesis: the observer is part of the context. Varying probe parameters (pulse timing, spectral window, field alignment) becomes a test of whether biological order depends on specific relational conditions. In this way, experiment and theory converge: measurement is not merely observation but participation – the point where relation becomes knowledge.