**Introduction**

This prompt is the culmination of the two prior prompts.

* One prompt was instructing GPT-3 to find the function, mechanism, and context of the organism in the sample.
* The second prompt was telling GPT-3 to find the organism and part of the organism performing the function.

Now, we ask GPT-3 to find all elements of a biological strategy in a concise form. We noticed for GPT-3 to be concise, we have to teach it how, thus we included a sample in the prompt.

**Structure of Prompt**

* Directions
  + Directions
    - Definition of biological strategy (first sentence)
    - Definition of the main elements of the strategy
    - Telling GPT-3 to include all the elements extracted in the strategy
  + One-Shot Sample
    - Sample “Text” → Tungara Frog …
    - Sample “Output”
  + Input
    - Input “Text” → {}
    - Output start → “Organism:”
      * GPT-3 only needs the first part of the output (in fact, it may not even need this)

**Prompt**

A biological strategy is a characteristic, mechanism, or process that an organism or ecosystem exhibits to accomplish a particular function within a particular context.

The main elements of a biological strategy are:

- The organism or ecosystem

- The part of the organism

- Function (what it does or accomplishes)

- Mechanisms (how it does it)

- Context (environment, conditions, constraints, stressors)

Text: Building a home from foam-túngara frog foam nest architecture and three-phase construction process. frogs that build foam nests floating on water face the problems of over-dispersion of the secretions used and eggs being dangerously exposed at the foam : air interface. nest construction behaviour of tungara frogs, engystomops pustulosus, has features that may circumvent these problems. pairs build nests in periodic bursts of foam production and egg deposition, three discrete phases being discernible. the first is characterized by a bubble raft without egg deposition and an approximately linear increase in duration of mixing events with time. this phase may reduce initial over-dispersion of foam precursor materials until a critical concentration is achieved. the main building phase is marked by mixing events and start-to-start intervals being nearly constant in duration. during the final phase, mixing events do not change in duration but intervals between them increase in an exponential-like fashion. pairs joining a colonial nesting abbreviate their initial phase, presumably by exploiting a pioneer pair's bubble raft, thereby reducing energy and material expenditure, and time exposed to predators. finally, eggs are deposited only in the centre of nests with a continuously produced, approximately 1 cm deep egg-free cortex that protectively encloses hatched larvae in stranded nests.

Organism: Túngara frog

Part of: Nest

Function: protect hatched larvae

Mechanism: building nests

Context: periodic bursts of foam production and egg deposition on water

Strategy: Túngara frogs protectively enclose hatched larvae by building nests in periodic bursts of foam production and egg deposition on water

Text: {}

Organism:

**Structure of Content**

* Each entry has a
  + Paper Id
  + Summary generated from GPT-3 Da Vinci consisting of
    - Biological Strategy
    - Organism
    - Part of
    - Function
    - Mechanisms
    - Context
  + My notes and analysis

**Content**

1. W2130285640
   * Sample: "title": "Foam nest components of the t\u00fangara frog: a cocktail of proteins conferring physical and biological resilience", "abstract": "the foam nests of the tungara frog (engystomops pustulosus) form a biocompatible incubation medium for eggs and sperm while resisting considerable environmental and microbiological assault. we have shown that much of this behaviour can be attributed to a cocktail of six proteins, designated ranaspumins (rsn-1 to rsn-6), which predominate in the foam. these fall into two discernable classes based on sequence analysis and biophysical properties. rsn-2, with an amphiphilic amino acid sequence unlike any hitherto reported, exhibits substantial detergent-like surfactant activity necessary for production of foam, yet is harmless to the membranes of eggs and spermatozoa. a further four (rsn-3 to rsn-6) are lectins, three of which are similar to fucolectins found in teleosts but not previously identified in a land vertebrate, though with a carbohydrate binding specificity different from previously described fucolectins. the sixth, rsn-1, is structurally similar to proteinase inhibitors of the cystatin class, but does not itself appear to exhibit any such activity. the nest foam itself, however, does exhibit potent cystatin activity. rsn-encoding genes are transcribed in many tissues of the adult frogs, but the full cocktail is present only in oviduct glands. combinations of lectins and cystatins have known roles in plants and animals for defence against microbial colonization and insect attack. tungara nest foam displays a novel synergy of selected elements of innate defence plus a specialized surfactant protein, comprising a previously unreported strategy for protection of unattended reproductive stages of animals."
   * Output:
     + Organism: Túngara frog
     + Part Of: Nest
     + Function: protect eggs and sperm
     + Mechanism: a cocktail of six proteins
     + Context: the foam nests of the tungara frog form a biocompatible incubation medium for eggs and sperm while resisting considerable environmental and microbiological assault
     + Strategy: Túngara frogs protect eggs and sperm by producing a cocktail of six proteins that exhibit surfactant activity and lectin activity.
   * Notes:
     + Correct
       - Organism
       - Function
       - Mechanism, but could have more info.
     + Incorrect
       - Part Of is not mentioned in abstract.
       - Context seems correct, but it is not present in biological strategy
       - Strategy is missing information.
     + 3/6
2. W2168114966
   * Sample: "title": "The suctorial organ of the Solifugae (Arachnida, Solifugae)", "abstract": "the ability of members of the arachnid order solifugae to climb smooth, vertical surfaces and the organs involved in this behavior are investigated. macroscopic, microscopic, and scanning electron microscopic observations are made of a palpal organ called the suctorial organ. observations of the behavior but not the microstructure have been made in the past. histological examination illustrates the internal gross anatomy of this structure and scanning electron microscopy demonstrates the fine structure in adults of four genera: eremobates (eremobatidae), eremochelis (eremobatidae), eremorhax (eremobatidae), ammotrechula (ammotrechidae), as well as an unidentified late stage immature and third stage instar. the suctorial organ is most likely primarily used for prey capture in the wild. q 2005 elsevier ltd. all rights reserved."
   * Output:
     + Organism: Solifugae
     + Part Of: Suctorial organ
     + Function: prey capture
     + Mechanism: suction
     + Context: smooth, vertical surfaces
     + Strategy: Solifugae use their suctorial organs to capture prey by suction on smooth, vertical surfaces.
   * Notes:
     + Correct!
     + Mechanism is abstracted from suctorial organ
     + Follow-up → Does this follow the samre structure as the Tungara Frog sample fed into GPT?
3. W1589686983
   * Sample: "title": "On the Mound of Macrotermes michaelseni as an Organ of Respiratory Gas Exchange", "abstract": "patterns and rates of air movements in the mounds and nests of macrotermes michaelseni were studied using tracer methods. wind is a significant source of energy for powering nest ventilation, despite the mound being a completely enclosed structure. nests are ventilated by a tidal movement of air driven by temporal variation in wind speed and wind direction. density gradients sufficiently steep to drive bulk flow by natural convection will be rare. however, metabolism-induced buoyant forces may interact with wind energy in a way that promotes homeostasis of the mound atmosphere."
   * Output:
     + Organism: Macrotermes michaelseni
     + Part Of: Mound
     + Function: Respiratory gas exchange
     + Mechanism: Tracer methods
     + Context: Wind speed and direction
     + Strategy: Macrotermes michaelseni uses wind energy to power nest ventilation by a tidal movement of air.
   * Notes:
     + Correct
       - Organism
       - Part Of
     + Incorrect
       - Function → nest ventilation
       - Mechanism → a tidal movement of air
       - Context → mound being a completely enclosed structure
       - Strategy is missing information, but on the right track.
     + 2/6
4. W1589686983
   * Sample: "title": "A multi-enzyme cascade of hemoglobin proteolysis in the intestine of blood-feeding hookworms.", "abstract": "blood-feeding pathogens digest hemoglobin (hb) as a source of nutrition, but little is known about this process in multicellular parasites. the intestinal brush border membrane of the canine hookworm, ancylostoma caninum, contains aspartic proteases (apr-1), cysteine proteases (cp-2), and metalloproteases (mep-1), the first of which is known to digest hb. we now show that hb is degraded by a multi-enzyme, synergistic cascade of proteolysis. recombinant apr-1 and cp-2, but not mep-1, digested native hb and denatured globin. mep-1, however, did cleave globin fragments that had undergone prior digestion by apr-1 and cp-2. proteolytic cleavage sites within the hb \u03b1 and \u03b2 chains were determined for the three enzymes, identifying a total of 131 cleavage sites. by scanning synthetic combinatorial peptide libraries with each enzyme, we compared the preferred residues cleaved in the libraries with the known cleavage sites within hb. the semi-ordered pathway of hb digestion described here is surprisingly similar to that used by plasmodium to digest hb and provides a potential mechanism by which these hemoglobinases are efficacious vaccines in animal models of hookworm infection."
   * Output:
     + Organism: Hookworm
     + Part Of: Intestine
     + Function: To digest hemoglobin
     + Mechanism: A multi-enzyme, synergistic cascade of proteolysis
     + Context:
     + Strategy: Hookworms digest hemoglobin by a multi-enzyme, synergistic cascade of proteolysis
   * Notes:
     + Correct
       - Organism
       - Part Of
       - Function
       - Mechanism
     + Incorrect
       - Context → not sure, but could be → blood-feeding pathogens
       - Strategy is missing information.
     + 4/6
5. W2052657884
   * Sample: "title": "The Diversity of Hydrostatic Skeletons", "abstract": "a remarkably diverse group of organisms rely on a hydrostatic skeleton for support, movement, muscular antagonism and the amplification of the force and displacement of muscle contraction. in hydrostatic skeletons, force is transmitted not through rigid skeletal elements but instead by internal pressure. functioning of these systems depends on the fact that they are essentially constant in volume as they consist of relatively incompressible fluids and tissue. contraction of muscle and the resulting decrease in one of the dimensions thus results in an increase in another dimension. by actively (with muscle) or passively (with connective tissue) controlling the various dimensions, a wide array of deformations, movements and changes in stiffness can be created. an amazing range of animals and animal structures rely on this form of skeletal support, including anemones and other polyps, the extremely diverse wormlike invertebrates, the tube feet of echinoderms, mammalian and turtle penises, the feet of burrowing bivalves and snails, and the legs of spiders. in addition, there are structures such as the arms and tentacles of cephalopods, the tongue of mammals and the trunk of the elephant that also rely on hydrostatic skeletal support but lack the fluid-filled cavities that characterize this skeletal type. although we normally consider arthropods to rely on a rigid exoskeleton, a hydrostatic skeleton provides skeletal support immediately following molting and also during the larval stage for many insects. thus, the majority of animals on earth rely on hydrostatic skeletons."
   * Output:
     + Organism: animals
     + Part Of: body
     + Function: support, movement, muscular antagonism, and the amplification of the force and displacement of muscle contraction
     + Mechanism: internal pressure
     + Context: contraction of muscle
     + Strategy: animals rely on hydrostatic skeletons by contracting muscle to create an internal pressure for support, movement, and other functions.
   * Notes:
     + Correct
       - Organism
       - Function
       - Mechanism
     + Incorrect
       - Part Of → hydrostatic skeleton
       - Context → majority of animals
       - Strategy is missing information.
     + 3/6

|  | Organism | Part Of | Function | Context | Mechanism | Strategy |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| W2130285640 | 1 | 0 | 1 | 1 | 1 | 0 | 4/6 |
| W2168114966 | 1 | 1 | 1 | 1 | 1 | 1 | 6/6 |
| W1589686983 | 1 | 1 | 0 | 0 | 0 | 0 | 2/6 |
| W1589686983 | 1 | 1 | 1 | 0 | 1 | 0 | 4/6 |
| W2052657884 | 1 | 0 | 1 | 0 | 1 | 0 | 3/6 |
|  | 5/5 | 3/5 | 4/5 | 2/5 | 4/5 | 1/5 |  |

* Conclusion
  + W2168114966
    - 6/6
    - Follow-up → Does this follow the samre structure as the Tungara Frog sample fed into GPT?
  + This prompt does a great job of getting the organism, function and mechanism.
  + The strategy will always be incorrect if it is missing information or any of the elements of it are incorrect.