

Identification and Classification of Fault Agent Detection Strategies in Nature

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Purpose

- To study how natural systems “resist” fault agents and prevent Byzantine fault from happening.

We want to study appropriate natural processes to design a multi-agent system to be resilient to Byzantine fault.

**Byzantine fault occurs when one agent of a system, or foreign intruder, which pretends to be an agent of a system, disrupt system’s normal operation while “pretending” to operate normally.*

- To fill the gap in biological inspirations for fault agent detection processes.

Today we cannot use biologically inspired approach to design a fault tolerant system due to lack of biological inspirations.

Biologically Inspired Design

- Biologically inspired design is a design approach that takes inspiration from nature to solve human problems and improve technologies.

Research Focus

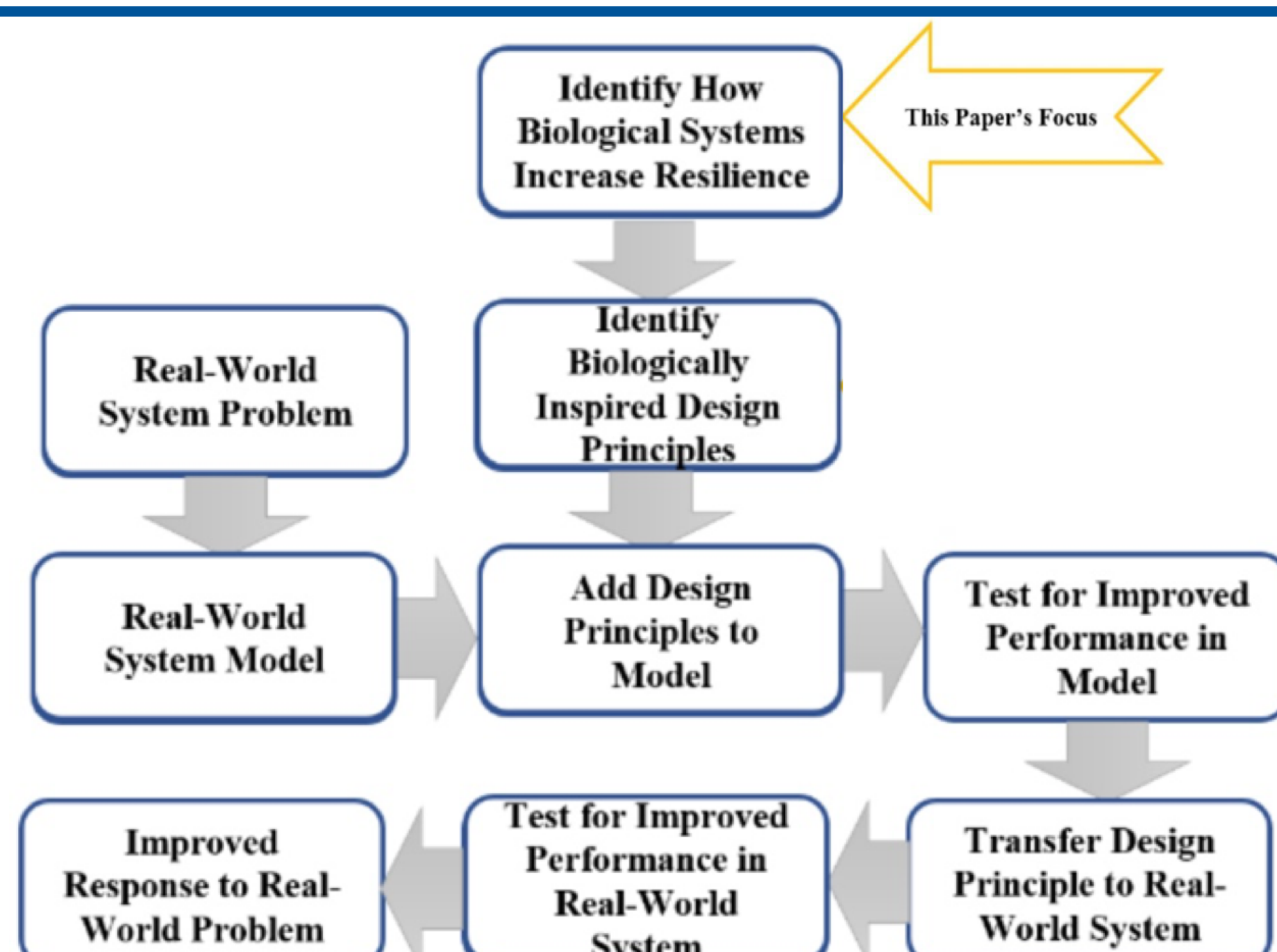


Figure 2 (reprinted). Research focus. Hernandez, IV, Watson, BC, Weissburg, M, & Bras, B. “Learning From Insects to Increase Multi-Agent System Resilience: Functional Decomposition and Transfer to Support Biologically Inspired Design.” August 17–19, 2021.

Systematic Literature Review Approach

- I am using Systematic Literature Review (SLR) approach throughout my research, to access existing knowledge on fault agent detection in nature.
- This approach tends to identify, select, evaluate, and synthesize all relevant literature on a specific research question or topic.
- One of the major steps in SLR approach is a comprehensive search of relevant databases to identify all relevant studies that meet the inclusion criteria.
- Hunt Library’s search engine was chosen as a primary database. However, other sources such as Google Scholar are used for literature collection.
- All natural domains within the macro world were identified as the main inclusion criteria. Thus, fault agent detection processes within the micro world will not be included in this research.

Following search terms were used to collect 34 research works:

- Fault Tolerant Biological System
- Social Parasites
- Temporary Social Parasites
- Mimicry
- Ant Mimics
- Parasite Hymenoptera
- Mixed Species Nest
- Social Immunity
- Nest Usurpation

During the search procedure, 201 scientific publications were reviewed.

Saturation criteria for each key word was decided to be 10 irrelevant publications in a row as offered by the search engine.

Research Timeline

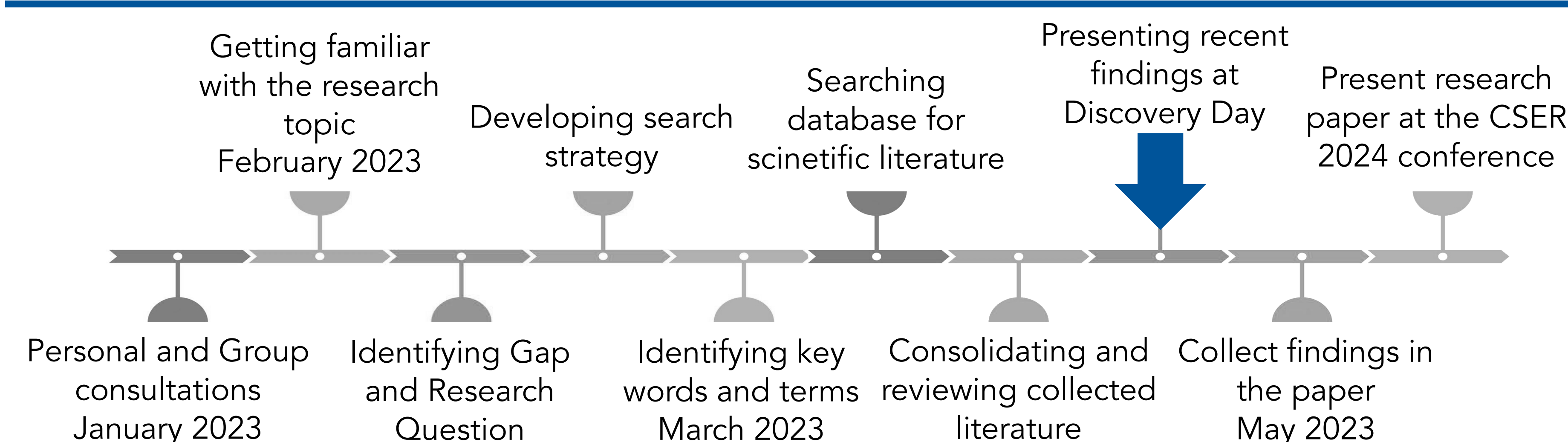


Figure 3. Research timeline

Fault Agent Detection

When herbivorous species consume too much vegetation in the area, it can cause soil erosion, which can lead to ecological disaster in the region.

Thus, the ecosystem’s normal functioning will be disrupted.

Even though these species are part of an ecosystem, in this scenario they become faulted agents of this system.

In response, some plants protect themselves from consumption by producing defensive chemical compounds.

For instance, when a caterpillar chews on a leaf, the plant can detect the damage through chemical signals released by the caterpillar’s saliva. This triggers a response in the plant, causing it to produce compounds that are toxic to the caterpillar, such as alkaloids or terpenes.

This process will control the population of invasive species and prevent them from becoming destructive for the ecosystem.

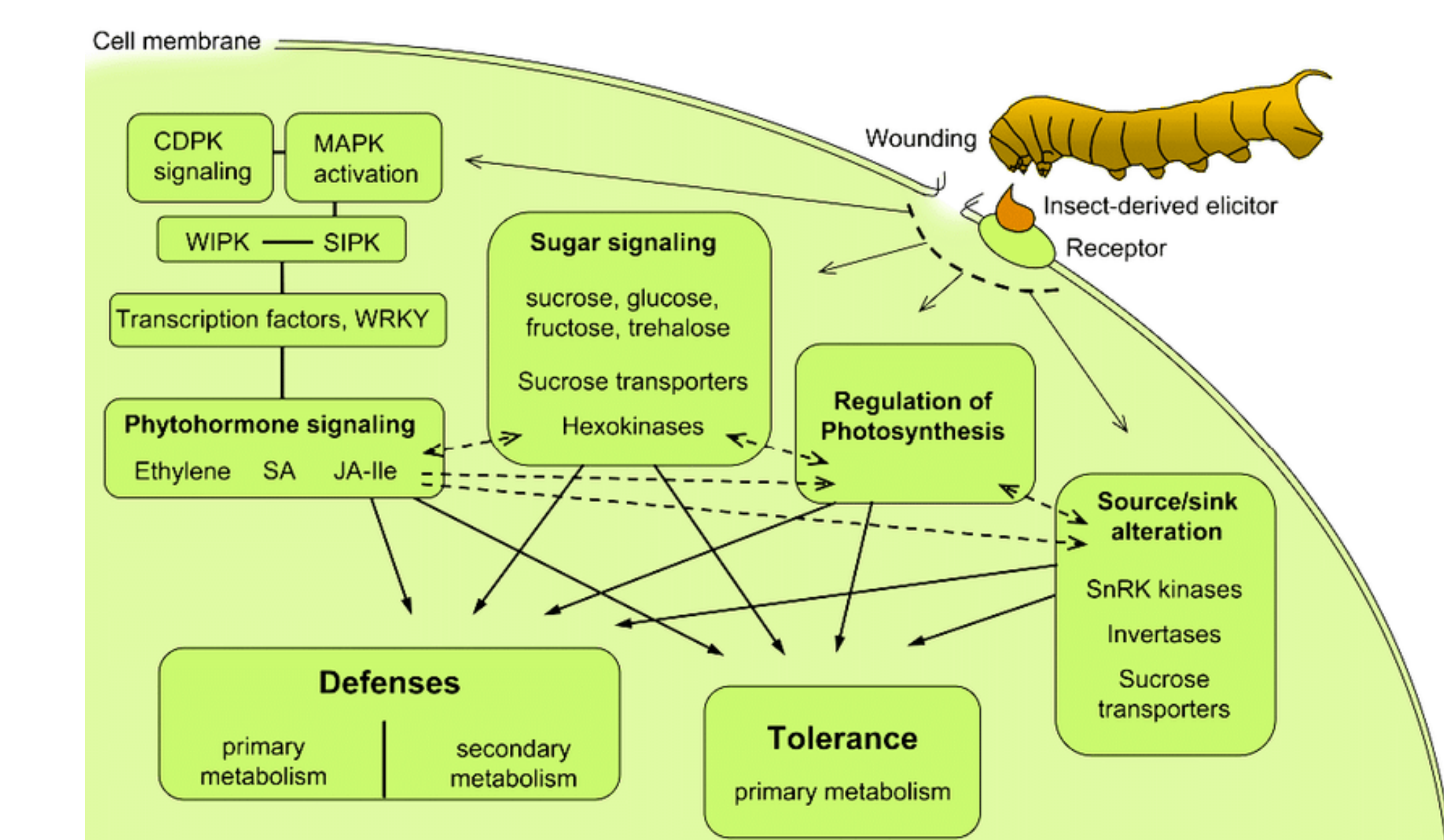


Figure 1. Plant’s response to herbivore attack. Body, Melanie. (2013). Plant manipulation by endophagous organisms: Physiological mechanisms, signaling, and nutritional consequences in a leaf-miner insect. 10.13140/RG.2.2.21011.02081.