

Signalling Showdown

Game Rules

Players: 4-6

Contents: 102 cards
& rules pamphlet

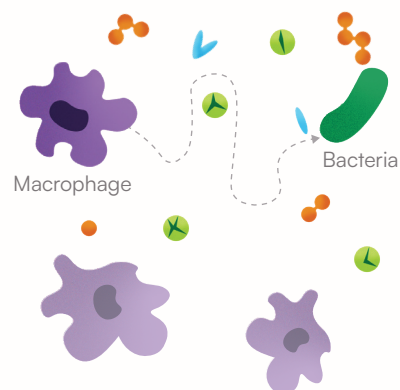
Of the many cells in the human body's immune system, one is *macrophages*. They seek out and race towards the foreign bodies like bacteria to destroy them.

To do so, various processes have to be set in motion—one to detect the first signal, one to move from one location to another, another to sense the direction of the signal, and finally one more to capture and digest it.

These processes are set in motion through a *signal transduction system*, (to read more about signal transduction, check out the science leaflet!) which includes a signal, a sensor, an amplifier and an effector. In cellular systems, these roles are performed by proteins and a few specialised molecules.

Objective

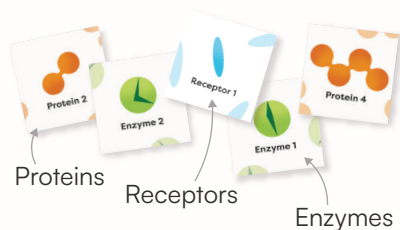
In this game, you each play the role of a macrophage racing to catch a bacteria, by collecting more signal complexes than others. By this you effectively clear the immune system load!



Components

Deck of 102 two-sided cards, with 2 sides- component and signal sides:

Component side



Signal side



Action cards

Signal transduction processes are amenable to regulation. These are represented in a subset of regulatory (pro-player and anti-competitor) cards:

Wild Card: Can only be used as any component card (not signal or other action cards) or as a specific component type (based on the components shown on the card)



Amplify: To be used on one of your complete sets to double the set's score



Attenuate: To be used on one of the opponent's complete sets to half that set's score

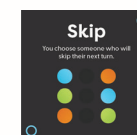
The game also includes other action cards to encourage player interaction:

Flip: To be used to flip either 1 opponent's cards in an incomplete set, or 2 of your own



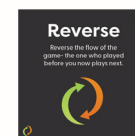
Extra turn: To be used to get an extra turn

Exchange: To be used to exchange one card with another player of your choice



Skip: To be used to make another player of your choice skip their next turn

Reverse: To be used to reverse the order of players





Steal: To be used to steal a card from any player's unfinished set

Setup

1. Prepare a single deck with all cards such that the signal side is on top.



2. Randomly divide the deck into 3 piles.



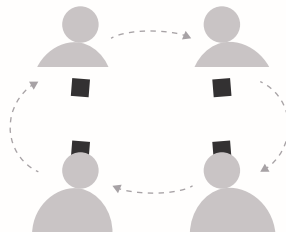
3. Flip 3 cards from each deck exposing the components or action cards to form the 'resource pool'.



Resource pool

How to play

Players take turns in a clockwise manner.



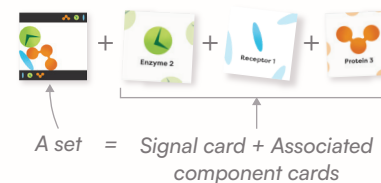
On each turn, a player can either take 1 signal card or 3 component cards.



If a player picks a component card, replenish the pool by flipping the card from the signal pile.



Each player has to build sets of signal & associated component cards. *All cards should be placed so that all players can see the sets being built by everyone.*



The science behind creating 'sets'

A signal informs a specific response in the body and hence requires specific components. This signal also contains information on the specific components required to complete it.

If the resource pool ends up with 3 action cards, players must discuss and decide who will pick what in the next round to clear out the slots for more component cards.



Remember, cells talk to each other!

Ending the game

Eventually, the signal cards available in the resource pool will run out. When this happens, the game ends, and the player with the highest score wins!

Scoring

No. of points a player can get from a set

$$= \frac{n-1}{\text{number of components in a completed set}}$$

Things to keep in mind:

- The active side of a card is always the one that faces the players.
- Players cannot flip their cards without spending a 'Flip' action card.
- An action card can only be used in a turn after the one in which it is picked.
- An action card can only be spent once, and must be placed afterwards in a separate discard pile.



® This project was possible due to the KMD Science Communication Fellowship 2024 by STEMPEERS to Ipsa Jain.

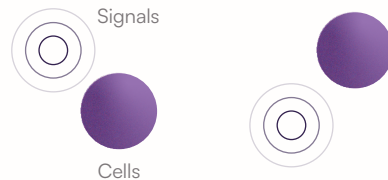
Signalling Showdown is conceptualised by Ipsa Jain and designed by Ipshita Raj.

Signalling Showdown

The Science Behind the Game

What is signal transduction?

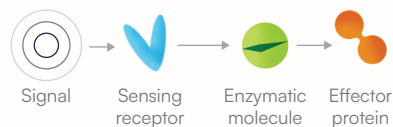
All living things—as well as the cells inside them have to make sense of the world. Warmth, foreign objects, hunger are all signals to be sensed. Each cell has to receive, interpret and respond to these signals—which it can do in a multitude of ways.



But what makes this graded sense and response possible?

A process called *signal transduction*.

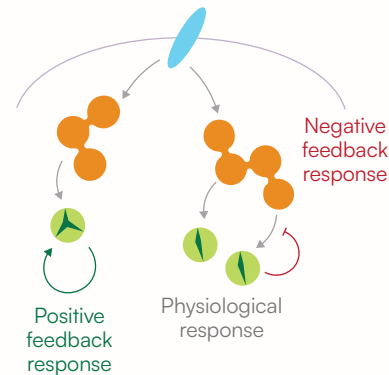
A physical, chemical or electrical stimuli/signal triggers a series of events in the cell. This signal is then received by a *sensing receptor* (in most circumstances) on the cell membrane. The engaged receptor sends a message across (again, in most cases) *enzymatic molecules*. These enzymatic molecules can then in turn, change *effector proteins*, that control the cellular response.



The signal transduction process shown through representative components from the game

Signal transductions not only receive and amplify signals aptly, they are also finely tunable across time and space. There are several feedback mechanisms that ensure tight regulation based on signal and cellular context.

A negative feedback response ensures that the signal pathway stops when the signal has receded or a sufficient response has been generated. A positive feedback response can ensure that a slight signal produces a sustained response over time.

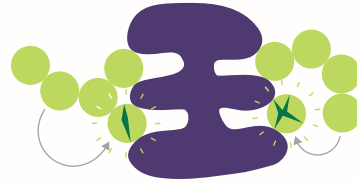


There are several molecular mechanisms by which the cells can tune these responses. Within the game, these are represented by the action cards. Examples include:

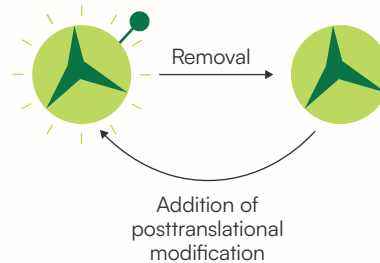
1. **Polymerization:** Some components may bind to one or more of the components, allowing faster/stronger response.



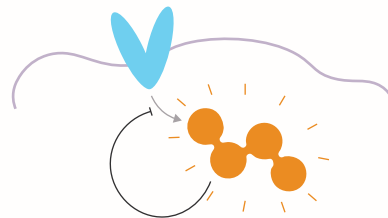
2. **Scaffolding proteins:** These proteins that allow all components of a signal pathway to come together tightly and facilitate faster message relay.



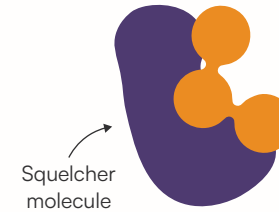
3. **Posttranslational modification:** Small molecular groups are added or removed from component, making them active or inactive.



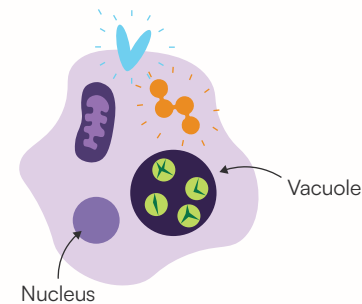
4. **Autoinhibition:** A component turns itself inactive in signal transduction pathway.



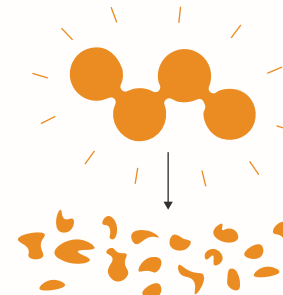
5. **Squelcher molecule:** A molecule binds to a component, taking it away, unable to participate in the signalling pathway.



6. **Translocation:** Change in component location in different cellular locations, making it unavailable to participate in signalling pathways.



7. **Proteolysis:** A component is specifically destroyed in the cell, making it unavailable to participate in signalling pathways.



So now, each time you play the game, remember the many, *many* molecular orchestras playing within every cell—from your eyes to your brain to your muscles—dancing, relaying information and regulating it all.

To learn more about signal transduction scan these QR codes with links to useful resources!



About Signal
Relay Pathways:
Khan Academy



Engineering Signal
Transduction
Pathways: Cell, a
Cell Press Journal



© This project was possible
due to the KMD Science
Communication Fellowship
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