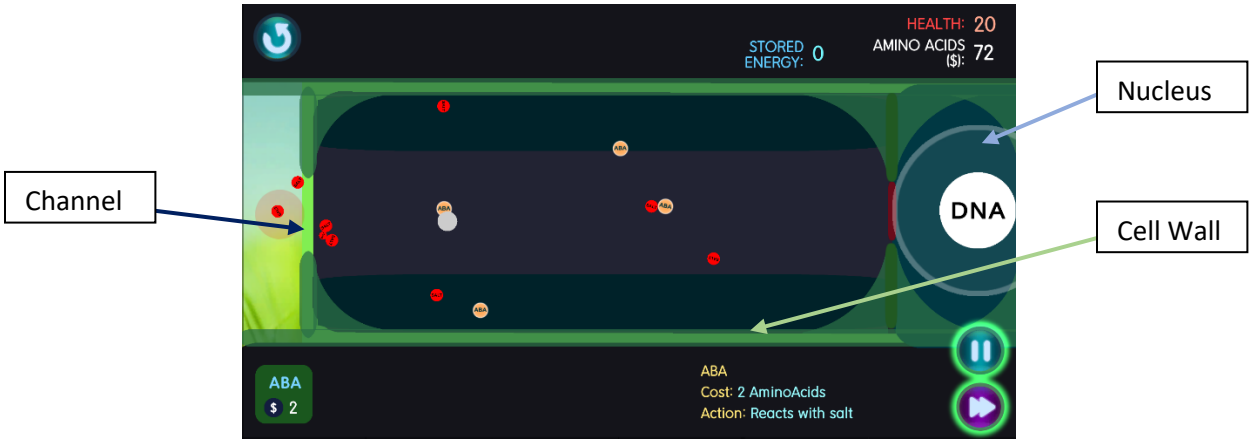
# TUTORIAL: PLANT VIDEO GAME

You can find the game at: https://rdale.itch.io/plants

The password is: plantGame

You are a plant cell defending your DNA against drought. **DNA** contains blueprints for everything cells do - growing, reproducing, and making proteins. Cells use **amino acids** to create proteins using the DNA blueprint. Proteins protect DNA and tell the DNA that danger is present! To win the game, you must protect your DNA, use proteins to send the danger message to the DNA, and save energy. Spend your amino acids wisely!

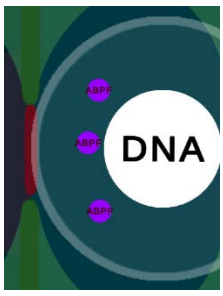



The **hormone ABA** is the first responder to drought. ABA  is able to bind to the salt  , becoming active ABA  . Active ABA can prevent salt from damaging plant cells. Place 3 ABA inside the cell by the cell wall! Click on the ABA button, drag it to the cell, and drop it place it. Watch out, the salt can enter the cell through channels in the cell wall.

To pause the game, click the || button. 

To restart or speed things up, click the >> button. 

ABA isn't enough, we need the **protein APBF** that can tell the DNA that drought is happening. ABPF lives in the **nucleus** with the DNA.. Build 3 ABPF proteins in the nucleus! Click on the ABPF button, drag and drop into the nucleus.




*ABPF is the only protein that lives in the nucleus.*

Finally, we need a messenger! The protein SNRK2 will leave PP2C 

only if ABA tells them to. In this way SNRK2 will be able to deliver the message. Proteins are expensive, and cells need to be very careful with their amino acids. ABA will react with **PP2C which will send SNRK2, the messenger** 

, to ABPF! Click on the PP2C/SNRK2 button, drag and drop it into the cell.


*Active ABA can randomly hit PP2C, which will send active SNRK2 to the DNA.*


*SNRK2 send the message to ABPF, who can tell the DNA that drought is occurring, and that we need more proteins.*

Whenever you successfully send the message to the DNA, you will receive **10 points** (amino acids). Use these amino acids to create the proteins you need to survive.

| | **Cost** | **Function** |
|---|---|---|
| **ABA** | 2 Amino Acids | Activated by salt; can activate SNRK2 |
| **ABPF** | 2 Amino Acids | Sends signal to DNA |
| **PP2C/SNRK2** | 3 Amino Acids | SNRK2 is activated by ABA; can travel into the nucleus |
| **Chloroplast** | 12 Amino Acids | Generates 1 energy every 2 seconds |

Now that we can defend the cell against drought, we should make some **chloroplasts** to gather energy from the sunshine! Build some chloroplasts in the cell to help the plant grow! Once you gather 100 energy, the plant can continue to grow even in these adverse drought conditions - and you win!

*Watch out – chloroplasts can be injured by salt.*

Proteins move **randomly** in the cell. How 'sticky' they are determines how easily they stay together. Change the binding rate to see how stickiness affects the proteins. It's more difficult to send messages with a lower binding rate, while increasing the binding rate makes it easier to send messages.

*Changing the binding rate changes the difficulty of sending messages to the DNA.*