Save Schrödinger's Cat Game

Based on the rules of a videogame called Quantum Odyssey by quarksinteractive.com

Dr. Schrödinger is conducting a classic quantum experiment! He has built a steel chamber in which he has placed a Geiger counter along with a tiny bit of radioactive substance, an amount so small that perhaps in a matter of minutes one of the atoms will decay, but perhaps, with equal probability, none of the atoms will decay. If this does happen, the counter tube will discharge, then through an electromagnet activated by a signal, release a hammer that shatters a flask of sleeping gas.

Dr. Schrödinger leaves the office for the night to feed his cat.

You are his lab assistant, and you are certain that if one of the atoms decays, the flask would surely break inside the steel chamber and the gas would put everything inside the chamber to sleep. As you ponder upon the experimental details, you hear a sudden "Meow!" coming from the steel chamber.

Oh no, Schrödinger's Cat must have sneaked inside the chamber searching for food!

You must quickly use your knowledge of quantum and Save Schrödinger's Cat!

How to Win

The purpose of the game is to start from one of the **Challenge Scenarios**, place the **cat token** as indicated in each scenario and then figure out and place down the right sequence of **Quantum Gates** to create a quantum path for the cat token to arrive from the initial state (given in the Challenge Scenario) to our desired final state: a single **blue** cat token on the **Awake** state. This will stabilize the atom and keep Schrödinger's cat awake.

You win a Challenge if you manage to obtain on the last card a **single**, **blue-colored token** at the end of an uninterrupted sequence of quantum gate cards.

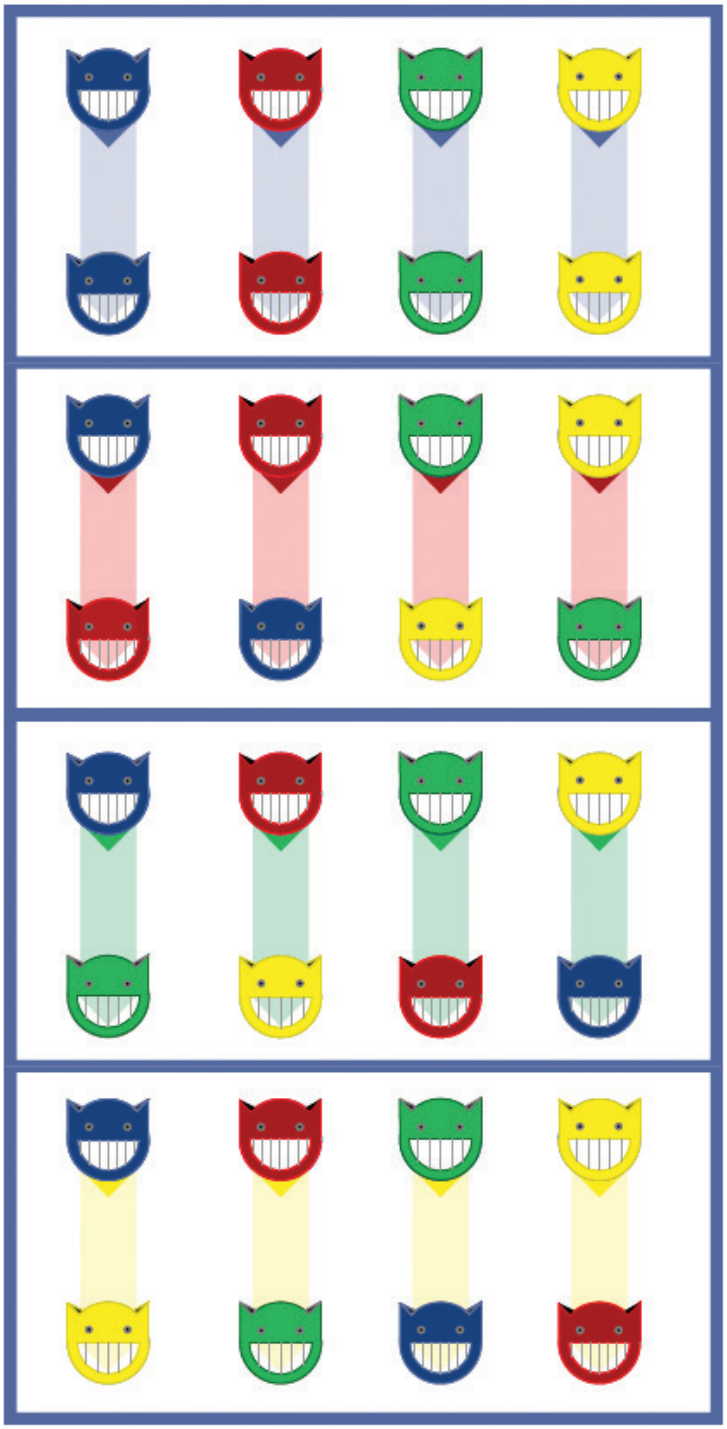
All quantum gates you placed should remain in place until you solve the Challenge Scenario. They represent the **Quantum Algorithm** you create to achieve the final state (**blue** cat token on the Awake state) out of an initial state given by the Challenge Scenario. There is more than one way to solve a problem!

Game Components

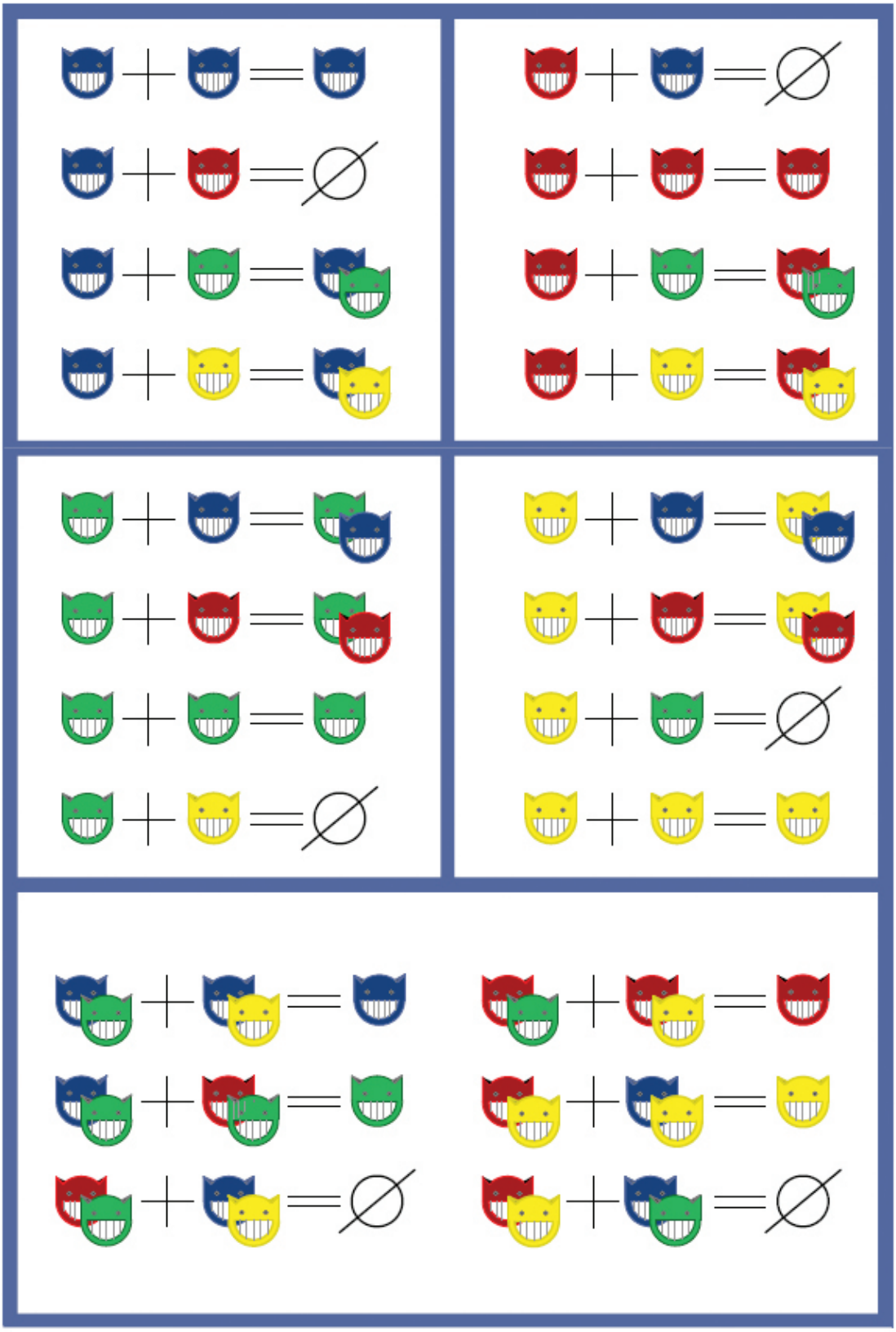
1. **The colors** in the game represent the quantum phase! There are 2 types of tokens: 4 **blue-red** tokens (blue on one side and red on the other), 4 **green-gold** tokens (green on one side and gold on the other). **These 8 tokens**, through their position and color, represent quantum states of the atom that decide the fate of Schrödinger's Cat!
2. The **Color Legend** table shows the rules for *phase interactions.*
3. The **Quantum Interference table** (next page) shows the behavioral rules of what happens to the quantum state inside an H gate. You will need an H gate when you want your tokens to be in a superposition of both SLEEP and AWAKE or create phase interference between the tokens.

Quantum Interference table: use **only** to calculate the quantum state of your cat inside an H gate

Color Legend



Quantum Interference



Game Setup

Rules of the game:

1. Place on a flat surface one of the Challenge Scenarios to start and the Final State card that shows the winning condition.
2. Place the cat token(s) as indicated by the Challenge Scenario.
3. Pick from the quantum gate cards those that you believe will bring the token closer to the Final state. Place these gates one below each other, from the Scenario card to the Final state card.
4. Navigate the quantum gates with the token. Follow the paths as indicated by the arrows. If one of the paths is a different color, look at the **Color Legend** and change the color of the token as indicated by the **Color Legend**.
5. Try to find the right combination of quantum gate cards to reach the Final State. The final combination of gates used is your quantum algorithm. Try to find the optimal one (to reach the Final State with the least number of gates).
6. A special case: **The H gate**:

   You can create additional tokens, combine them, or remove tokens using the **H gate**. This gate has two arrows pointing out from each state and two arrow pointers arriving to each state. For each state on the H gate, add another identical copy of the same token(s) that are already present on that state to be able to travel both arrows simultaneously. When the tokens collide, use the **Quantum Interference** table to calculate what tokens are left!

Two examples of navigating quantum gate cards:

Case 1: **blue** cat token on Awake state entering a Z gate, followed by an X gate. The output will be a **red** cat on the Sleep state.

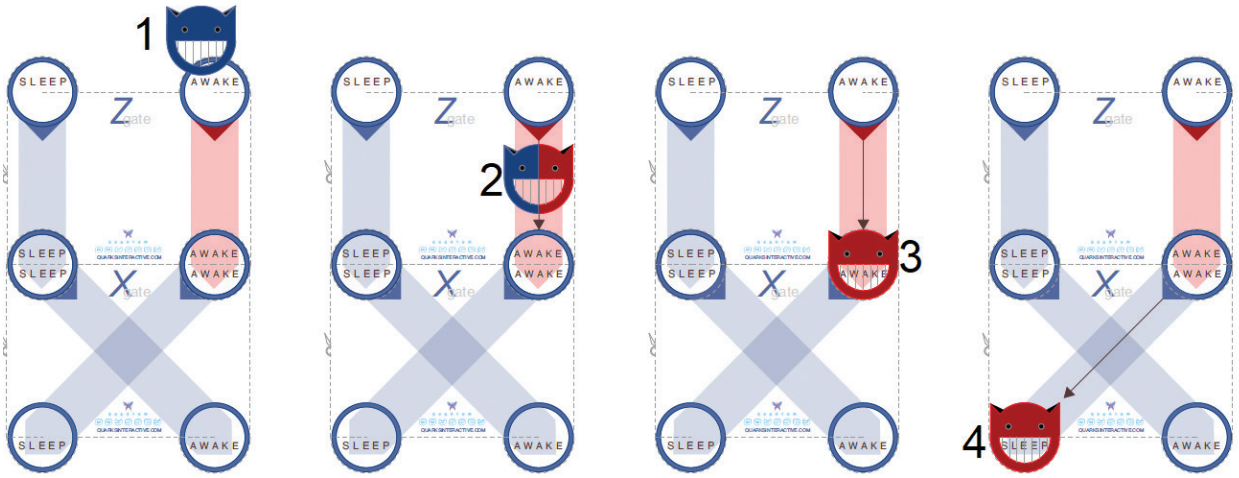
ZX Sequence:

(1) Place **blue token** on the Z gate's AWAKE state,

(2) Token will navigate a **red** path, flip it according to the Color Legend,

(3) The now **red token** enters X gate on the AWAKE state,

(4) Token crosses from the AWAKE state to the SLEEP state, through a **blue** path (according to the Color Legend).



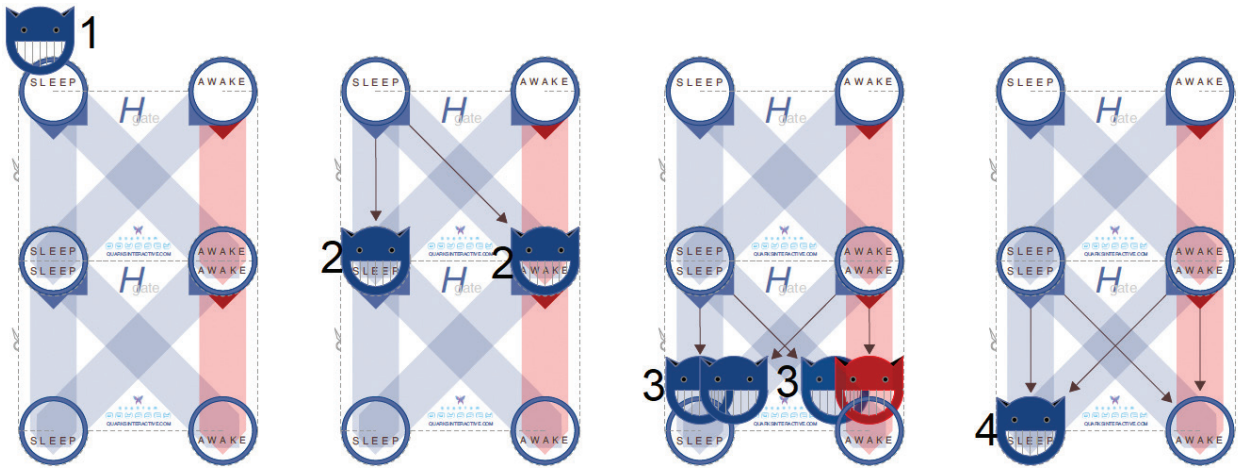
HH sequence:

(1) Place **blue token** on the H gate's SLEEP state,

(2) There are two arrow pointers in the SLEEP state within the H gate. You must duplicate your token on the board (add another one in this case). Tokens now navigate both paths of **blue** color (nothing changes according to **Color Legend**) at the same time.

(3) In this step, you must repeat step (2) from **both SLEEP and AWAKE** states of the second H gate, to have four tokens in total. Take notice that one of the paths from the AWAKE state is of **red** color, which will flip one copy of the token from **blue** to **red**.

(4) Use the Quantum Interference table to calculate what happens to the colliding cats from step (3)! Two **blue** cats colliding will leave a single **blue** one, while a **blue** and a **red** cat will result in no cats.



Color Legend table:

These are the rules for what happens to a cat token when it navigates a path of a specific color. Remember there are two types of tokens (blue-red and green-gold).

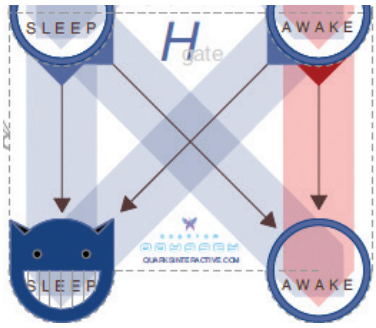
Useful tips for colors:

1. The **blue** path is neutral, it preserves the color of the token.
2. The **red** path will always flip the token.
3. A **green** cat going through a **green** path will result in a **red** cat.
4. A **gold** cat going through a **green** path will result in a **blue** cat.
5. If you know a thing or two about **Complex Numbers**, it could be easier to think of multiplication between complex numbers. For convenience, a **blue** cat is **1+0i**, a **red** cat is **-1+0i**, a **green** cat is **0+i**, a **gold** cat is **0-i**. If you know that **(0+i)*(0+i)= -1+0i**, this is just as saying a **green** cat goes through a **green** path and comes out **red** (rule 3).

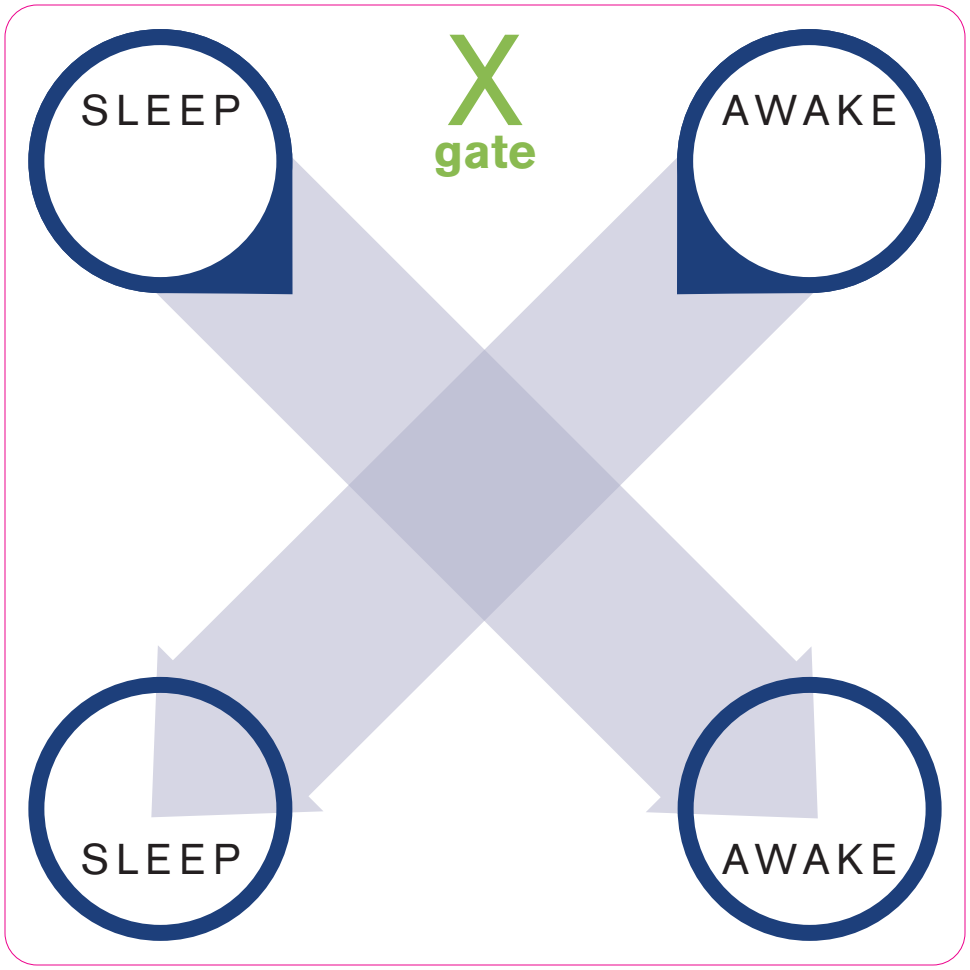
After you decide to place an H gate, you will notice that because of how the paths within this gate are laid out, your cat tokens will collide like what you see here:

Now look at the table on the right. In this example we have two cases: **blue** + **blue** on the SLEEP state and **blue** + **red** on the AWAKE state. The table shows yout the outcome. Replace or remove the tokens as indicated in the table.

For our example, we are left with a single **blue** cat:



If you know a thing or two about Complex Numbers, these are the rules for addition!
Example: **blue** + **gold** cats = form a **blue** and a **gold** cat together **1+0i+(0-i)=1-i**


SLEEP
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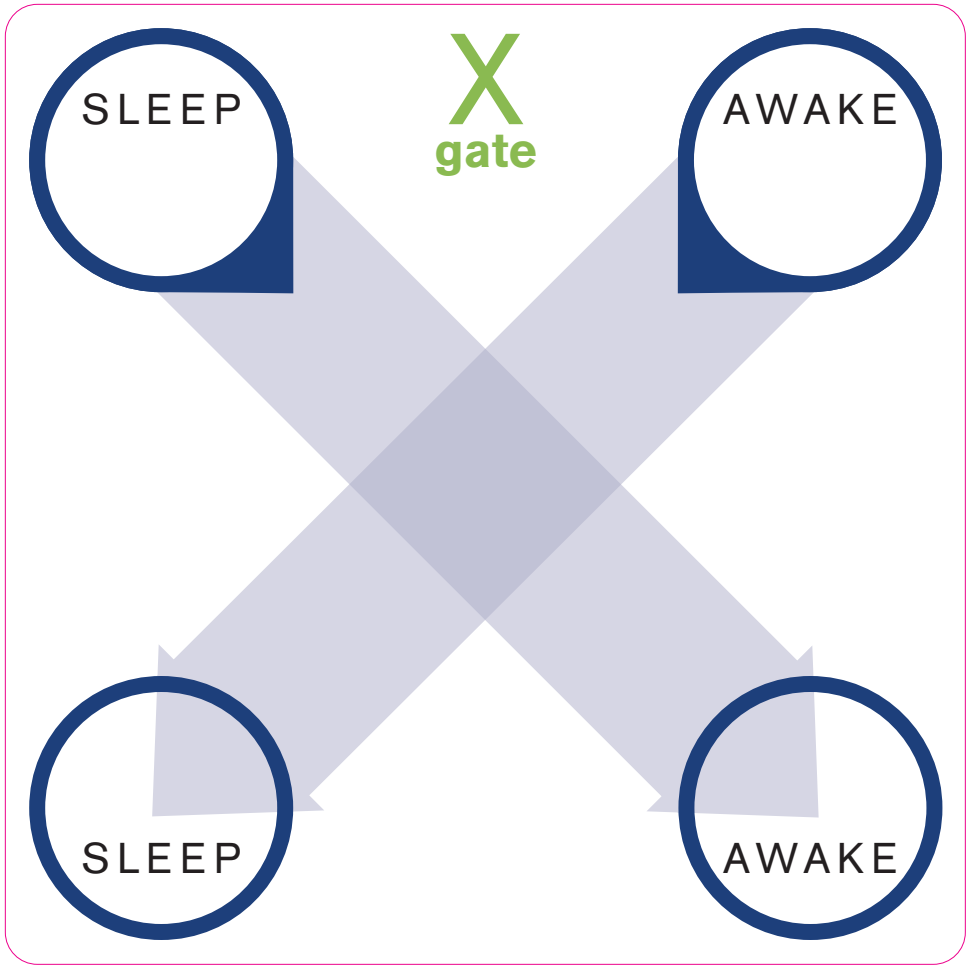
SLEEP
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gate
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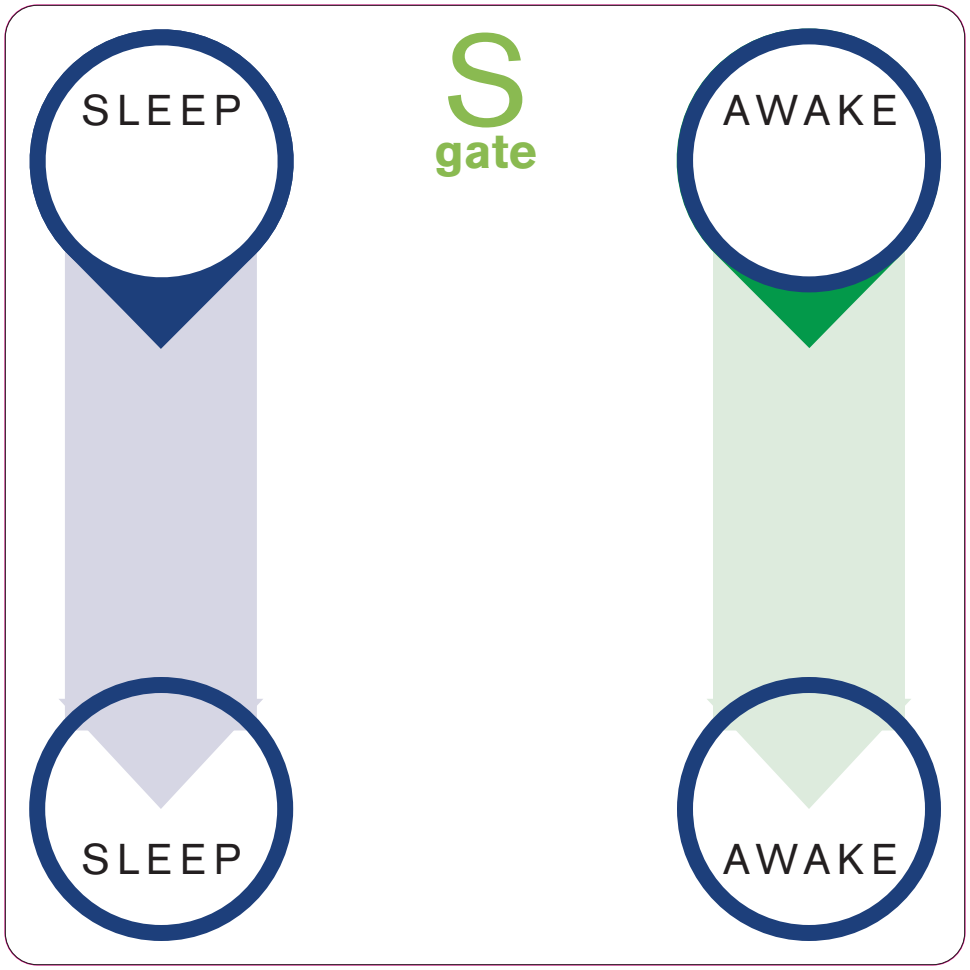
Save Schrödinger's Cat

Save Schrödinger's Cat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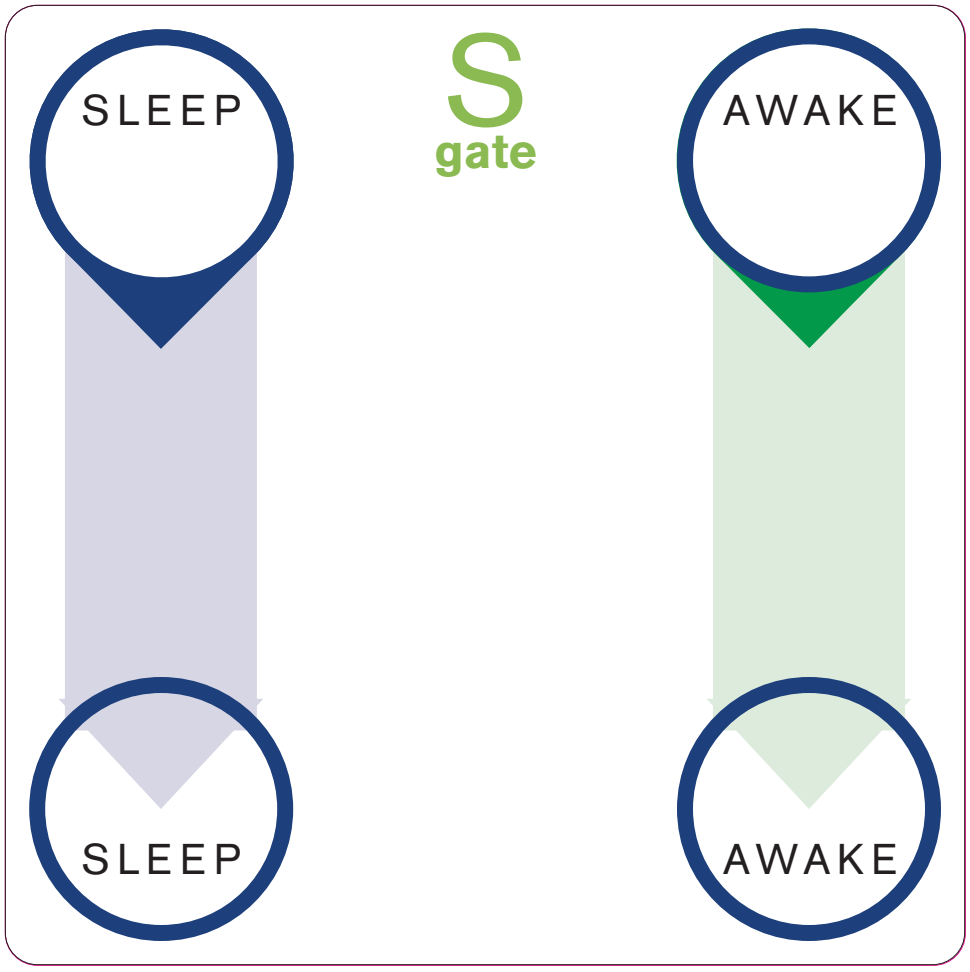
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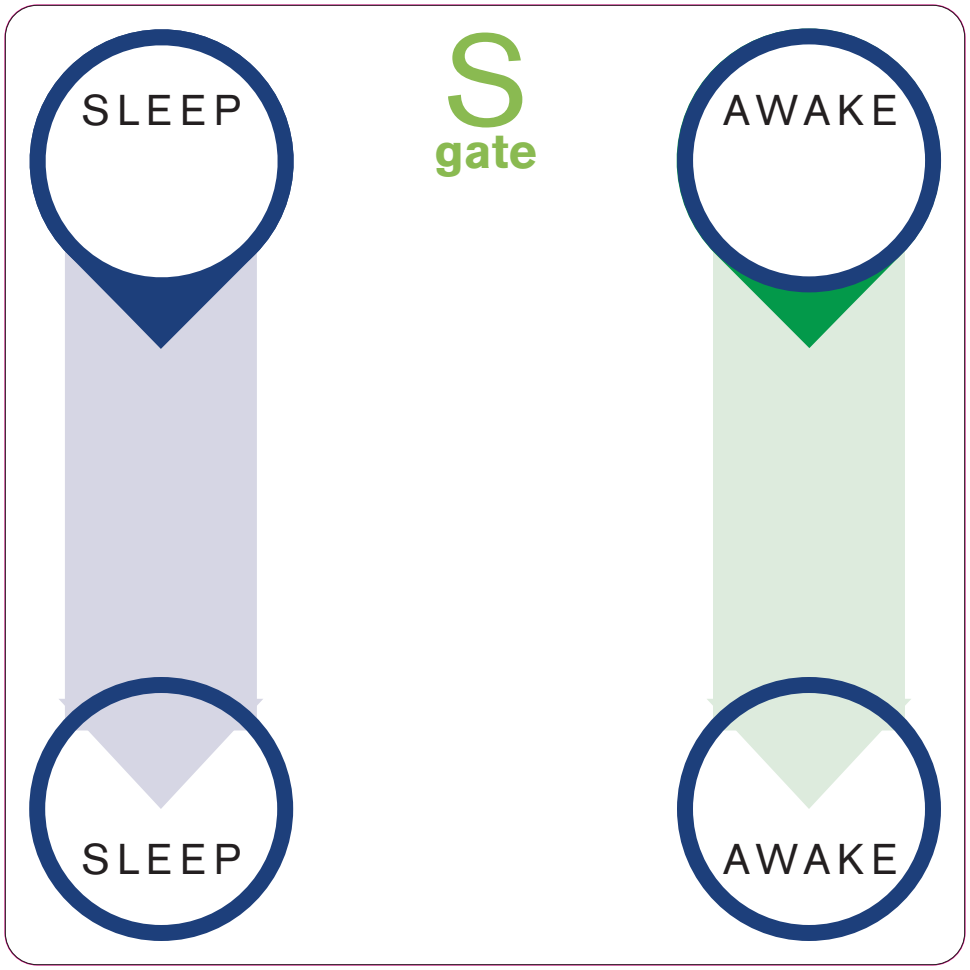
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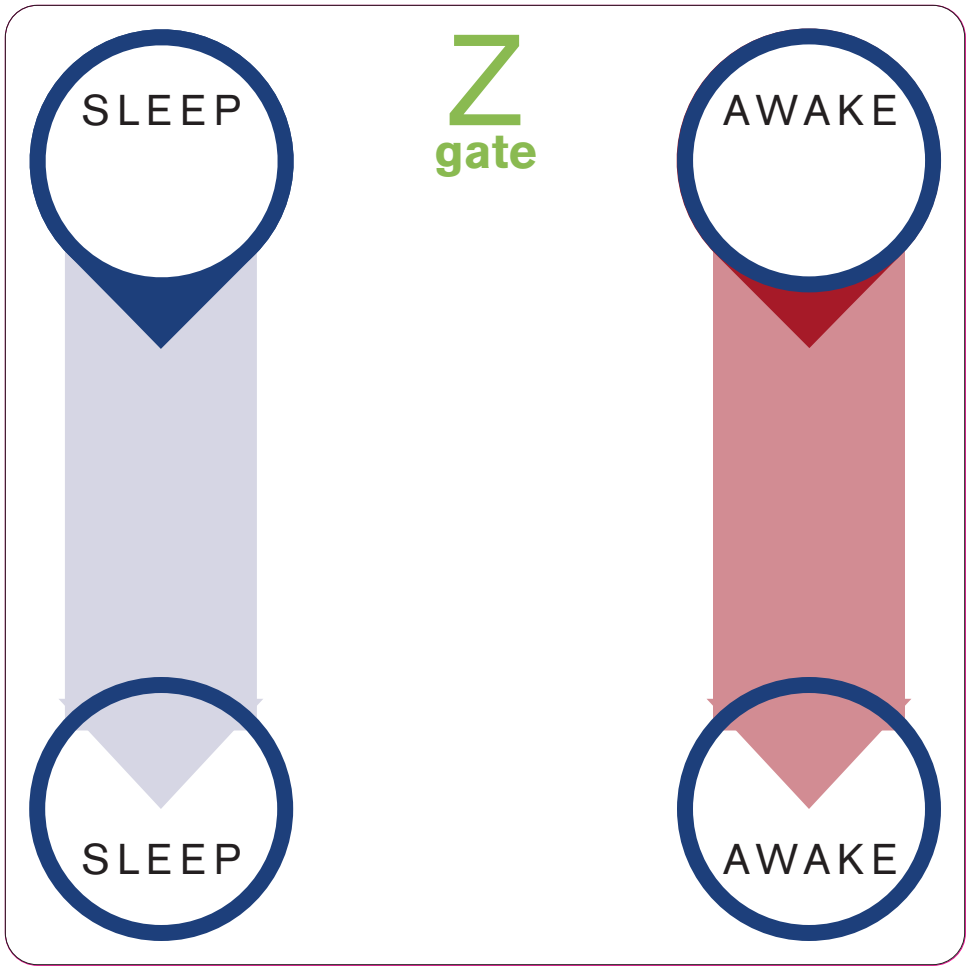
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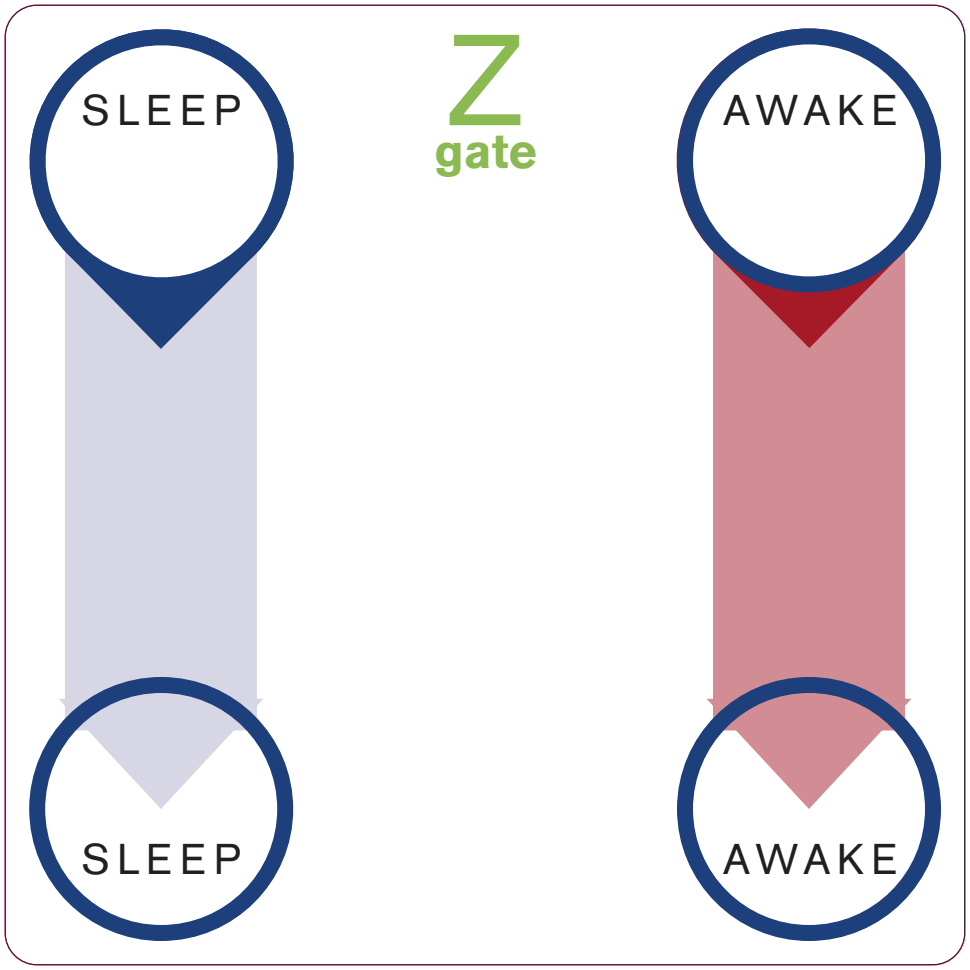
Save Schrödinger's Cat

Save Schrödinger's Cat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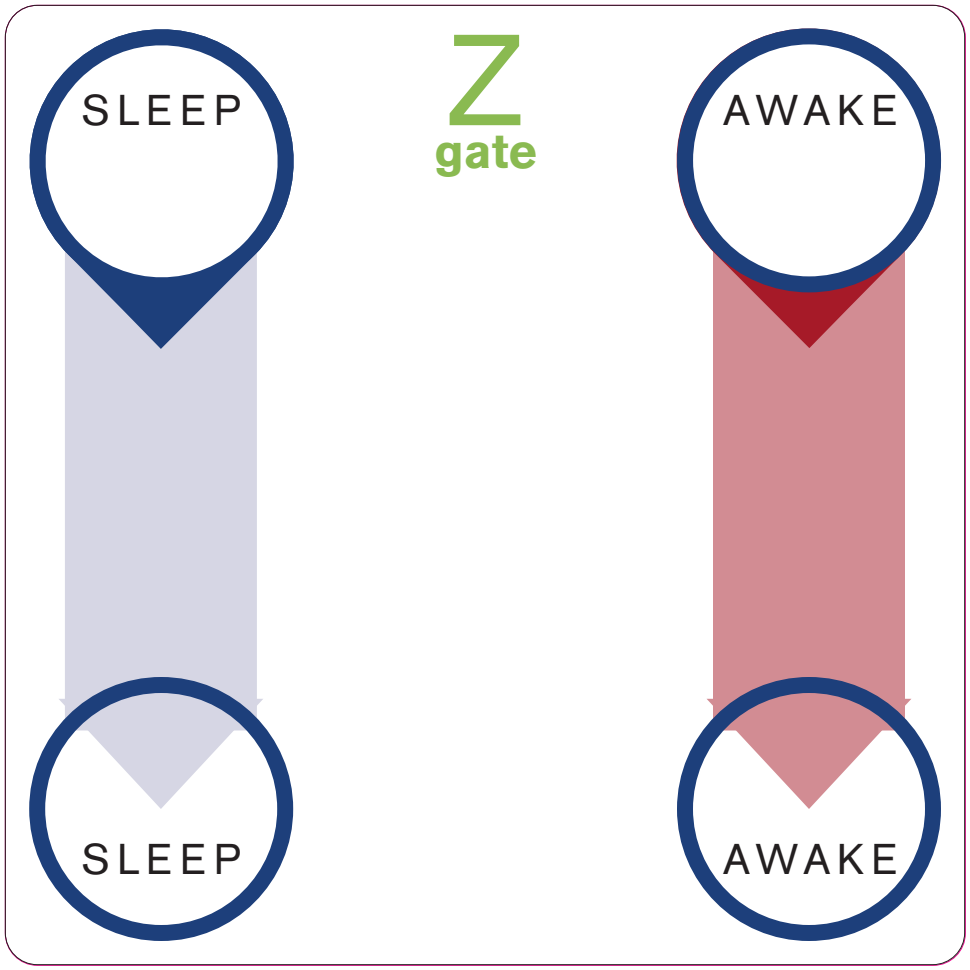
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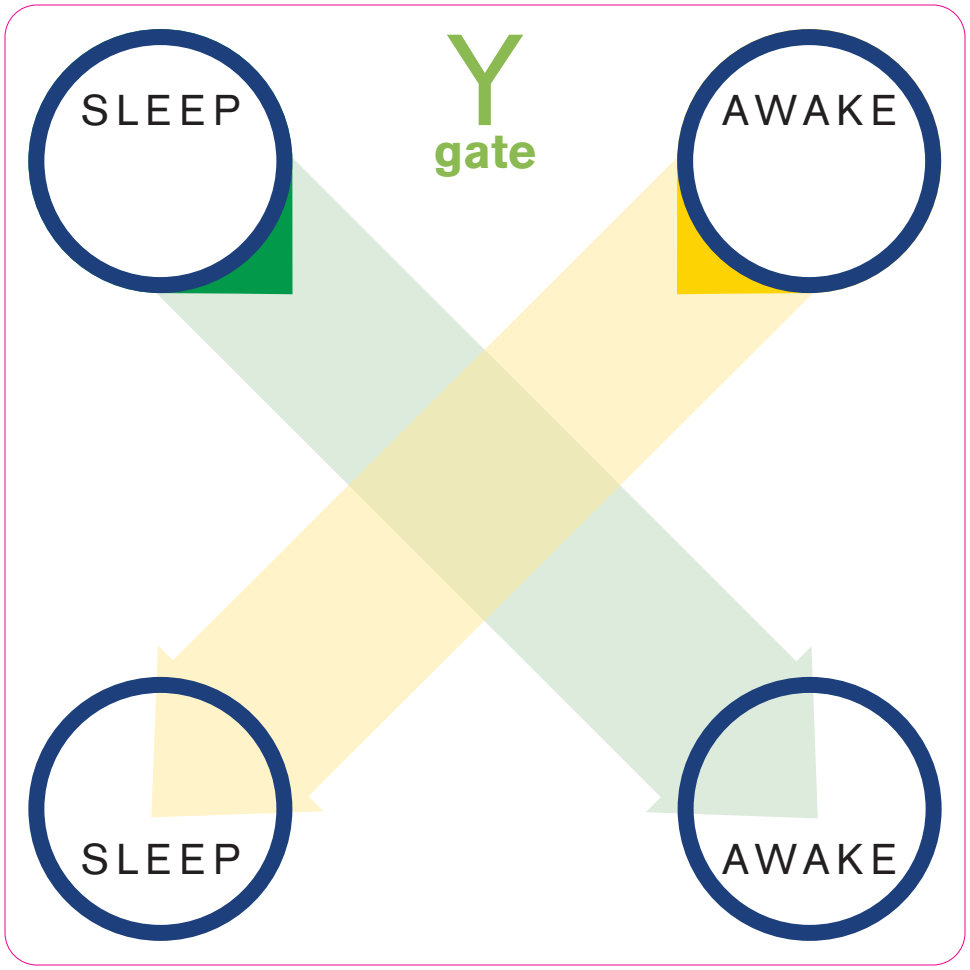
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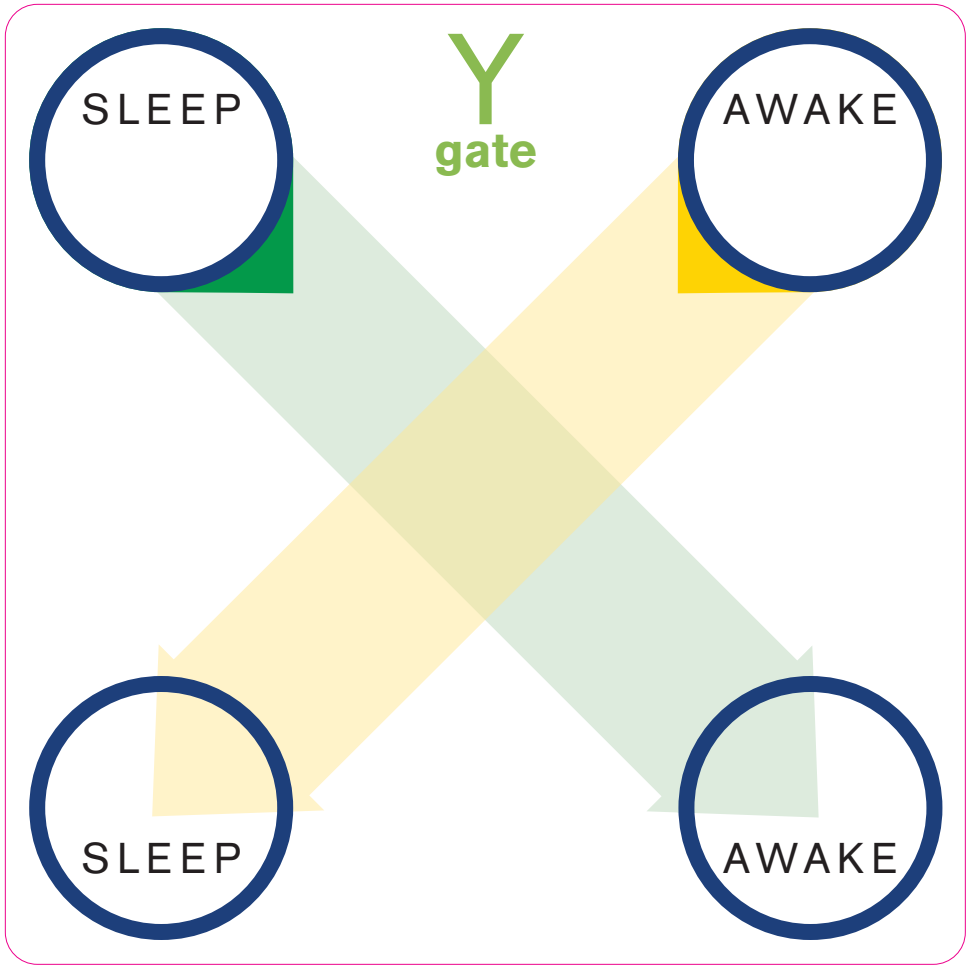
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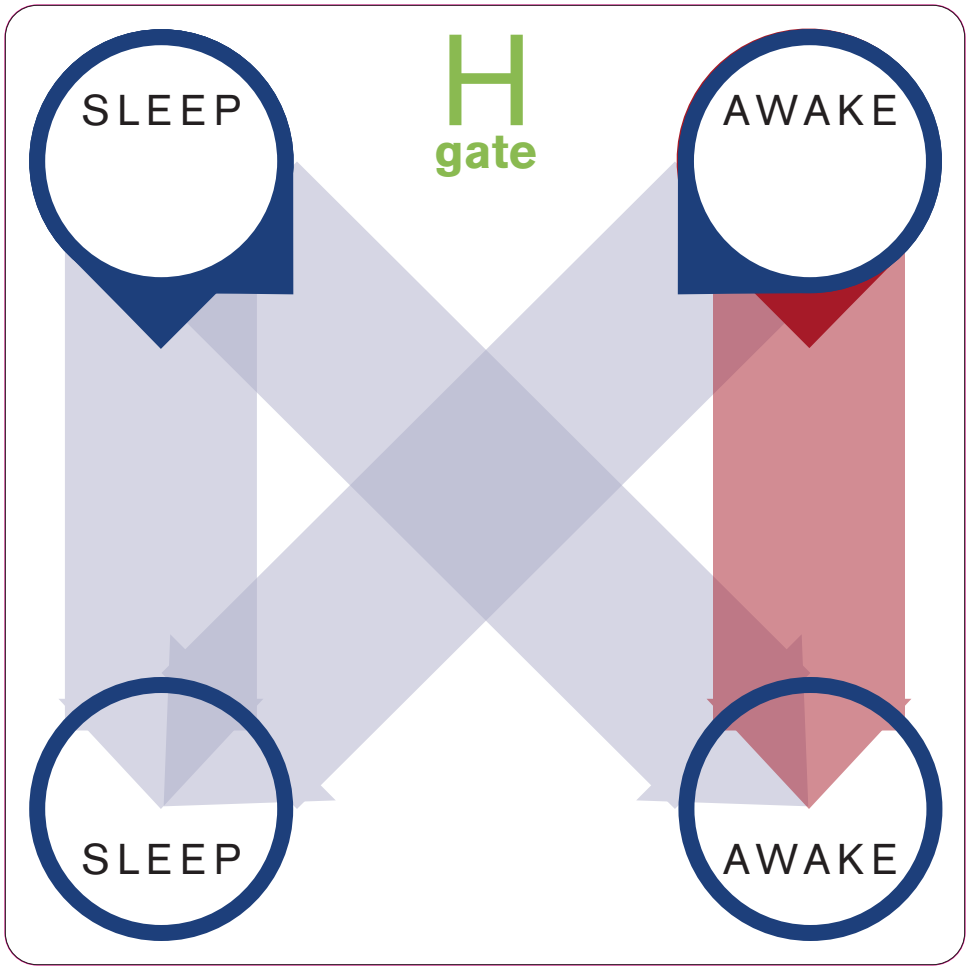
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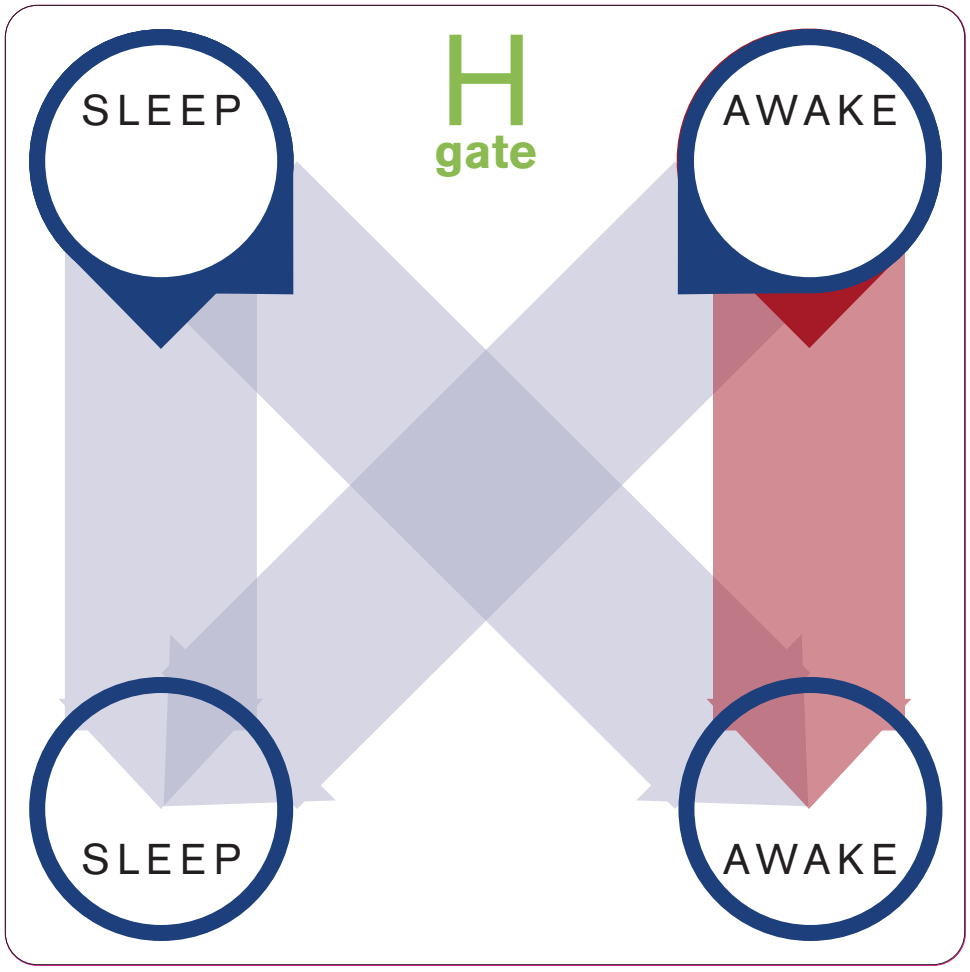
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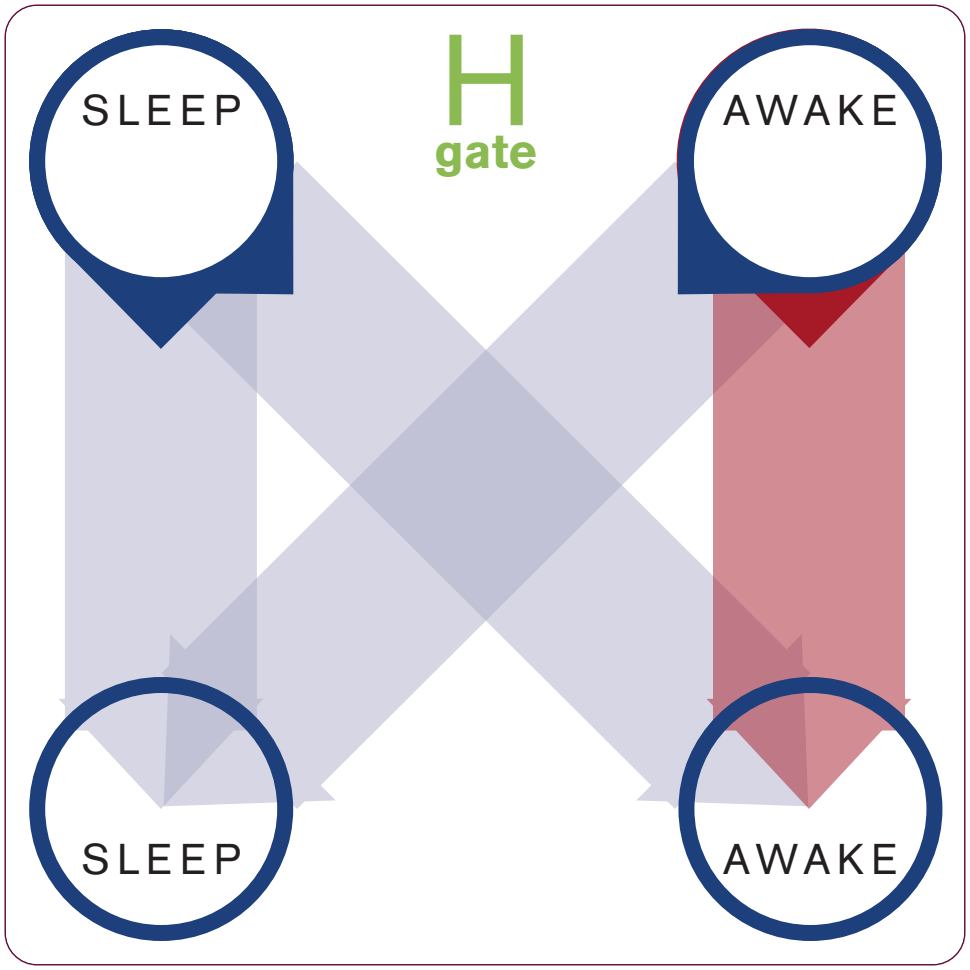
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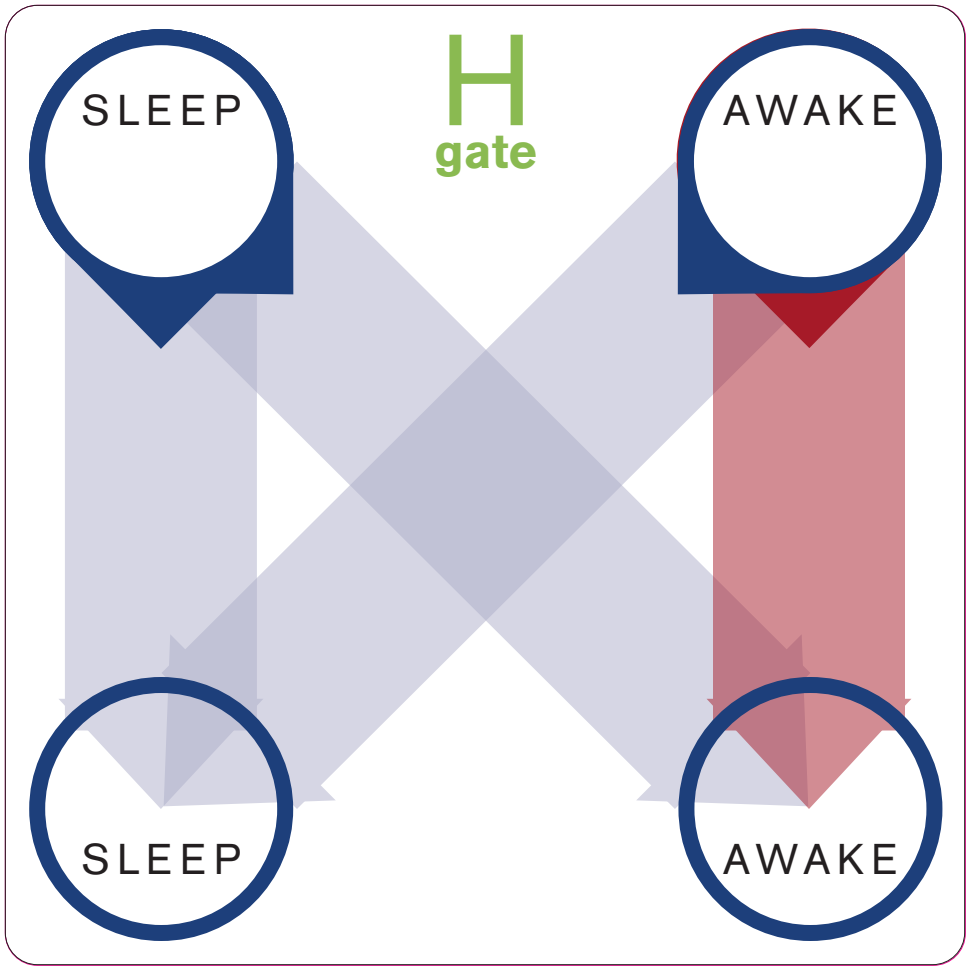
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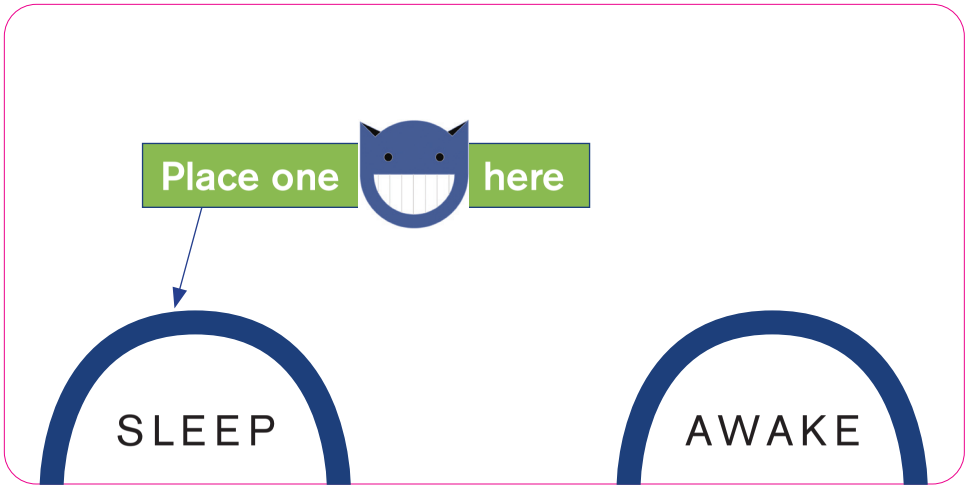
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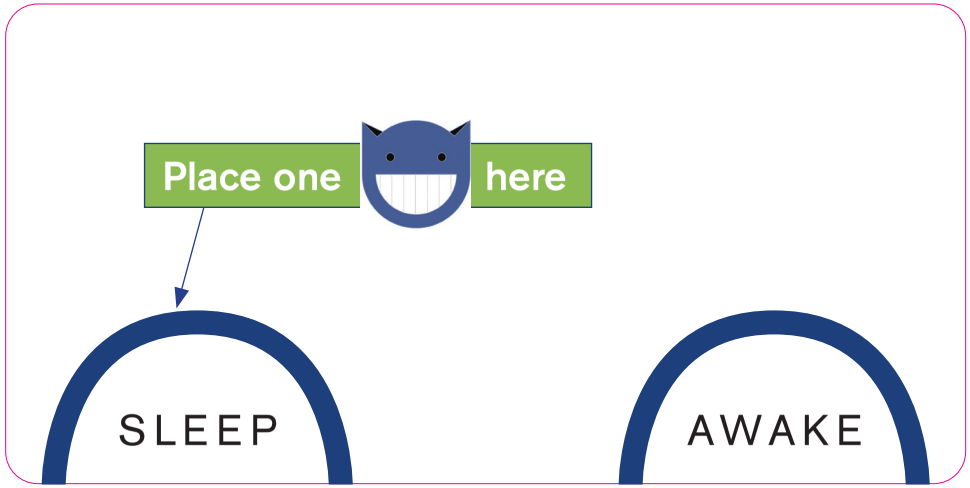
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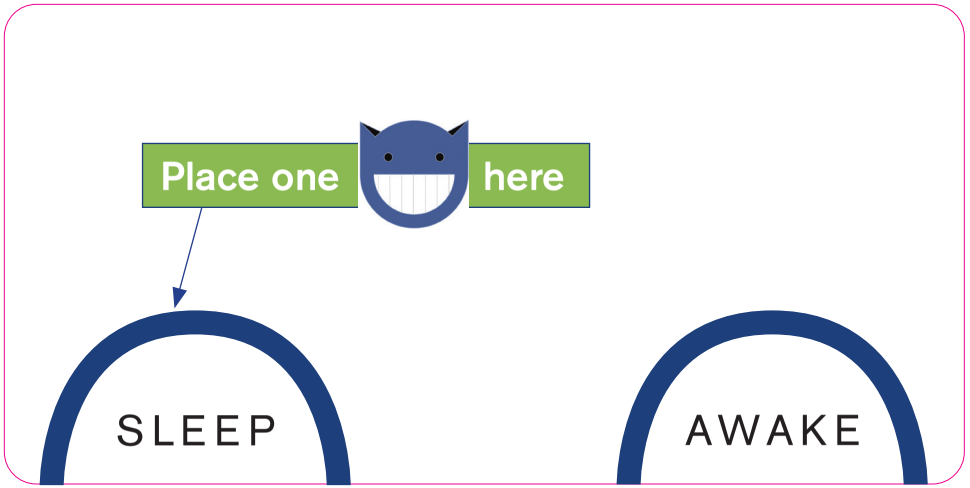
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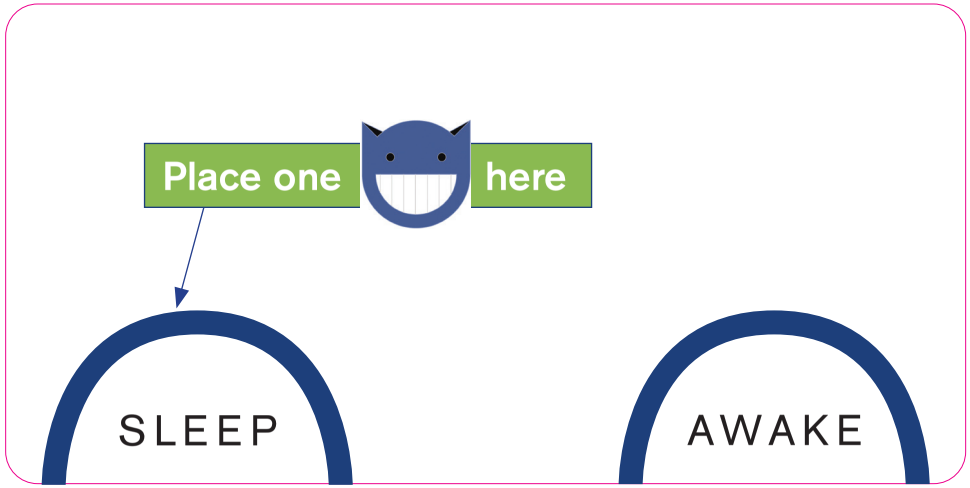
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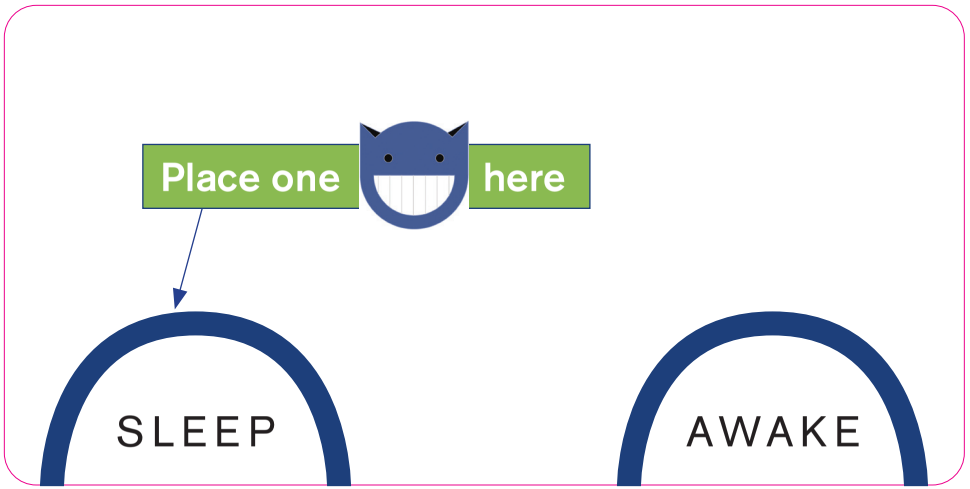
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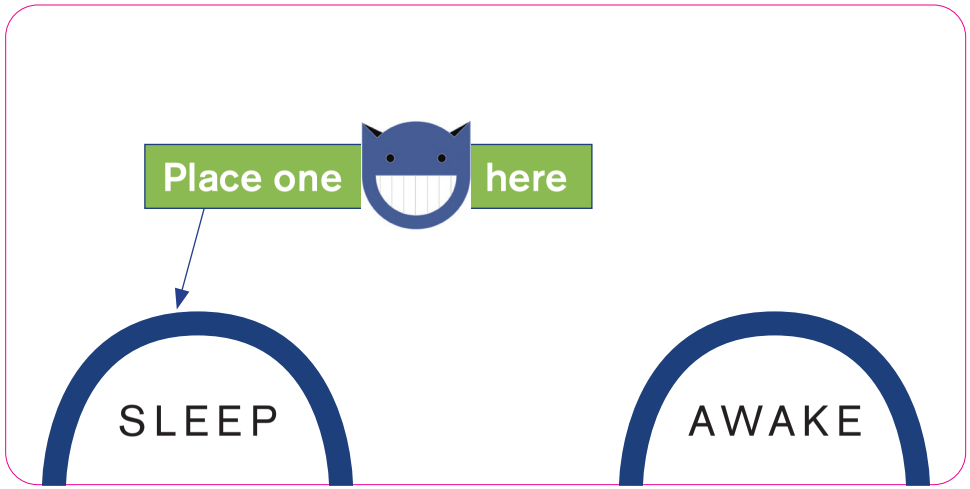
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SLEEP
AWAKE

Save Schrödinger's Cat

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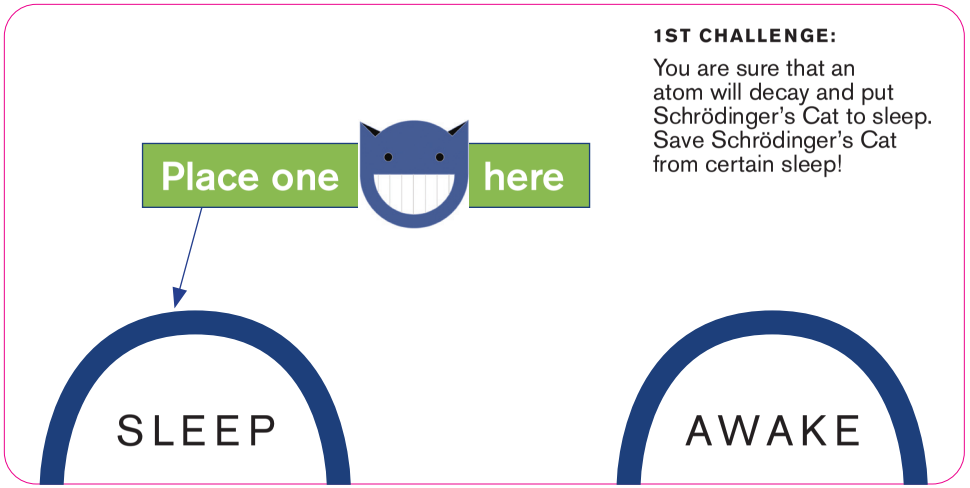
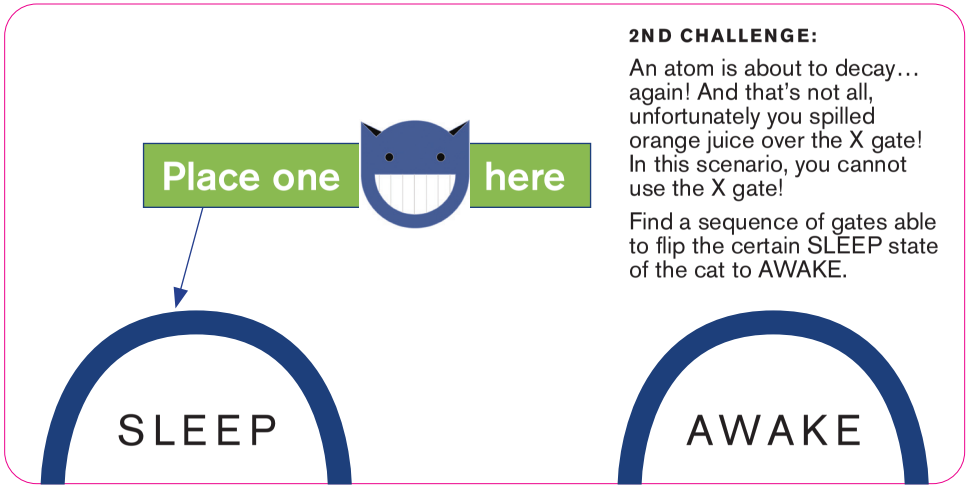


1ST CHALLENGE:

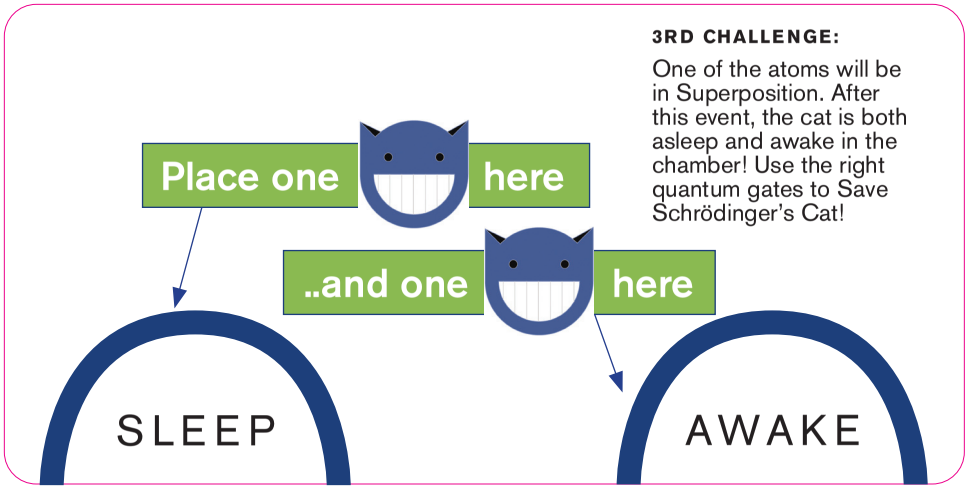
You are sure that an atom will decay and put Schrödinger's Cat to sleep. Save Schrödinger's Cat from certain sleep!



2ND CHALLENGE:

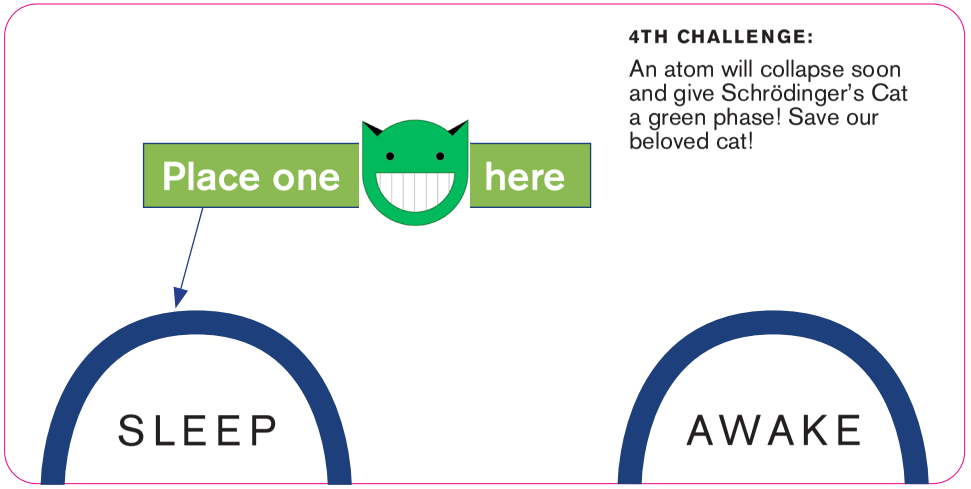
An atom is about to decay… again! And that's not all, unfortunately you spilled orange juice over the X gate! In this scenario, you cannot use the X gate!

Find a sequence of gates able to flip the certain SLEEP state of the cat to AWAKE.



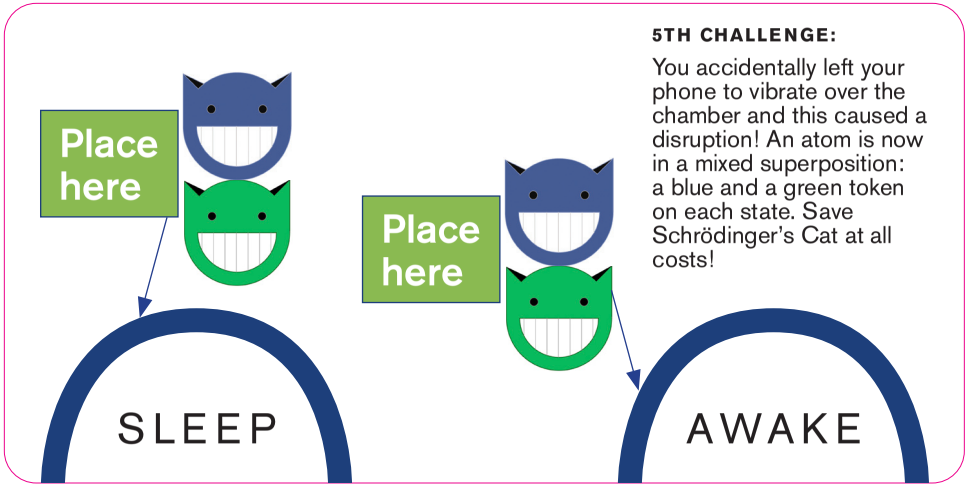
3RD CHALLENGE:

One of the atoms will be in Superposition. After this event, the cat is both asleep and awake in the chamber! Use the right quantum gates to Save Schrödinger's Cat!



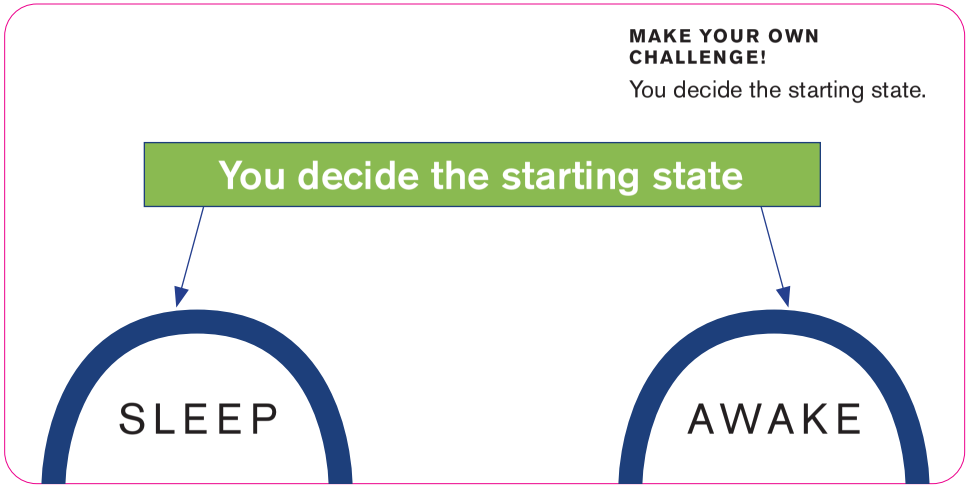
4TH CHALLENGE:

An atom will collapse soon and give Schrödinger's Cat a green phase! Save our beloved cat!



5TH CHALLENGE:

You accidentally left your phone to vibrate over the chamber and this caused a disruption! An atom is now in a mixed superposition: a blue and a green token on each state. Save Schrödinger's Cat at all costs!



MAKE YOUR OWN CHALLENGE!

You decide the starting state.

Save Schrödinger's Cat

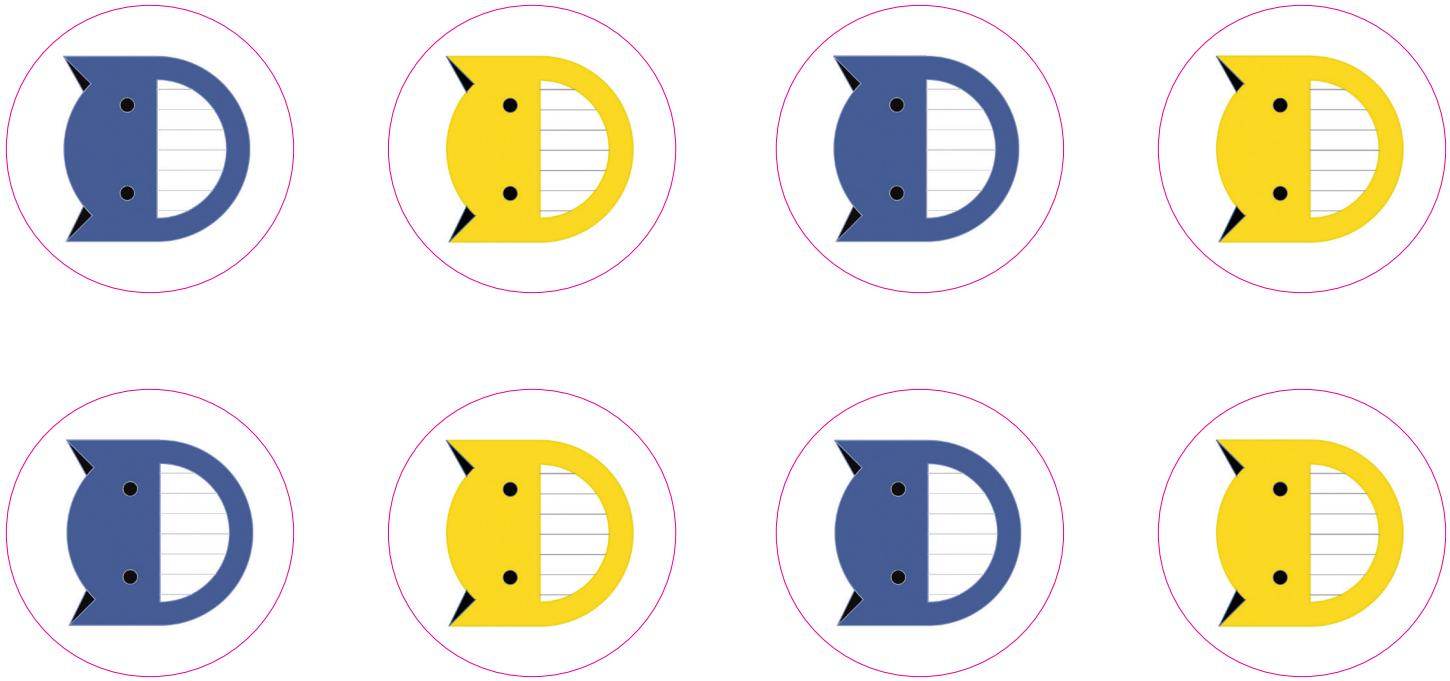
Save Schrödinger's Cat

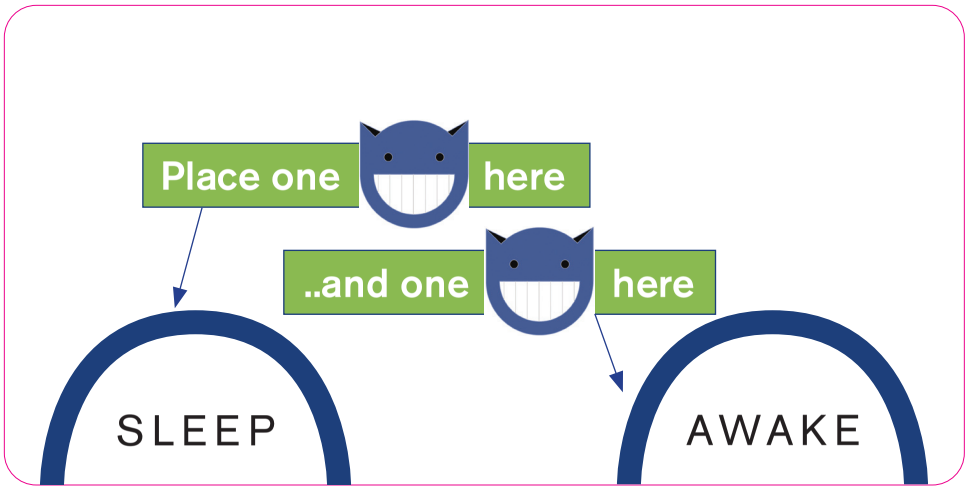
Save Schrödinger's Cat

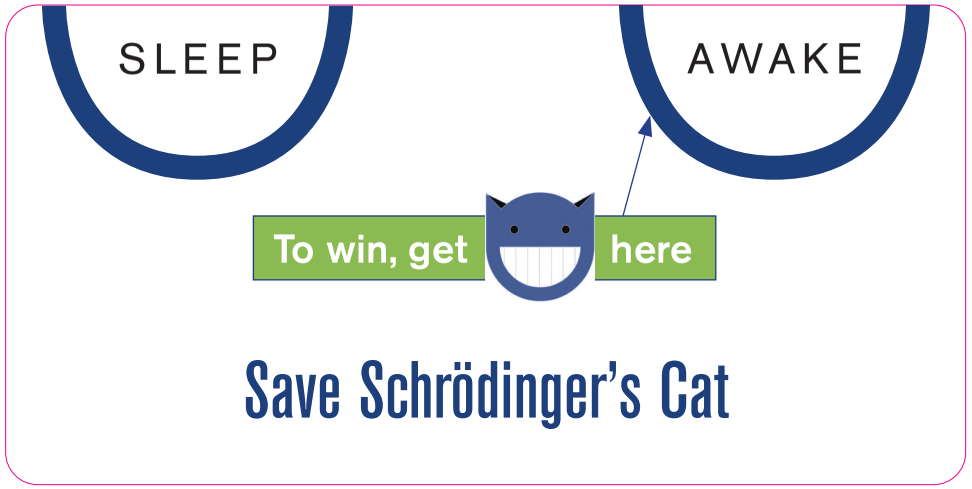
Save Schrödinger's Cat

Save Schrödinger's Cat

Save Schrödinger's Cat




Place one
here
..and one
here
SLEEP
AWAKE


SLEEP
AWAKE
To win, get
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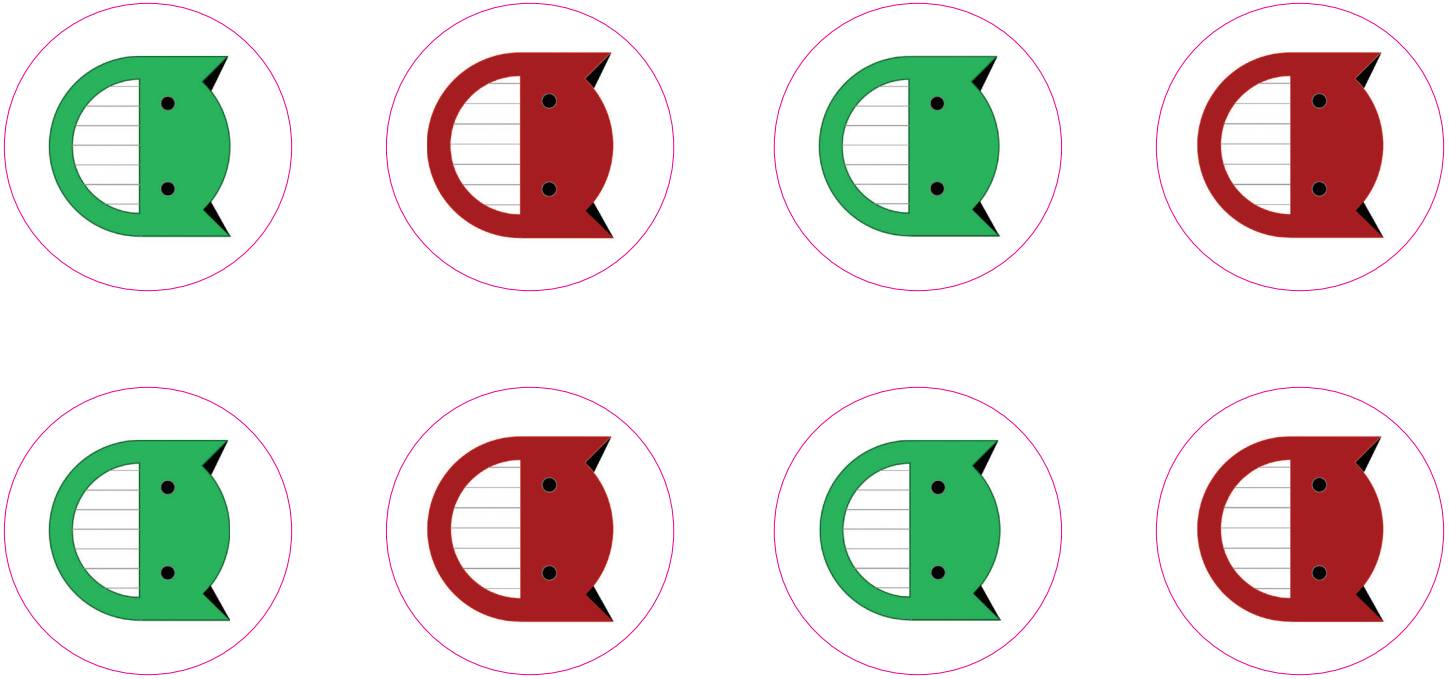
Save Schrödinger's Cat



Save Schrödinger's Cat

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