



ESERA 2021

Fostering scientific citizenship
in an uncertain world

30 Aug - 3 Sep 2021

Organised by
University of Minho, Braga, Portugal

Resources and barriers in reasoning

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Louis Moeller (1855-1930), "Discussing the catch"



Louis Moeller (1855-1930), "Discussing the catch"

Reasoning

Attended objects –
semiotic resources.



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Reasoning

Attended objects –
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Associations – resources.



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Attended objects –
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Associations – resources.

Productive or
unproductive.



Louis Moeller (1855-1930), "Discussing the catch"

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Attended objects –
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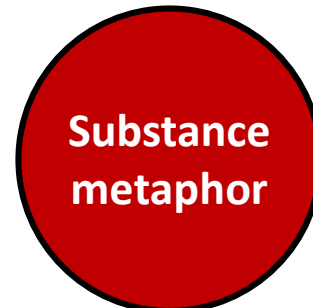
Productive or
unproductive.

Context-dependent.

The resources framework

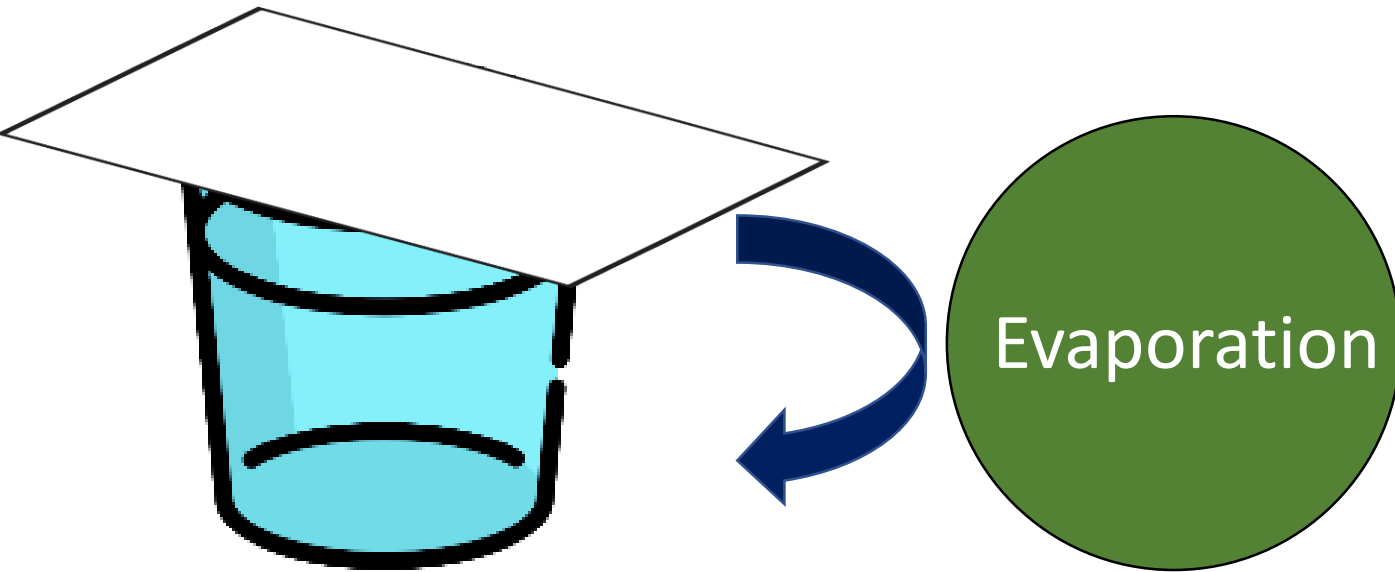
(Hammer, 2000; Redish, 2004)

“**Resource** - a compiled knowledge element [...] different levels of structure may be used as resources by different individuals.”
(Redish, 2004, p. 58)

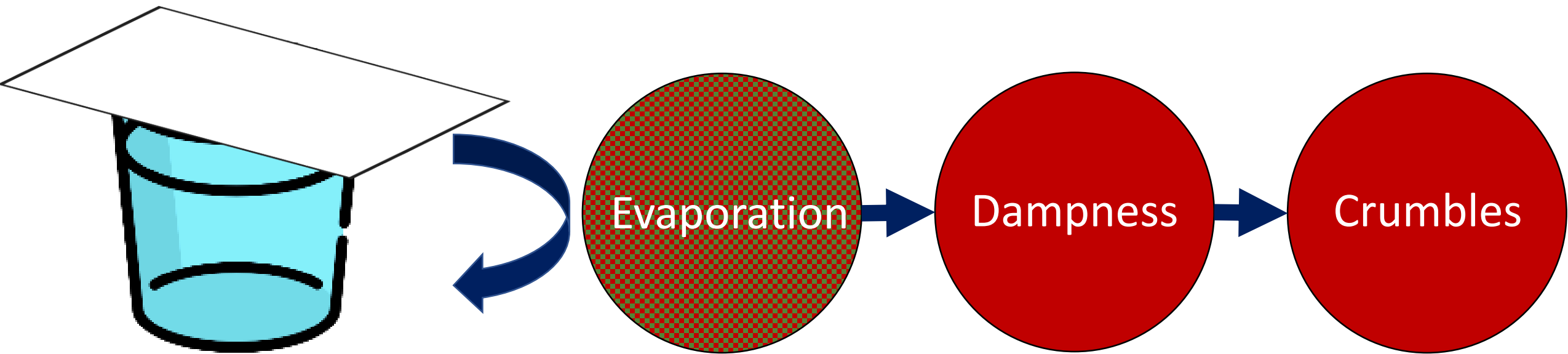


Why?

1. Identify the source of “unproductive” reasoning, i.e. the barrier.
2. Turn it productive by adding or removing information.



Data from Samuelsson, Elmgren, Xie & Haglund (2019)



Data from Samuelsson, Elmgren, Xie & Haglund (2019)

A proposal of how to apply the concepts in an analysis

Data from Samuelsson, Elmgren, Xie & Haglund (2019)

Transcript of researcher's talk

Transcript of student's talk



Association



Productive cognitive resource



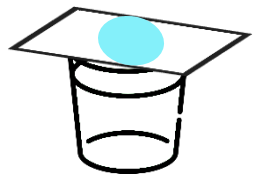
Unproductive cognitive resource



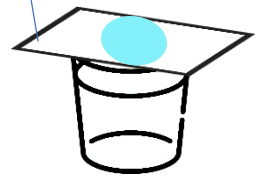
Semiotic resource

Purpose with the activity:

To relate the concepts of energy and phase transition (evaporation) to the experiment.



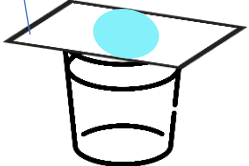
It will be dripping, right?



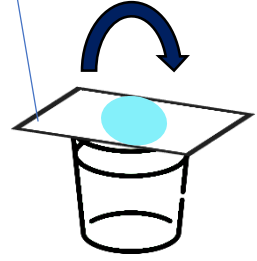
What happens when the water is just standing like this in the glass?



It will be dripping, right?

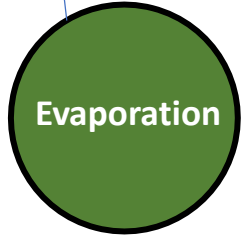
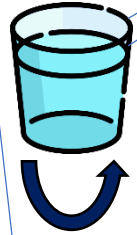


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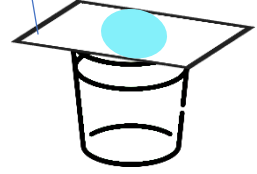


What happens when the water is just standing like this in the glass?

It evaporates

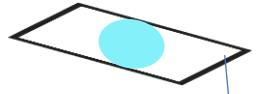
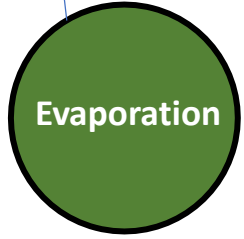


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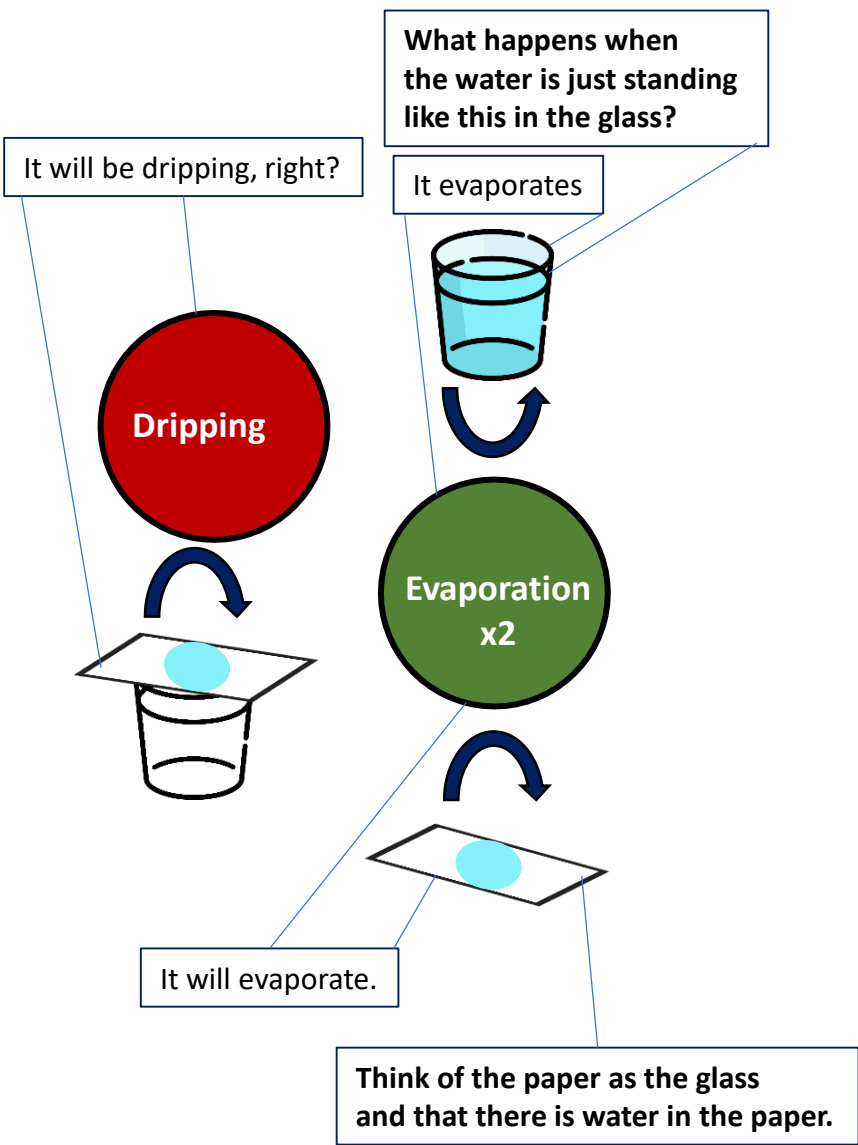


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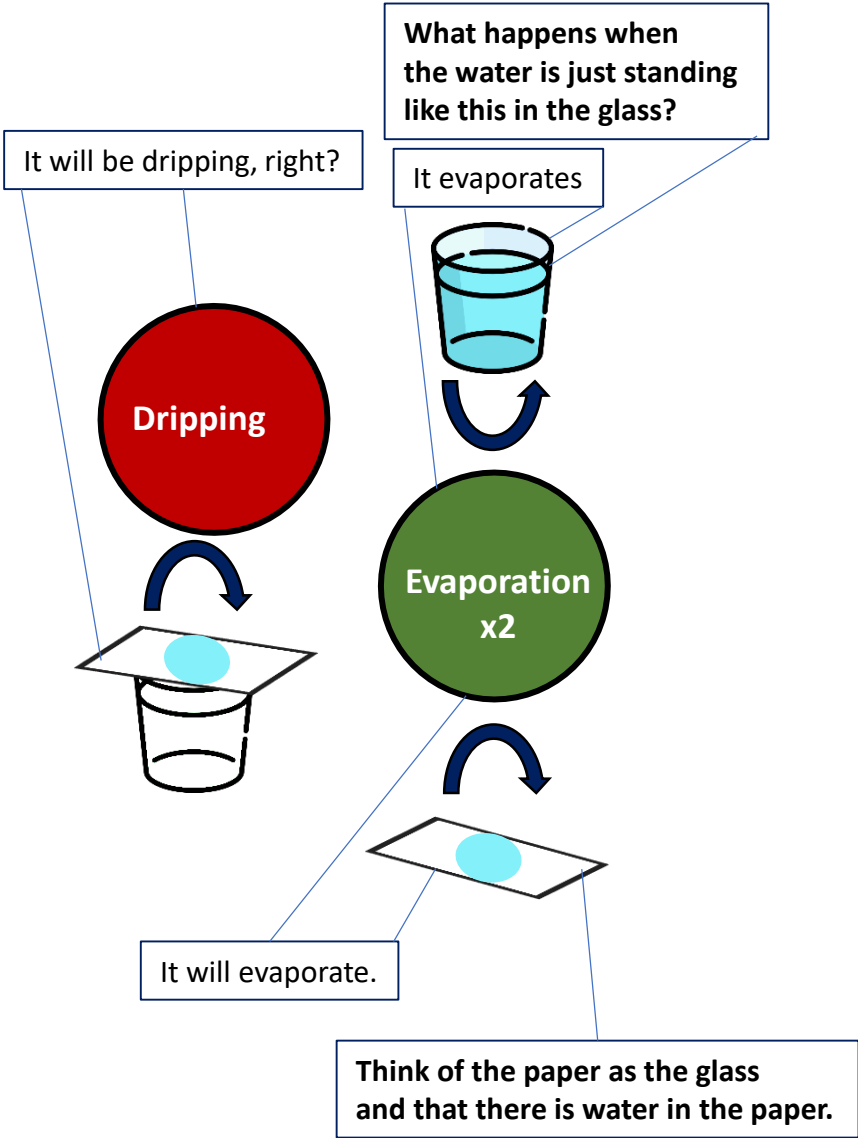
It evaporates



Think of the paper as the glass and that there is water in the paper.



And what happens to the temperature then?



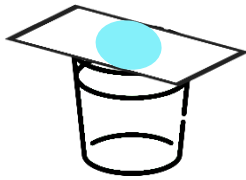
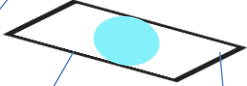
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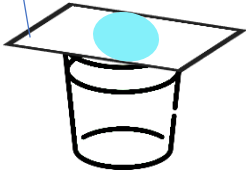


Evaporation
x2



It will be dripping, right?

Dripping



It will evaporate.

Think of the paper as the glass and that there is water in the paper.

And what happens to the temperature then?

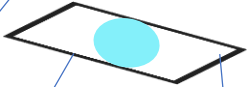
The energy was moved from the water to the paper and now it is moved from the paper down into the glass again.

What happens when the water is just standing like this in the glass?

It evaporates



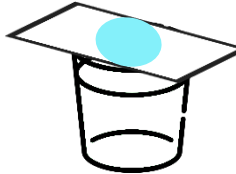
Evaporation x2



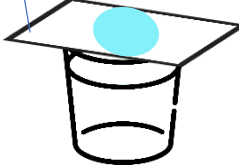
It will evaporate.

Think of the paper as the glass and that there is water in the paper.

Substance metaphor



Dripping



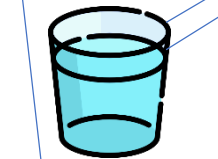
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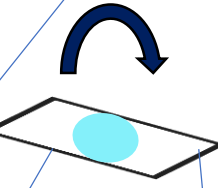
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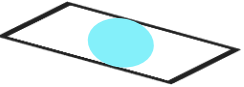
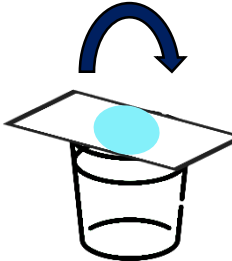
It evaporates



Evaporation x2

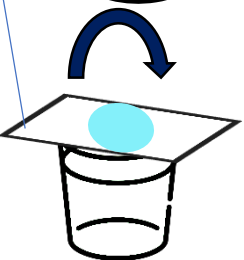


Substance metaphor



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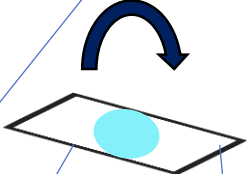
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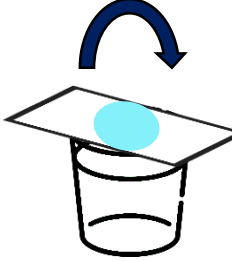
It evaporates



Evaporation x2

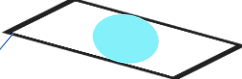


Substance metaphor



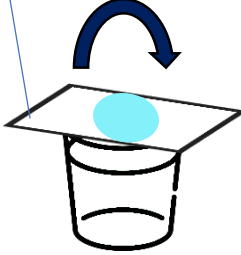
Change in energy

Condensate



It will be dripping, right?

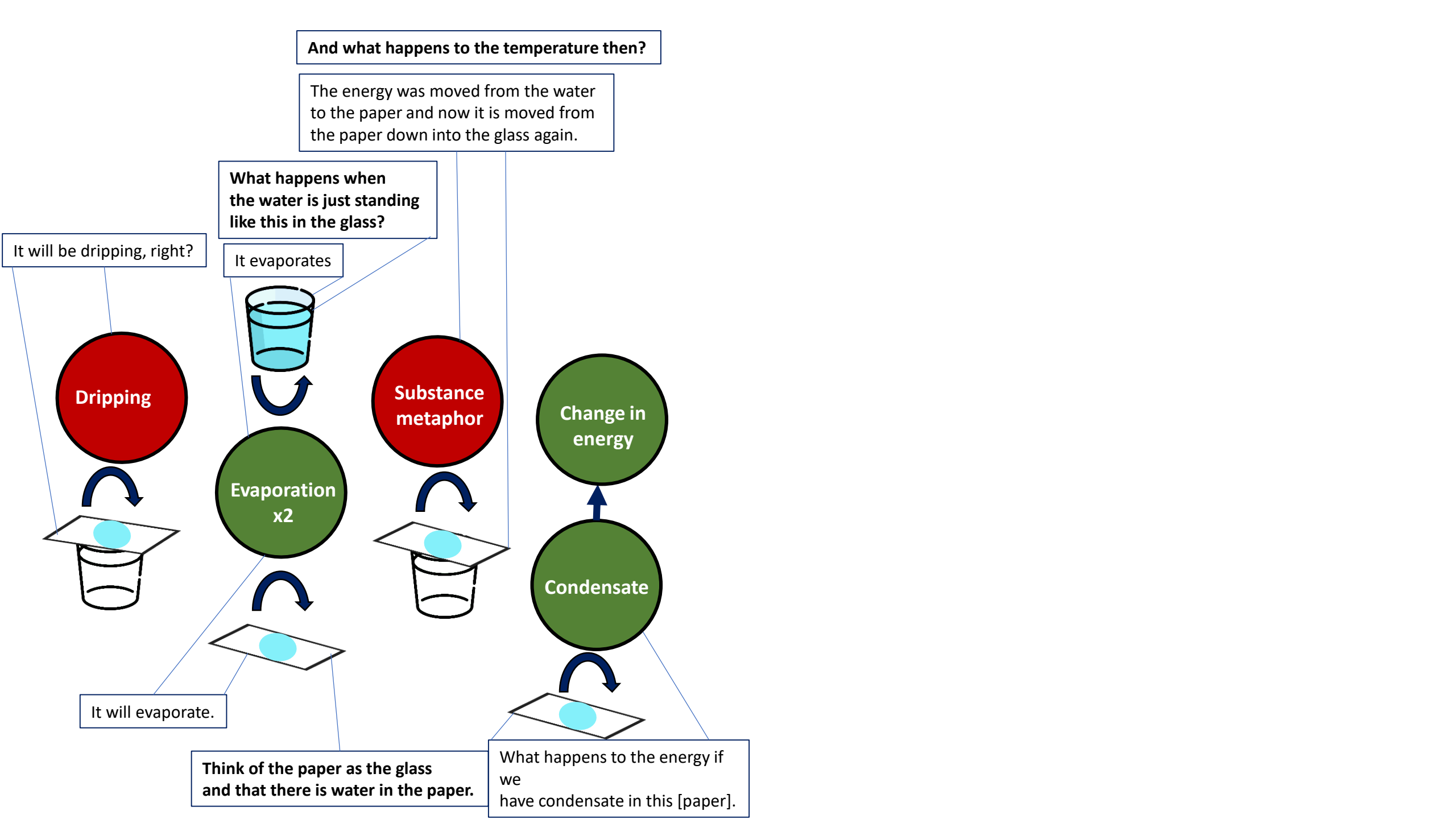
Dripping



It will evaporate.

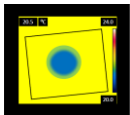
Think of the paper as the glass and that there is water in the paper.

What happens to the energy if we have condensate in this [paper].



And what happens to the temperature then?

The energy was moved from the water to the paper and now it is moved from the paper down into the glass again.

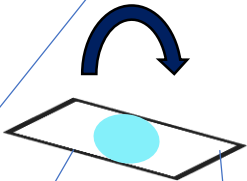


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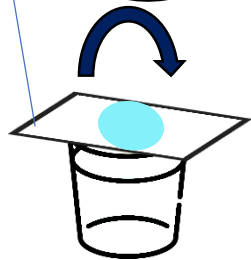


Evaporation x2



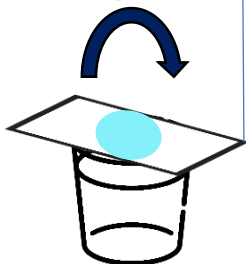
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Dripping



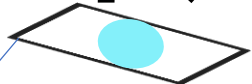
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Substance metaphor



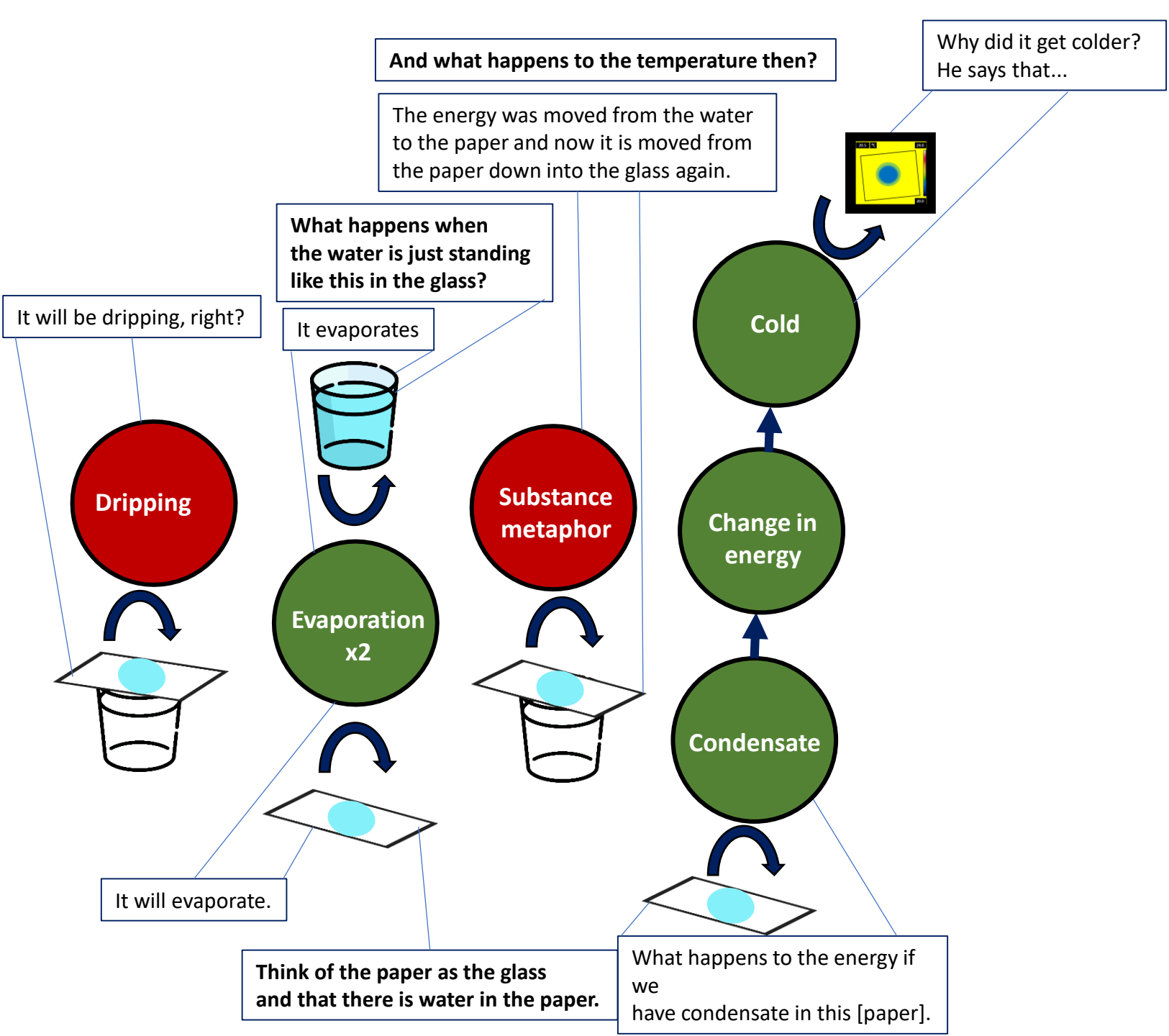
Change in energy

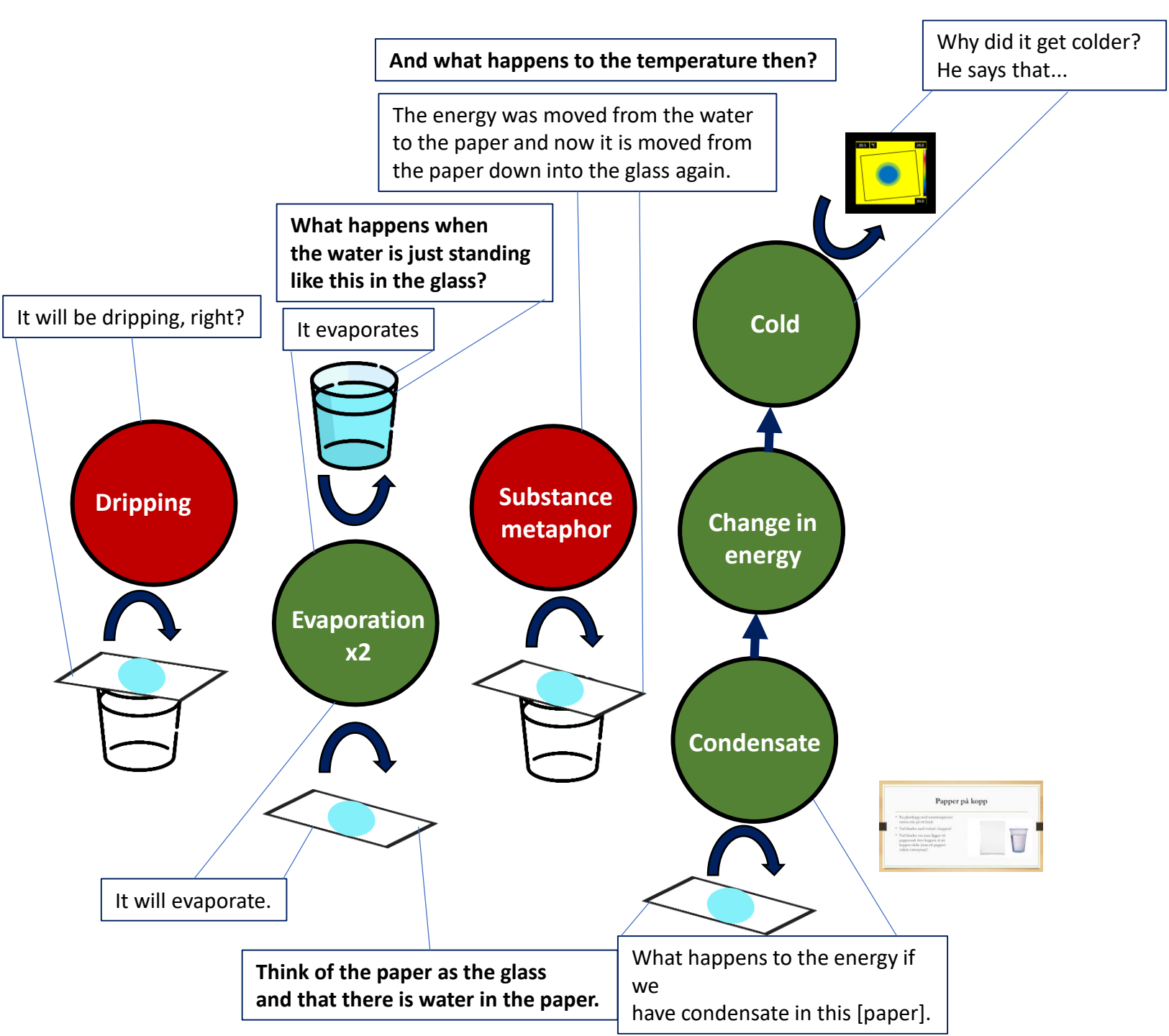
Condensate

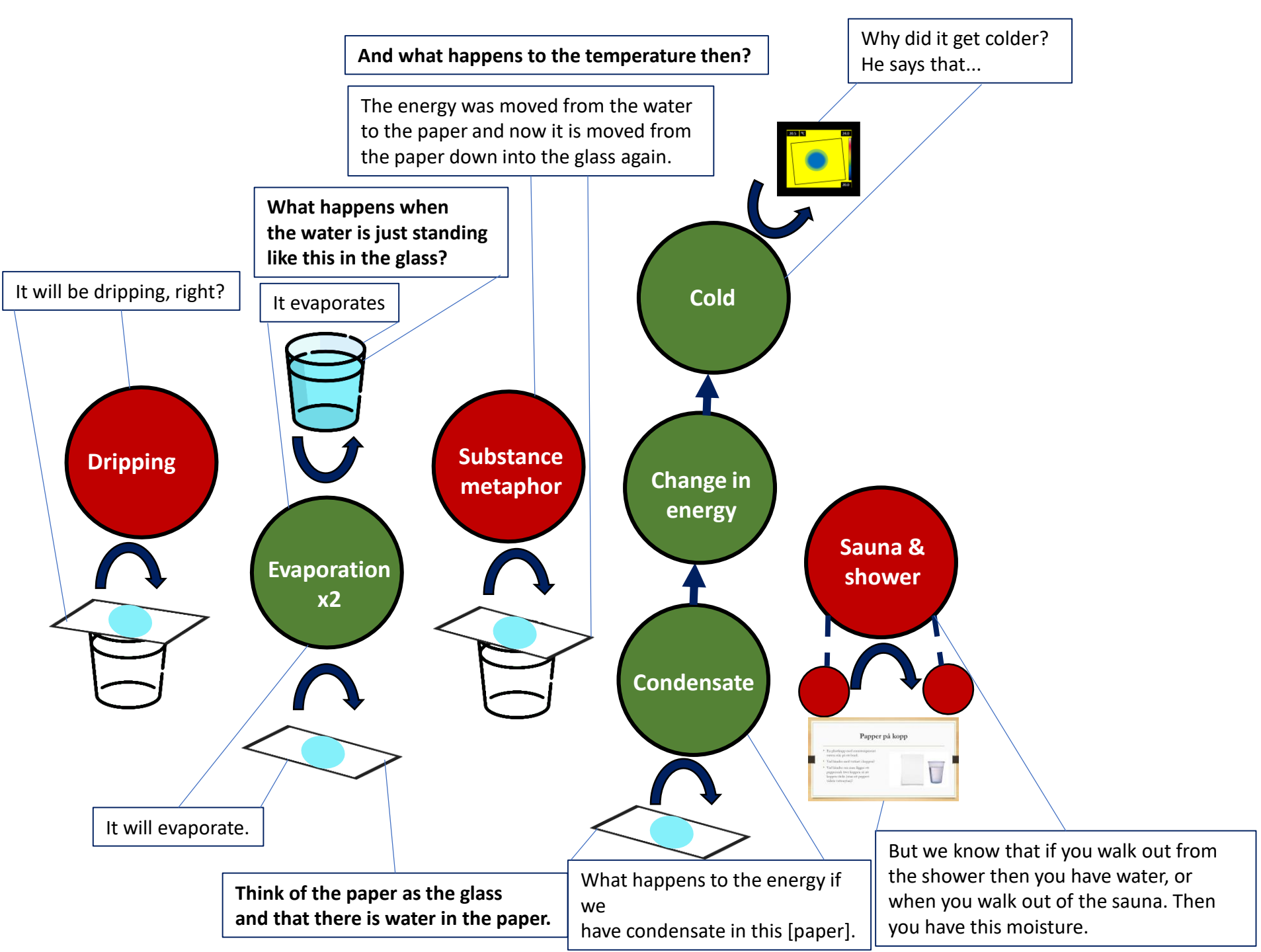


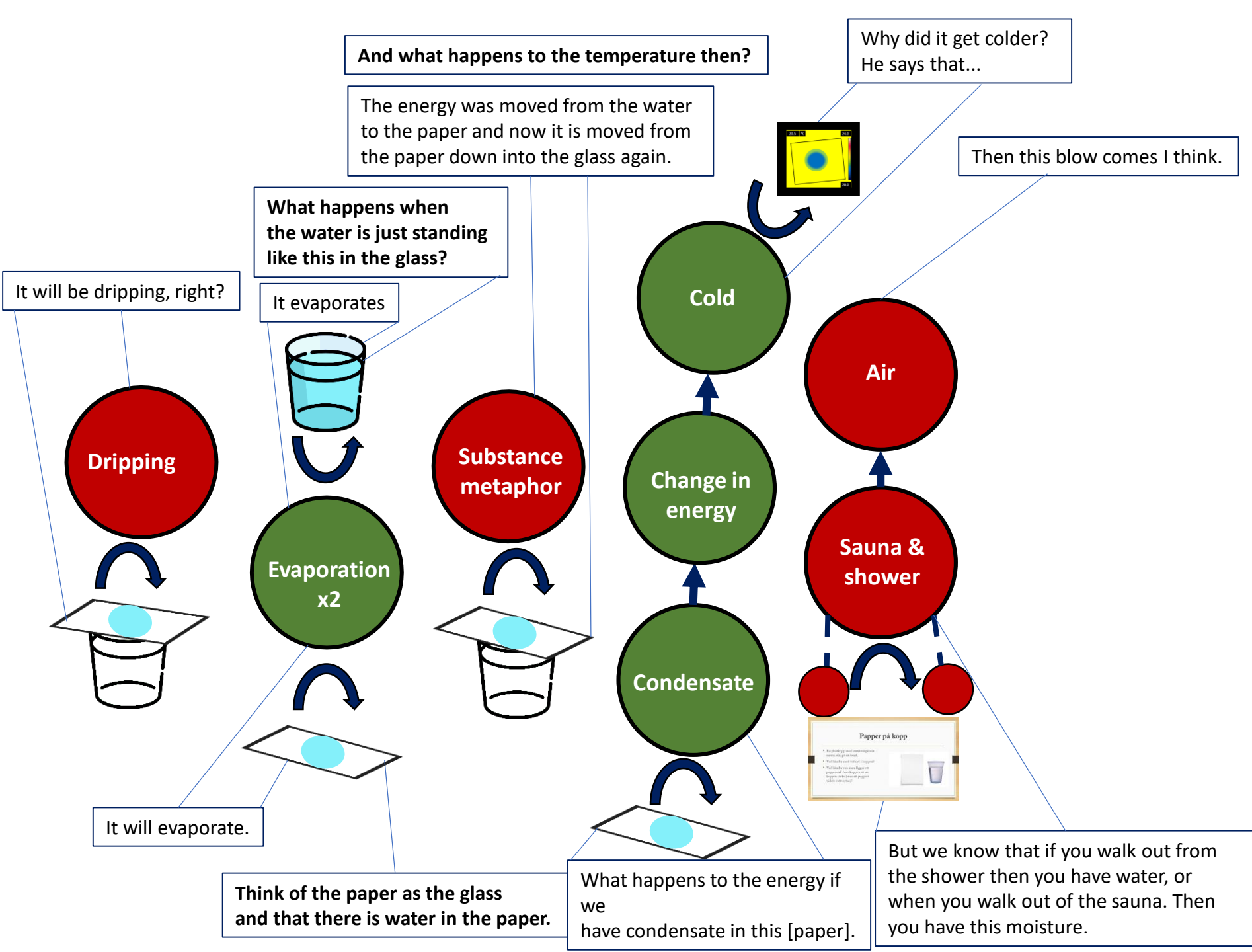
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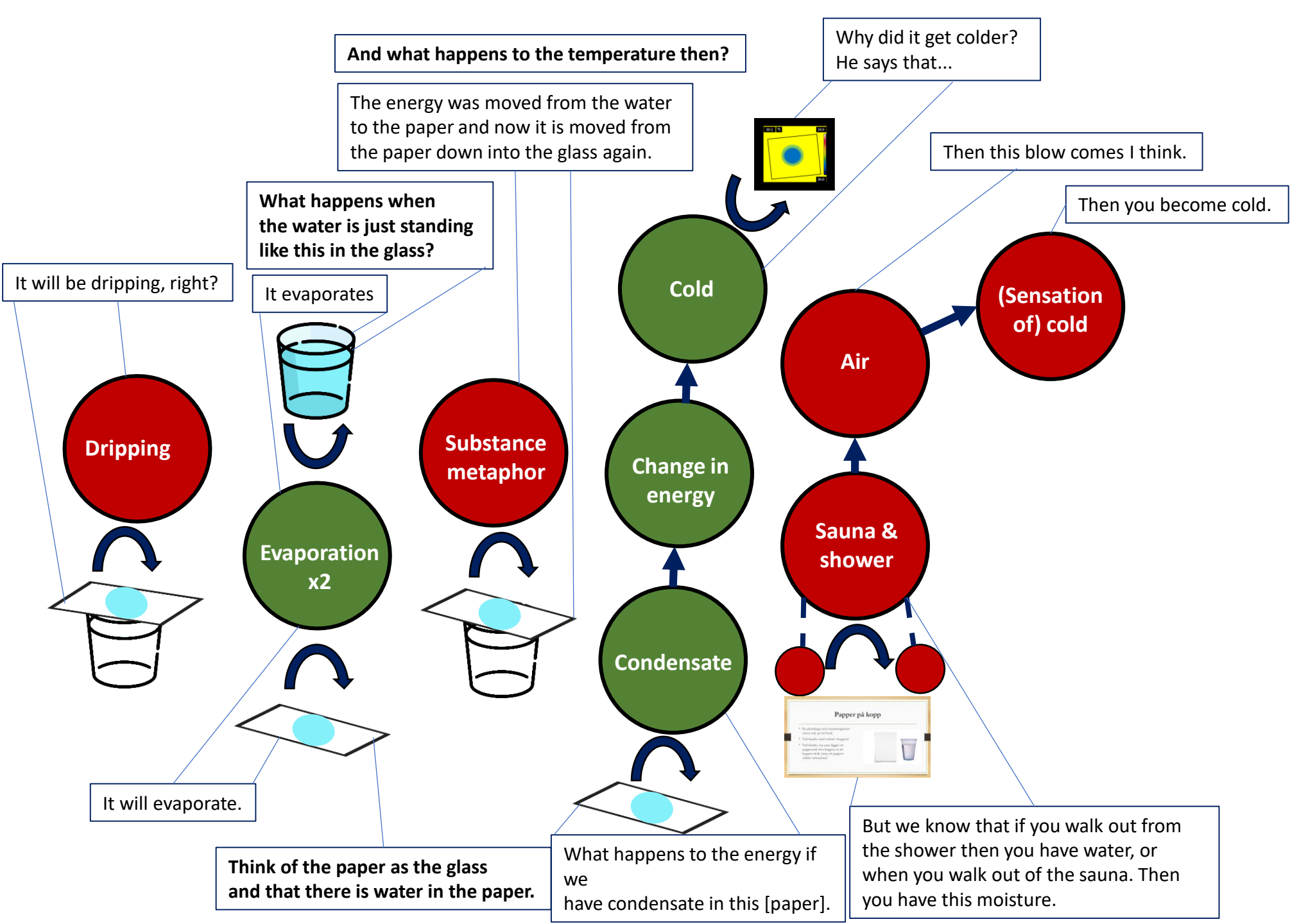
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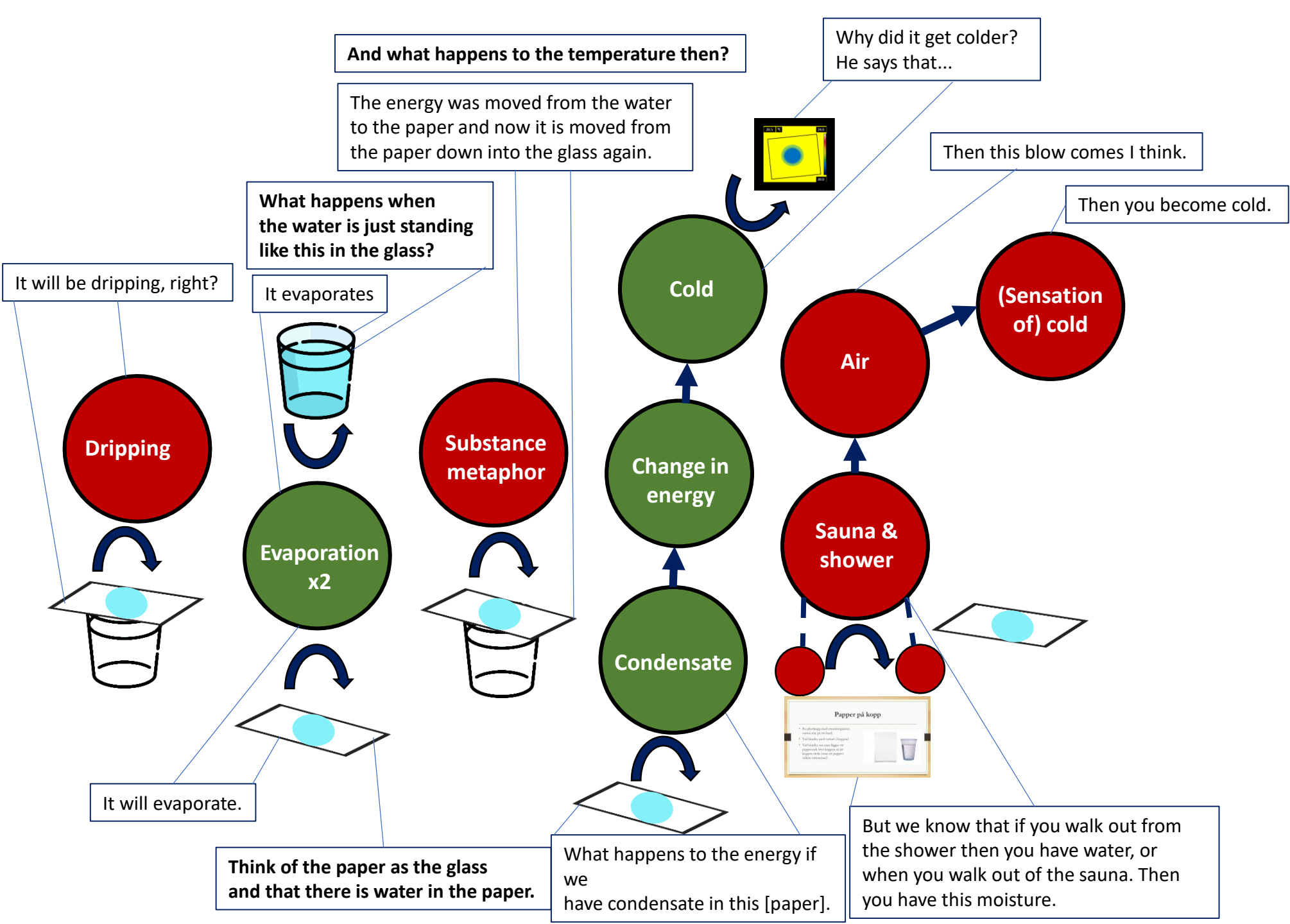


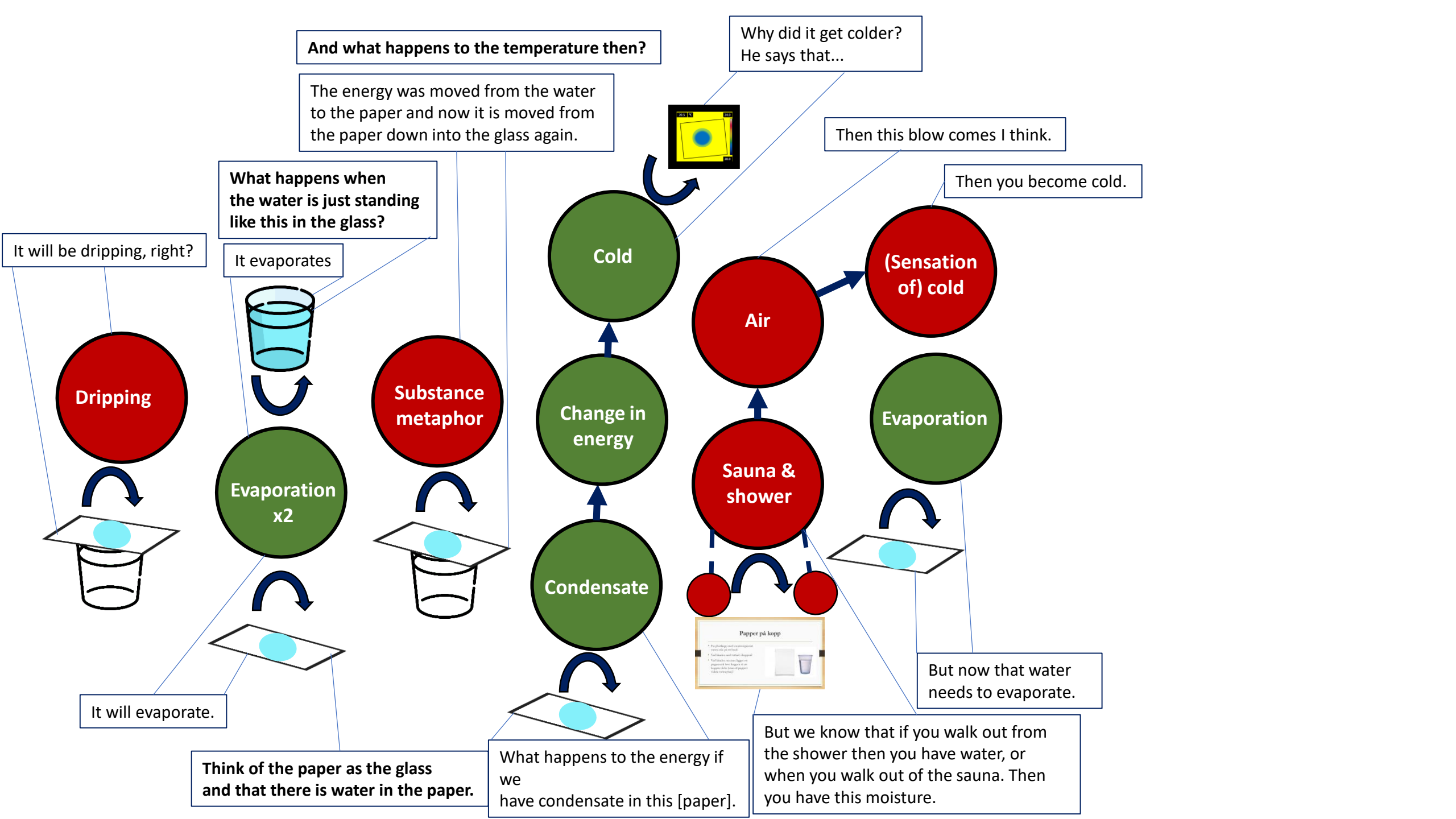


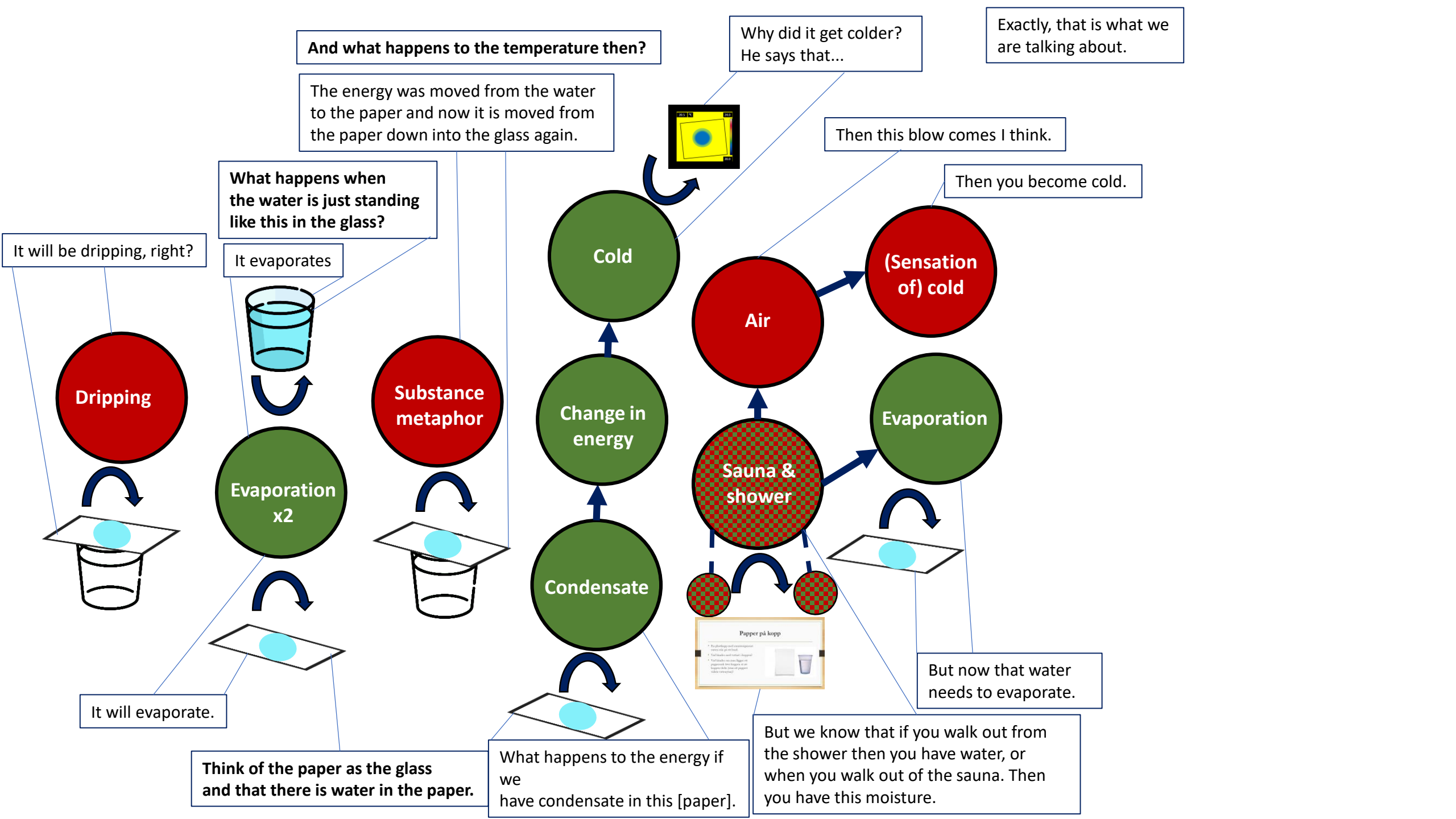


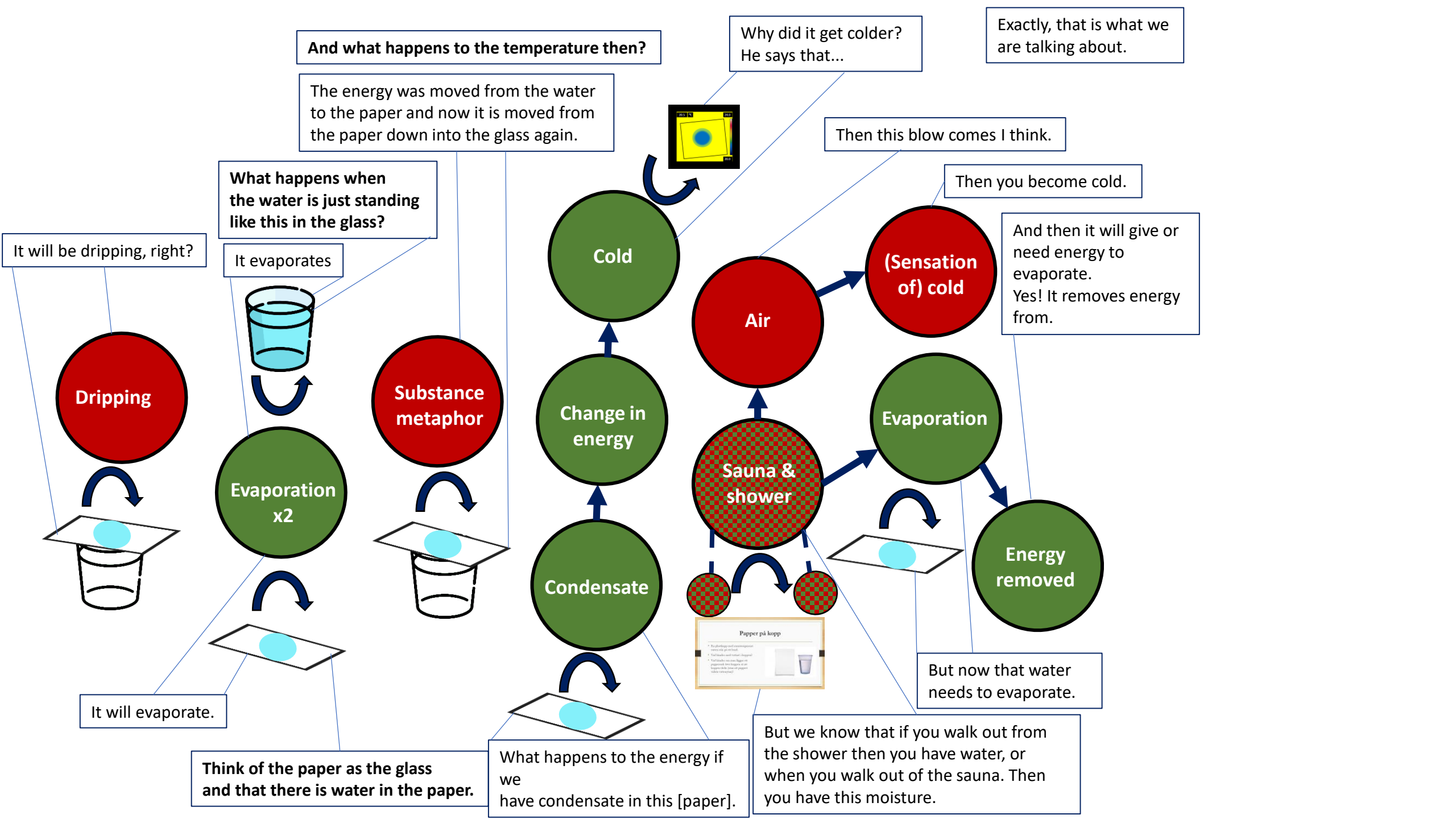


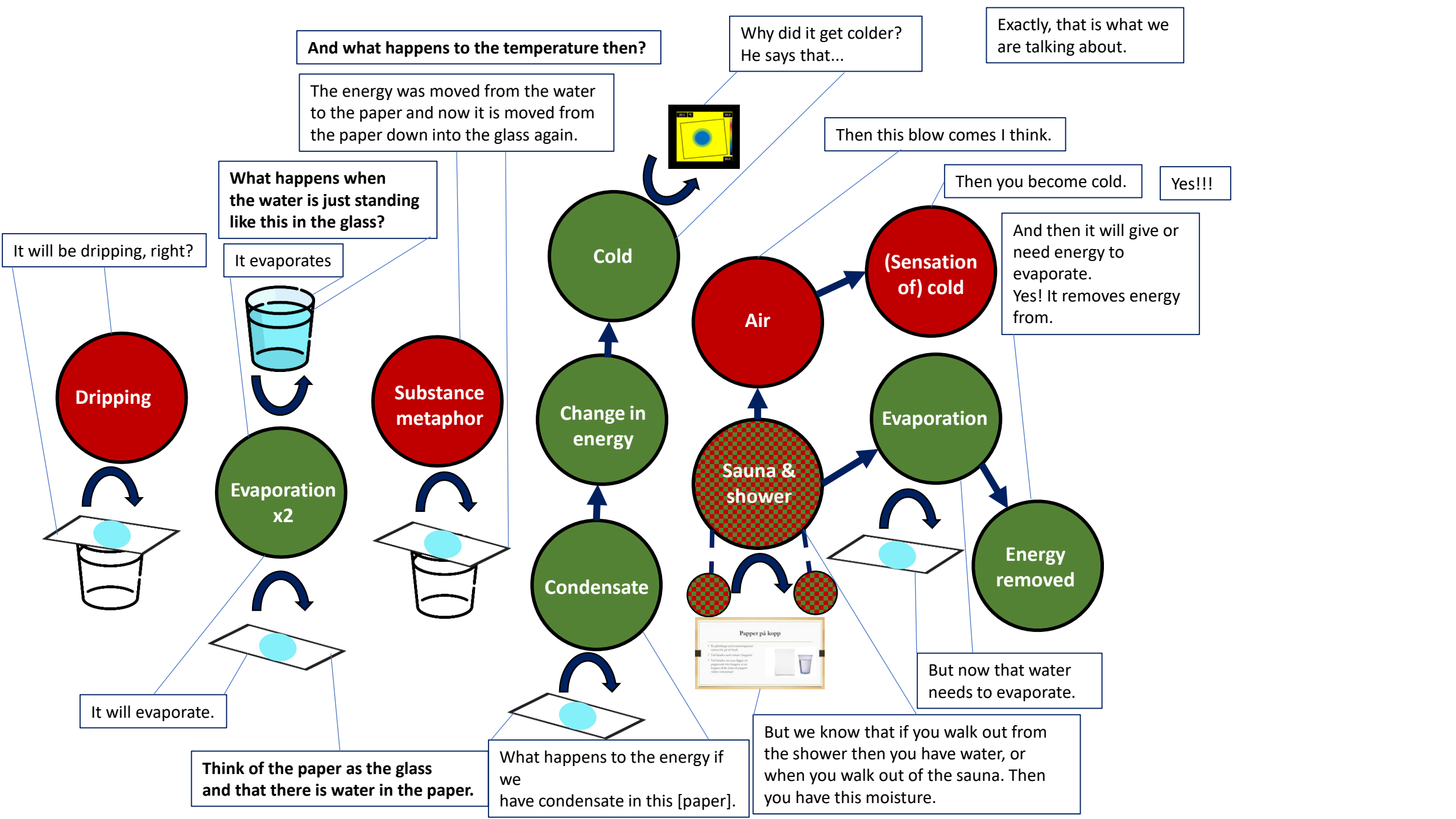


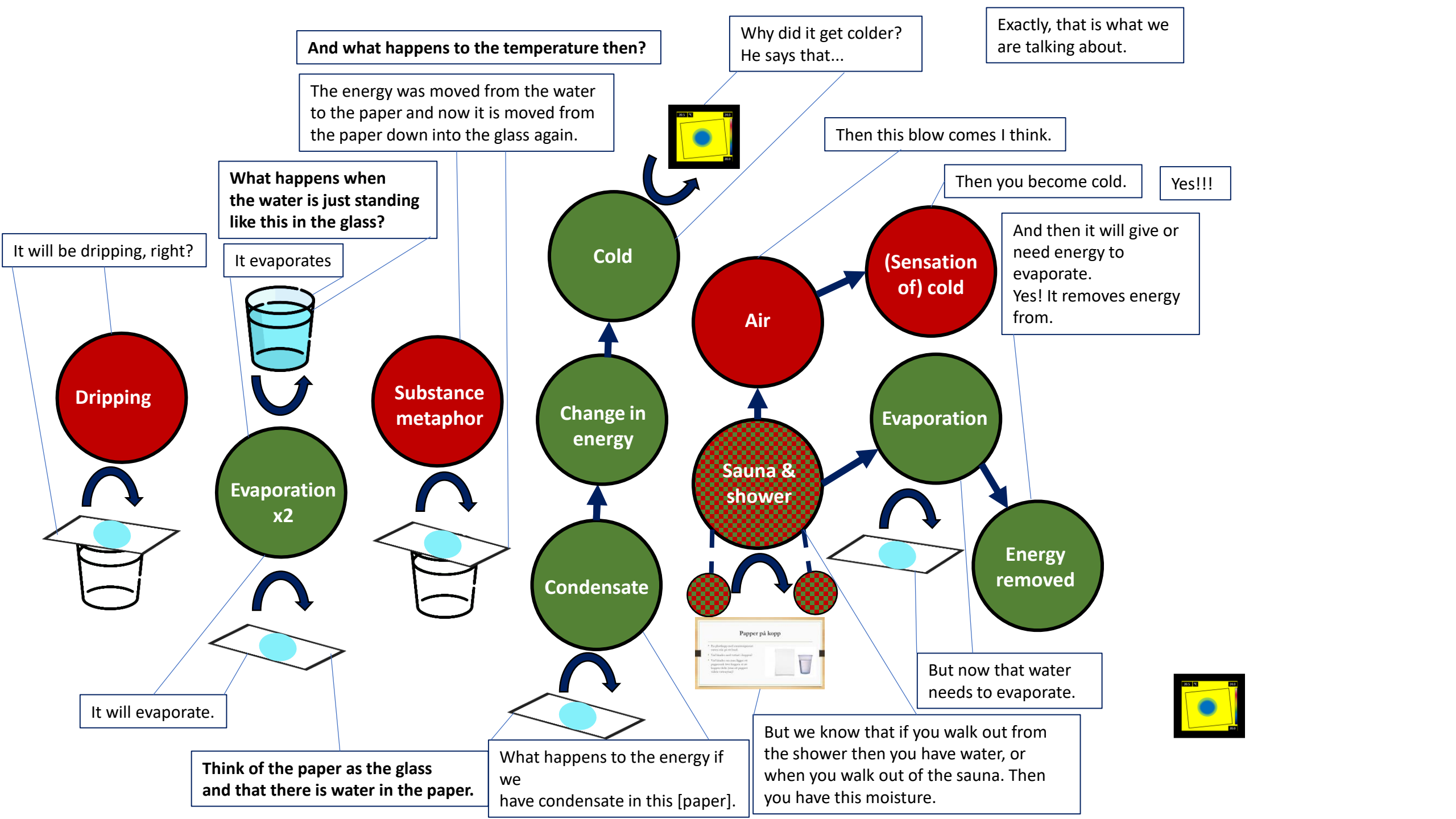


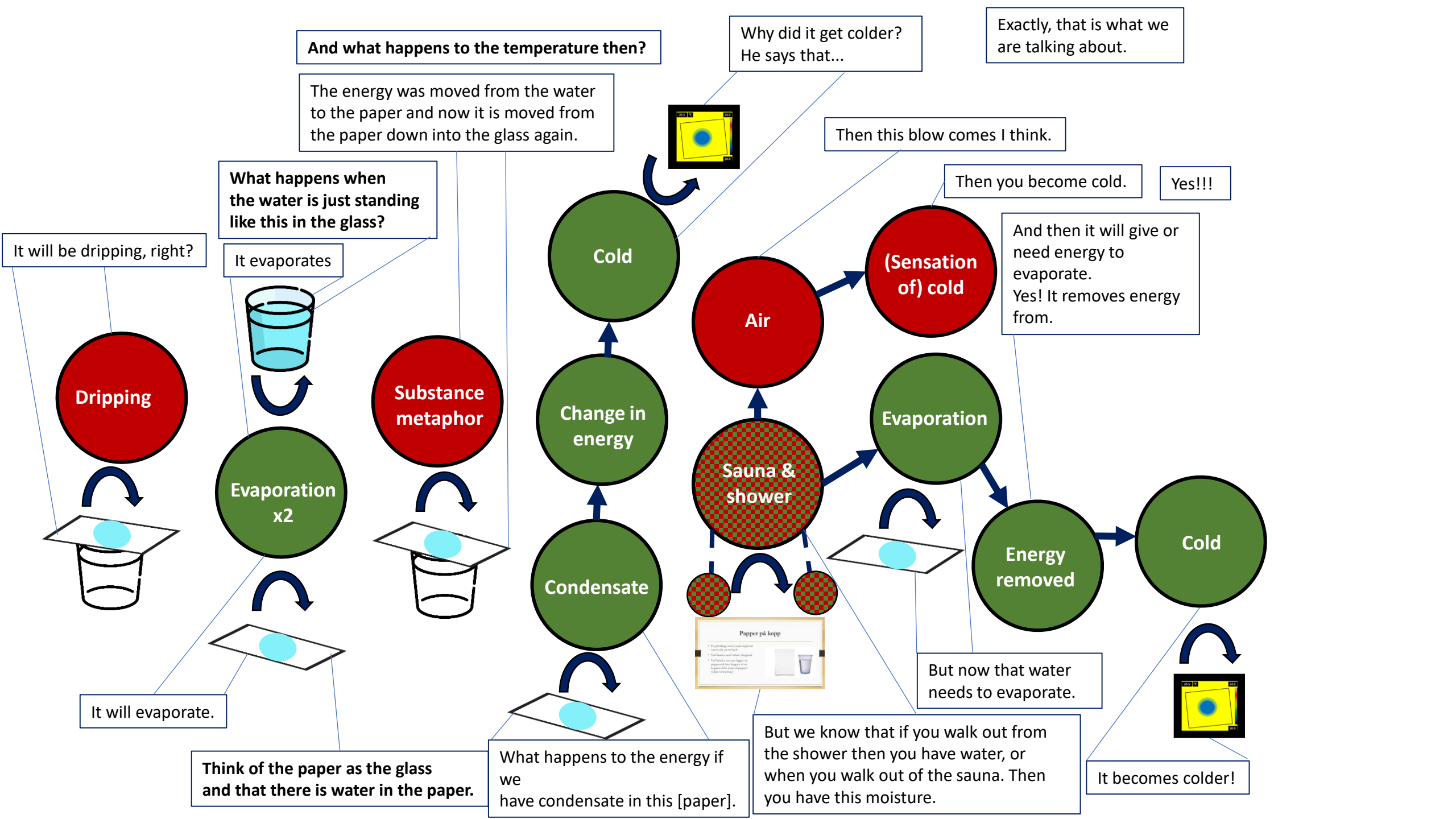


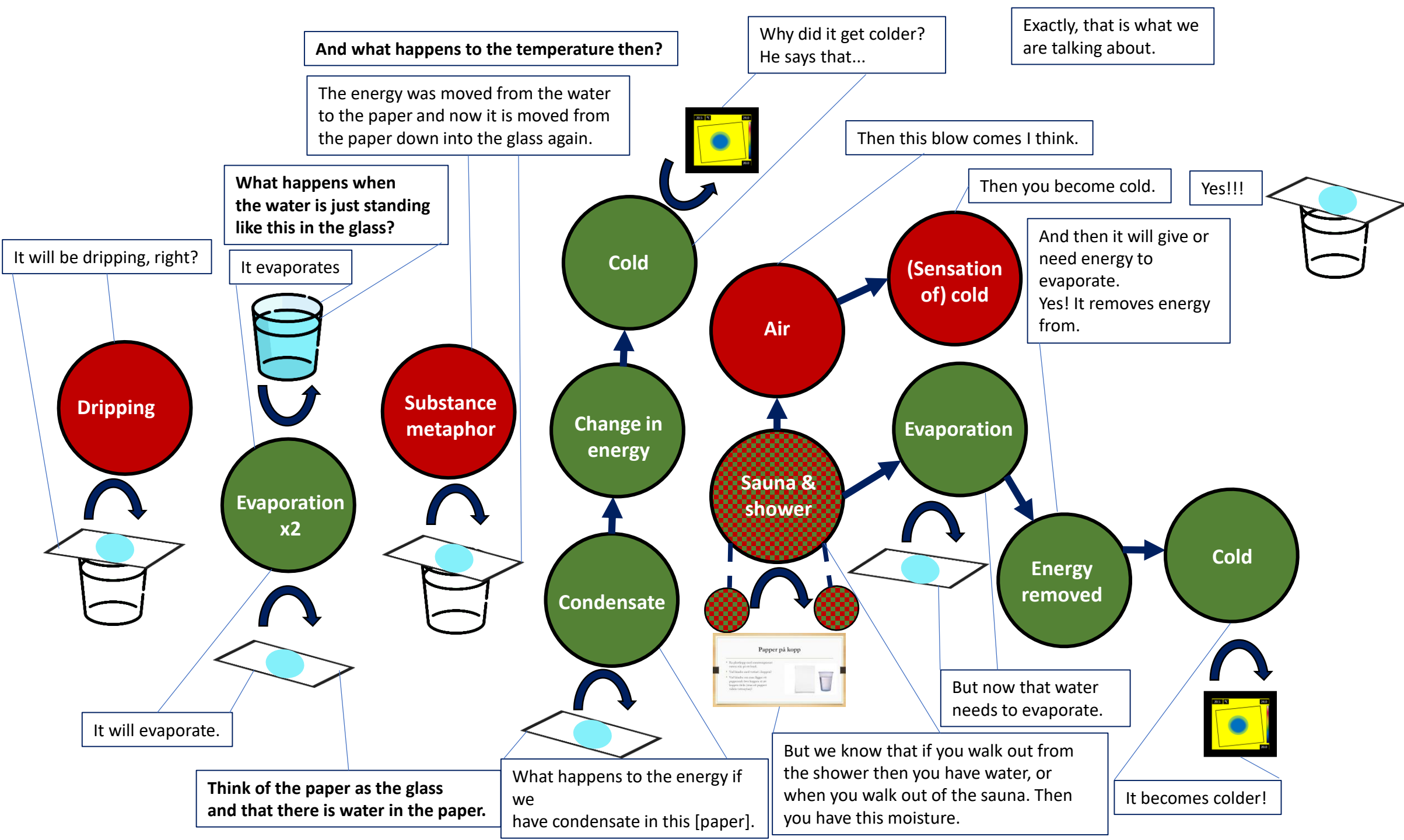


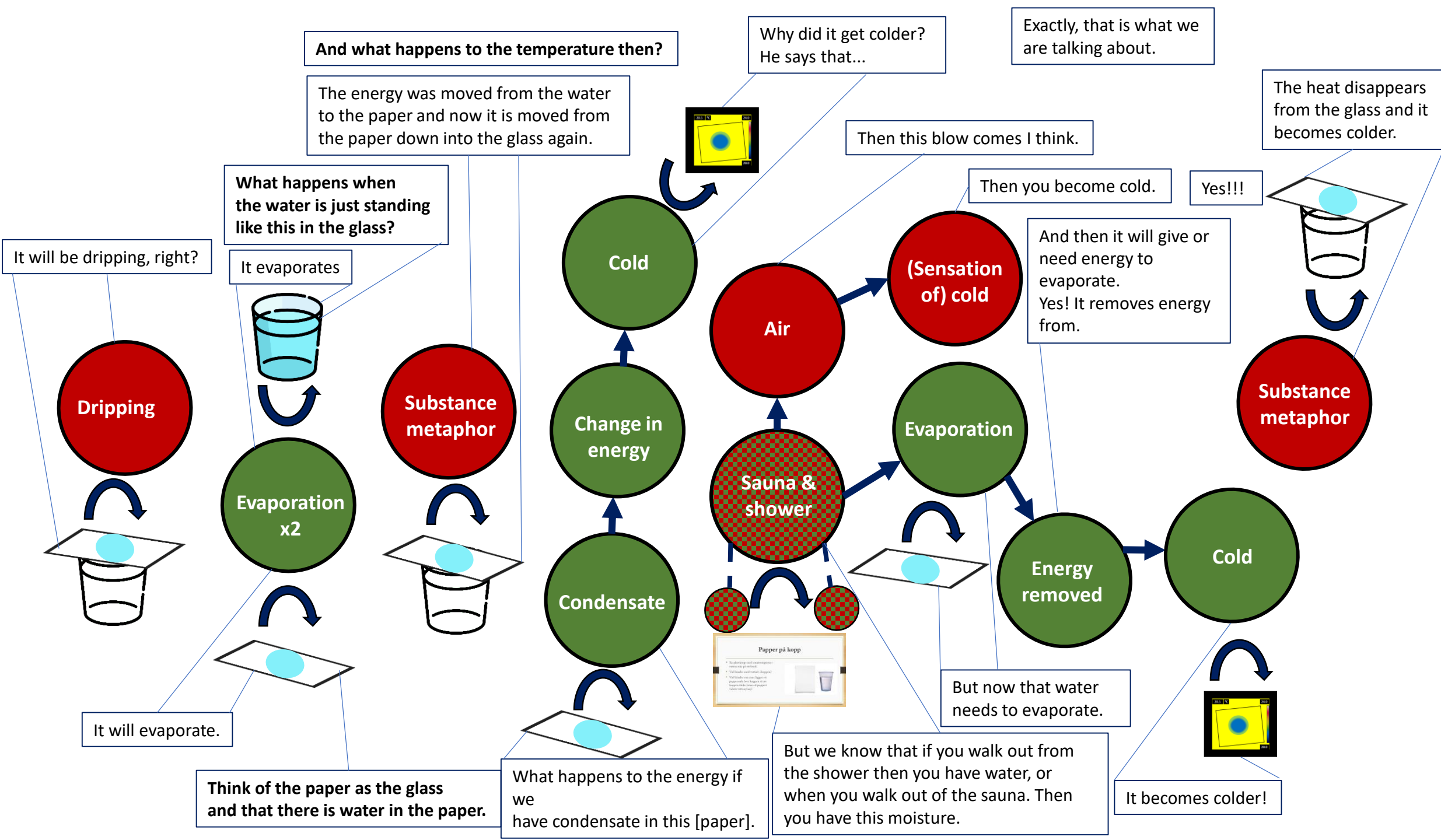


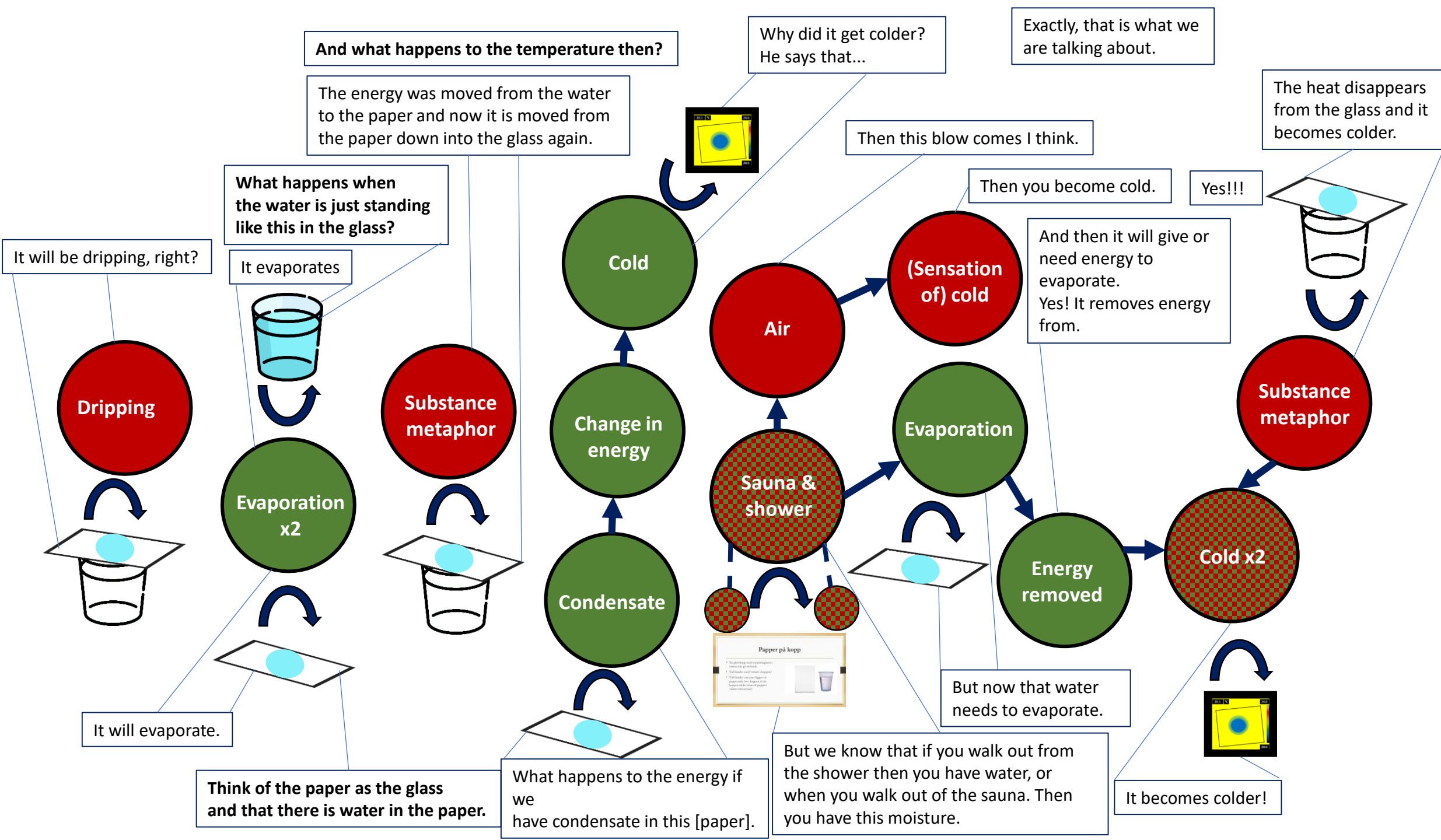




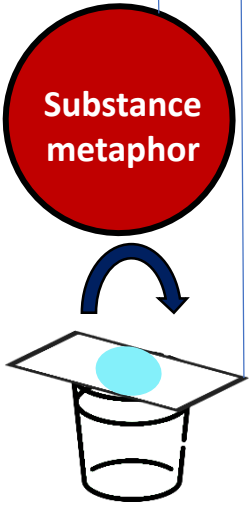






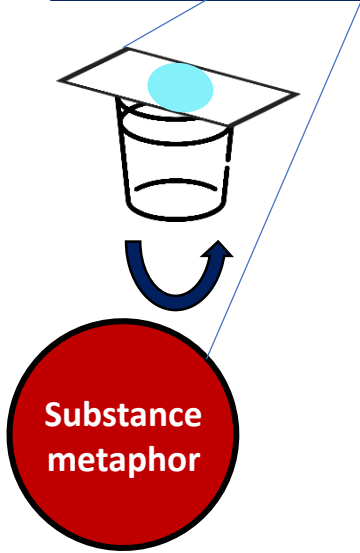


The energy was moved from the water to the paper and now it is moved from the paper down into the glass again.

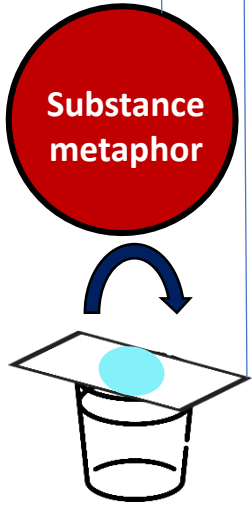


Barrier 1: Remove information!

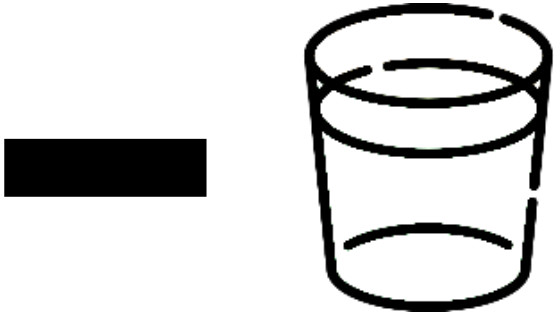
The heat disappears from the glass and it becomes colder.



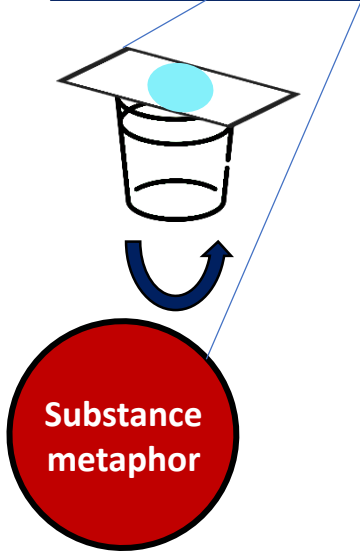
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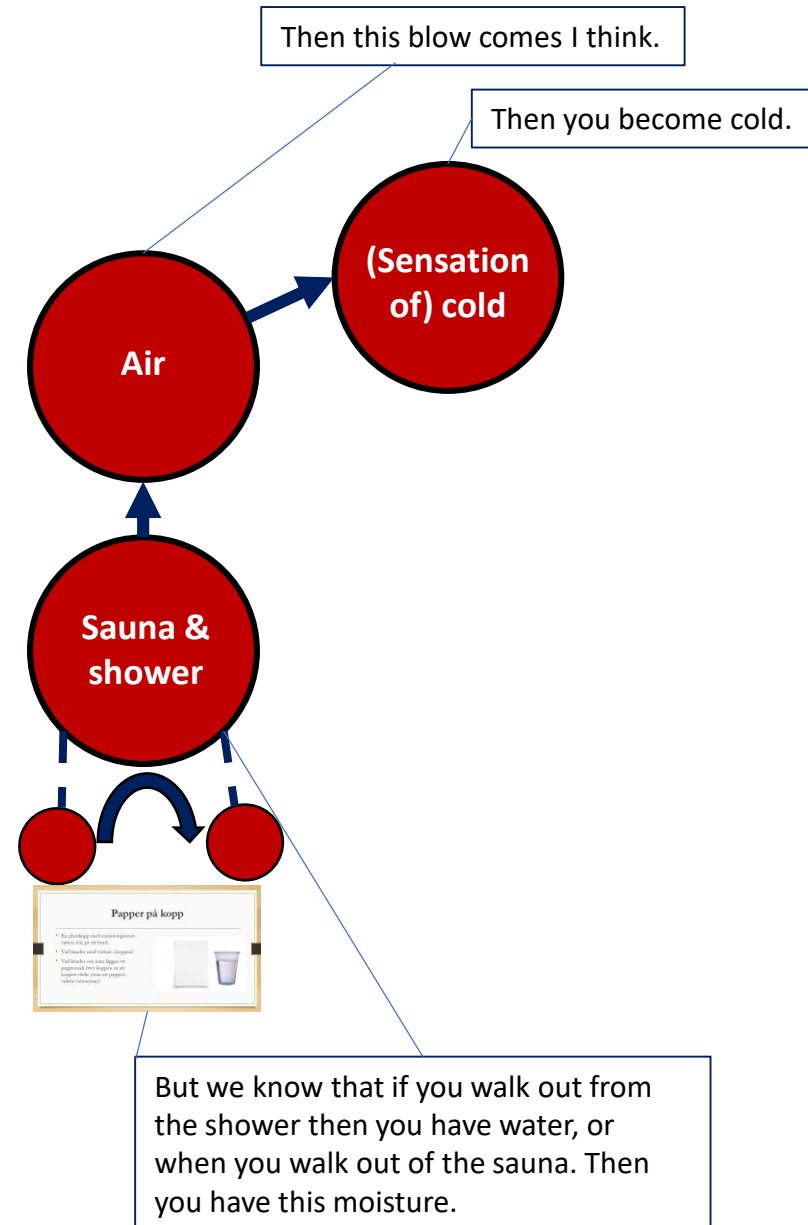
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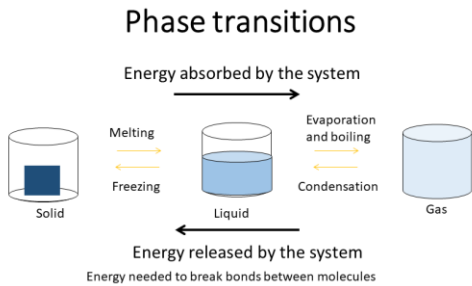
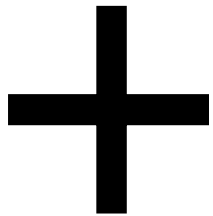
The heat disappears from the glass and it becomes colder.



Barrier 2: Add information!

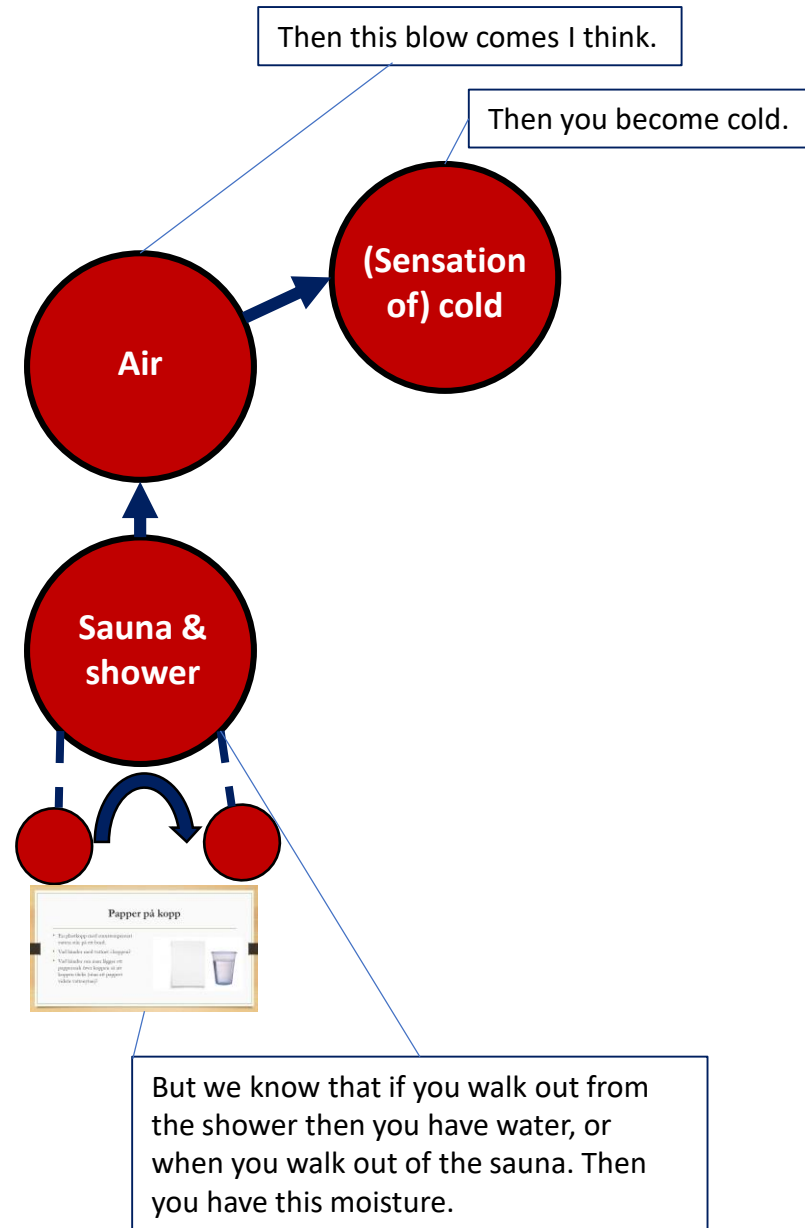


Barrier 2: Add information!



Sauna

Shower



What do we do with this?

- Add information: Responsive teaching.
- Remove information: Semiotic resources that form barriers.

