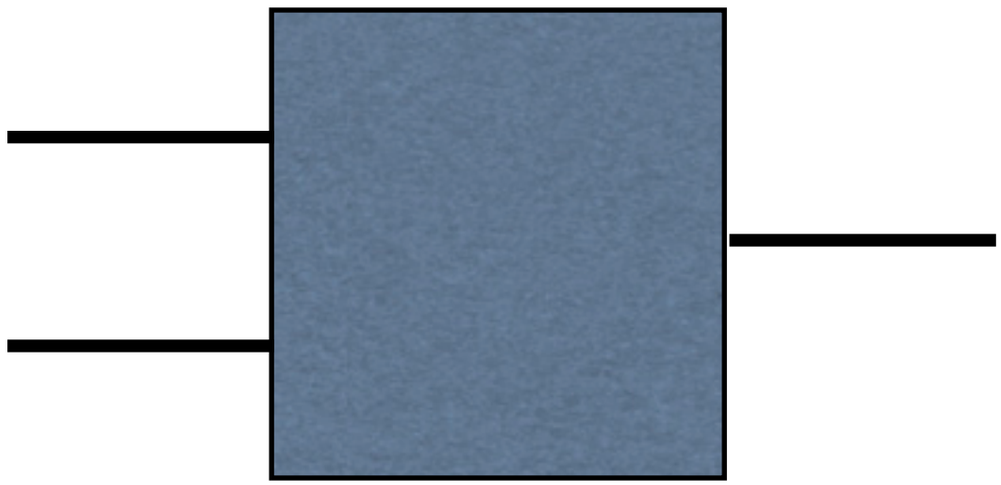
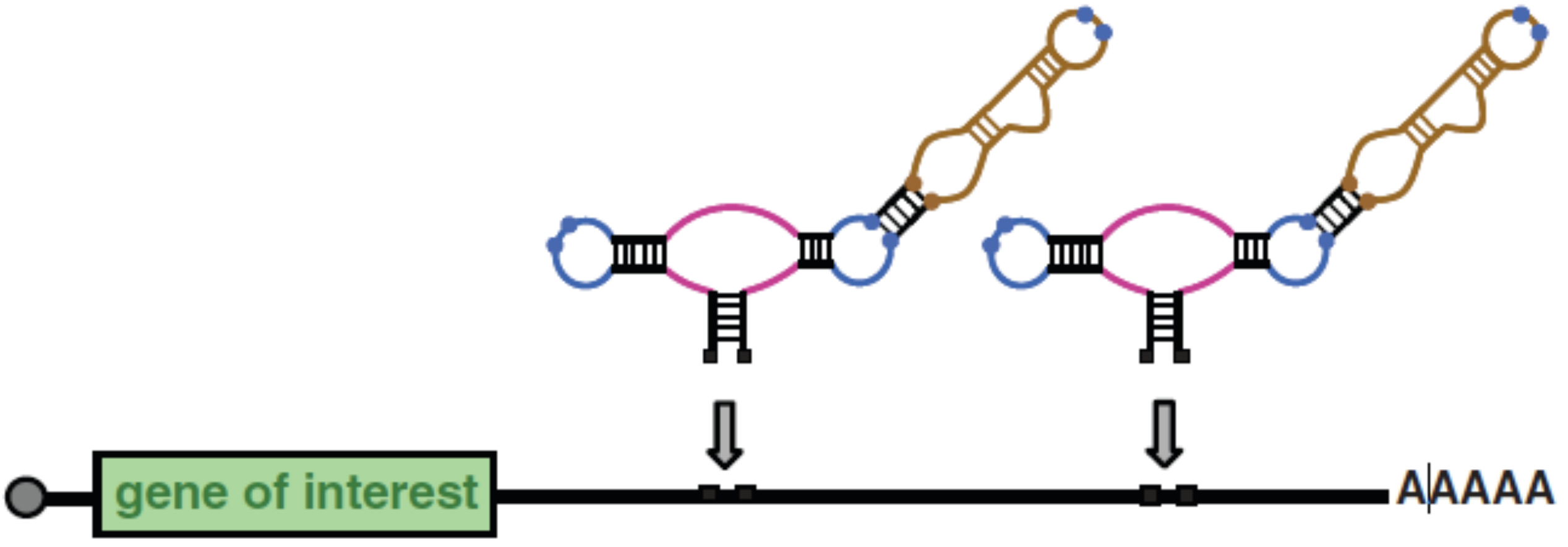
3 demonstrated approaches to making "higher order" gates



Here, "higher order" means integrating multiple inputs within a single gate

Materials adpated from http://www.sciencemag.org/cgi/content/abstract/322/5900/456

Approach 1: Multiple single input gates w/in a single 3'UTR



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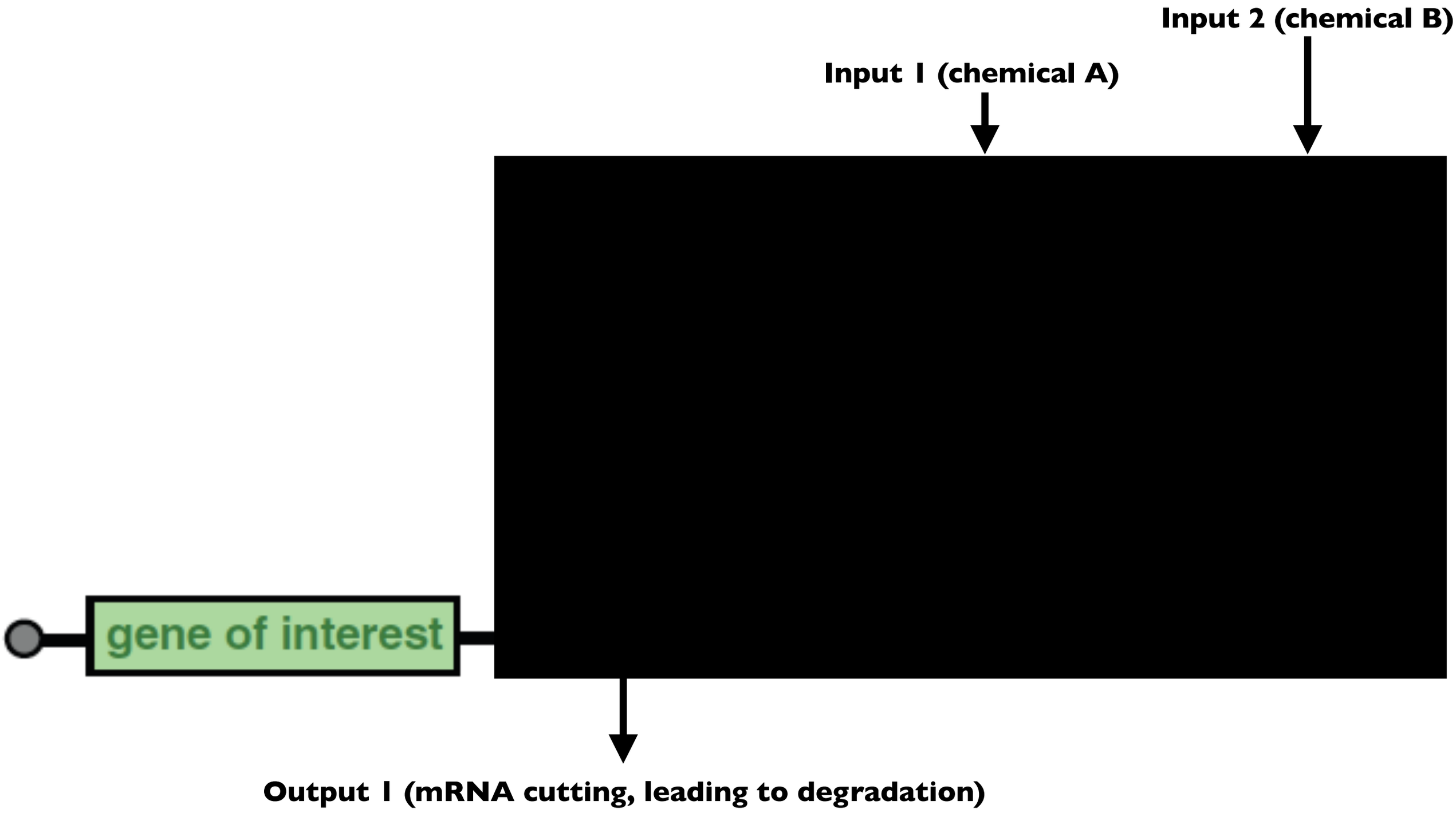

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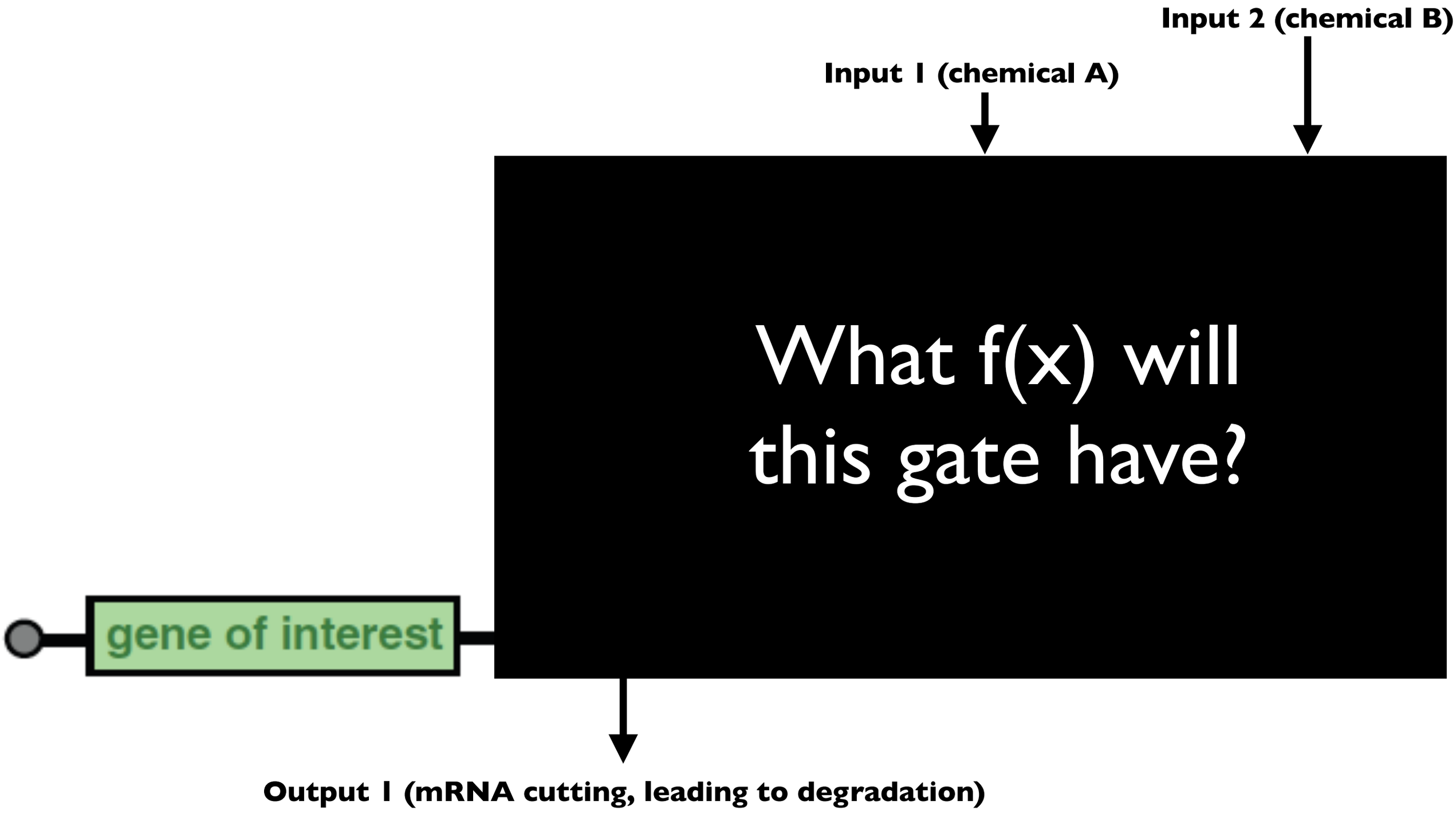

Higher-order gate functions depends on individual internal gates!

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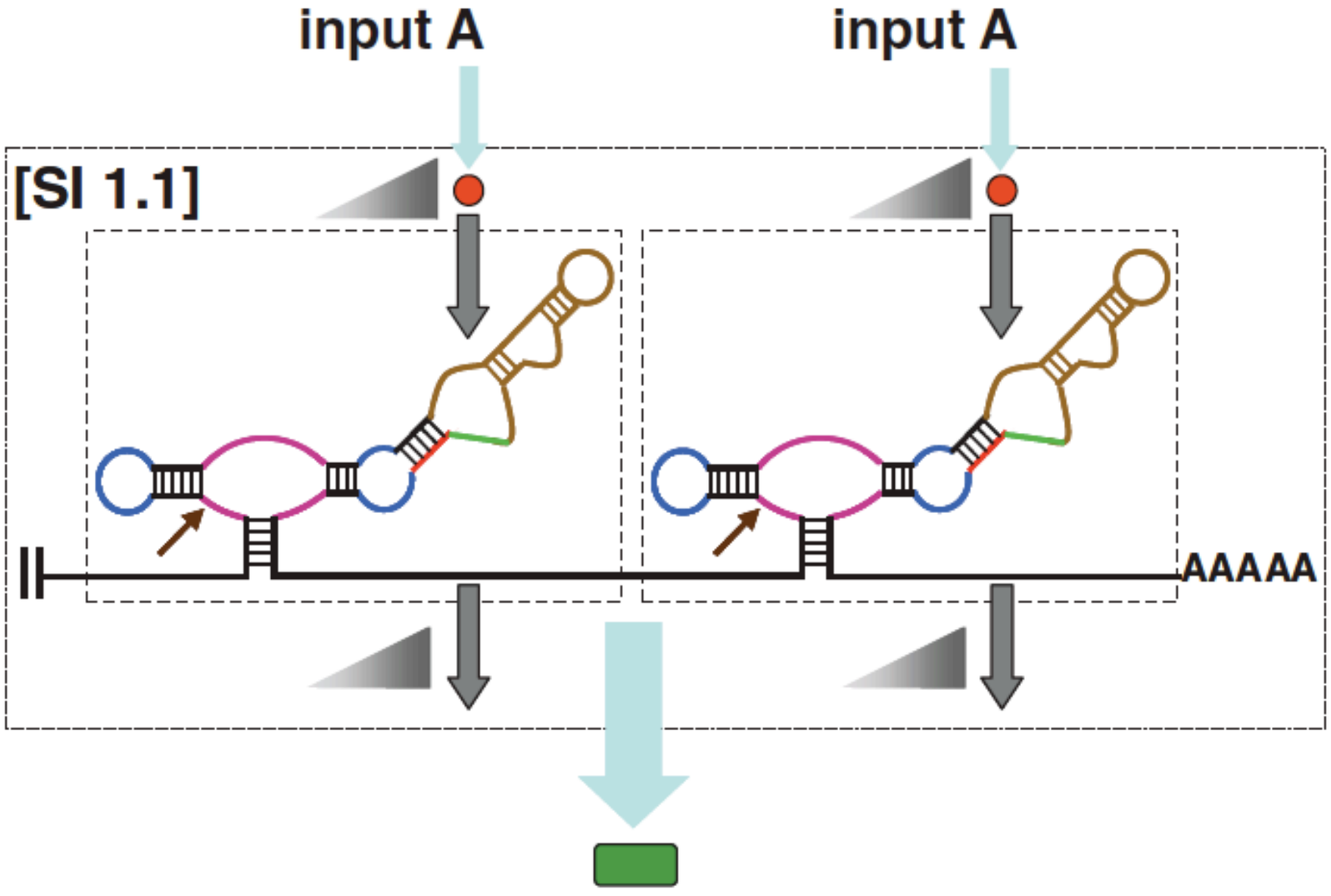

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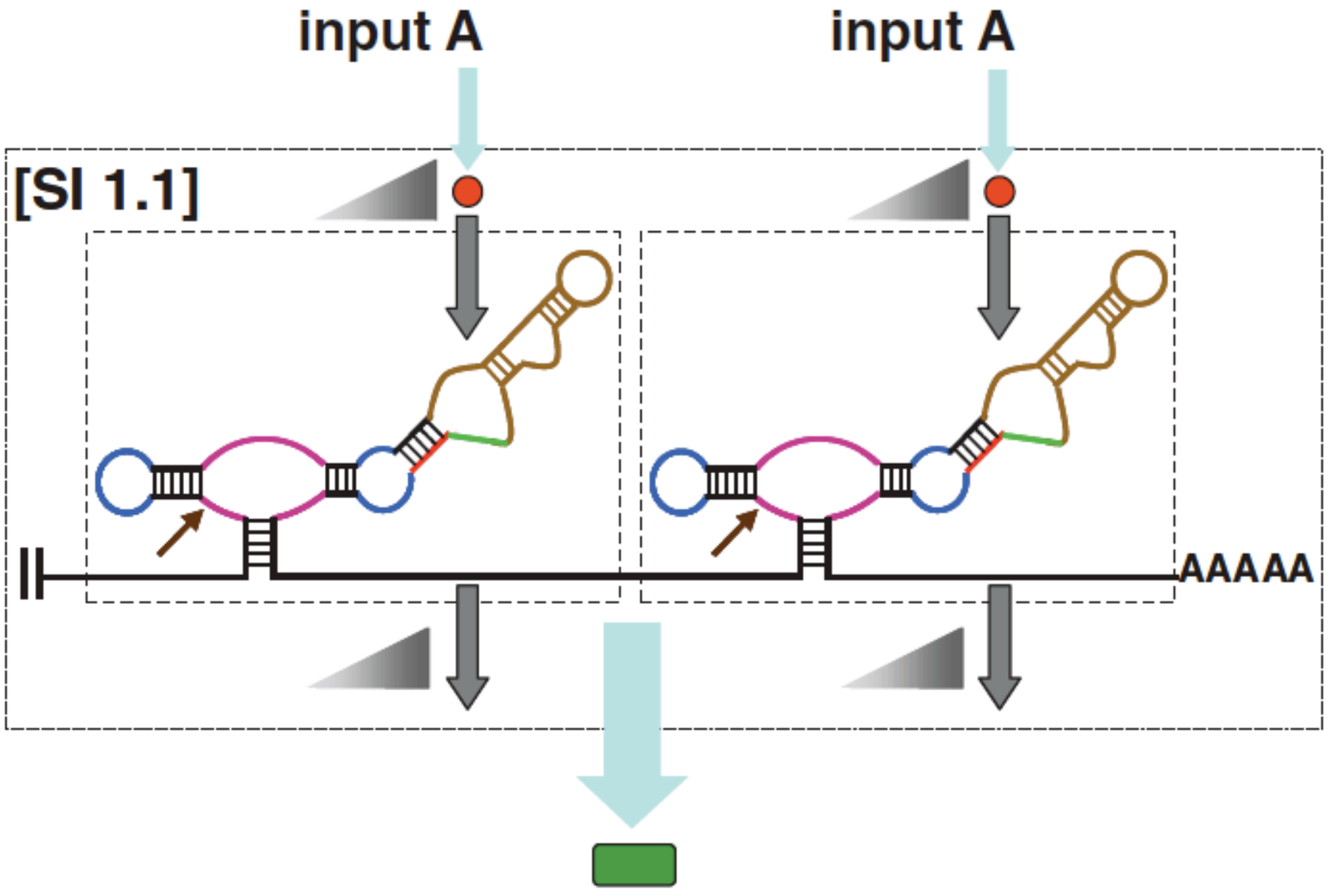

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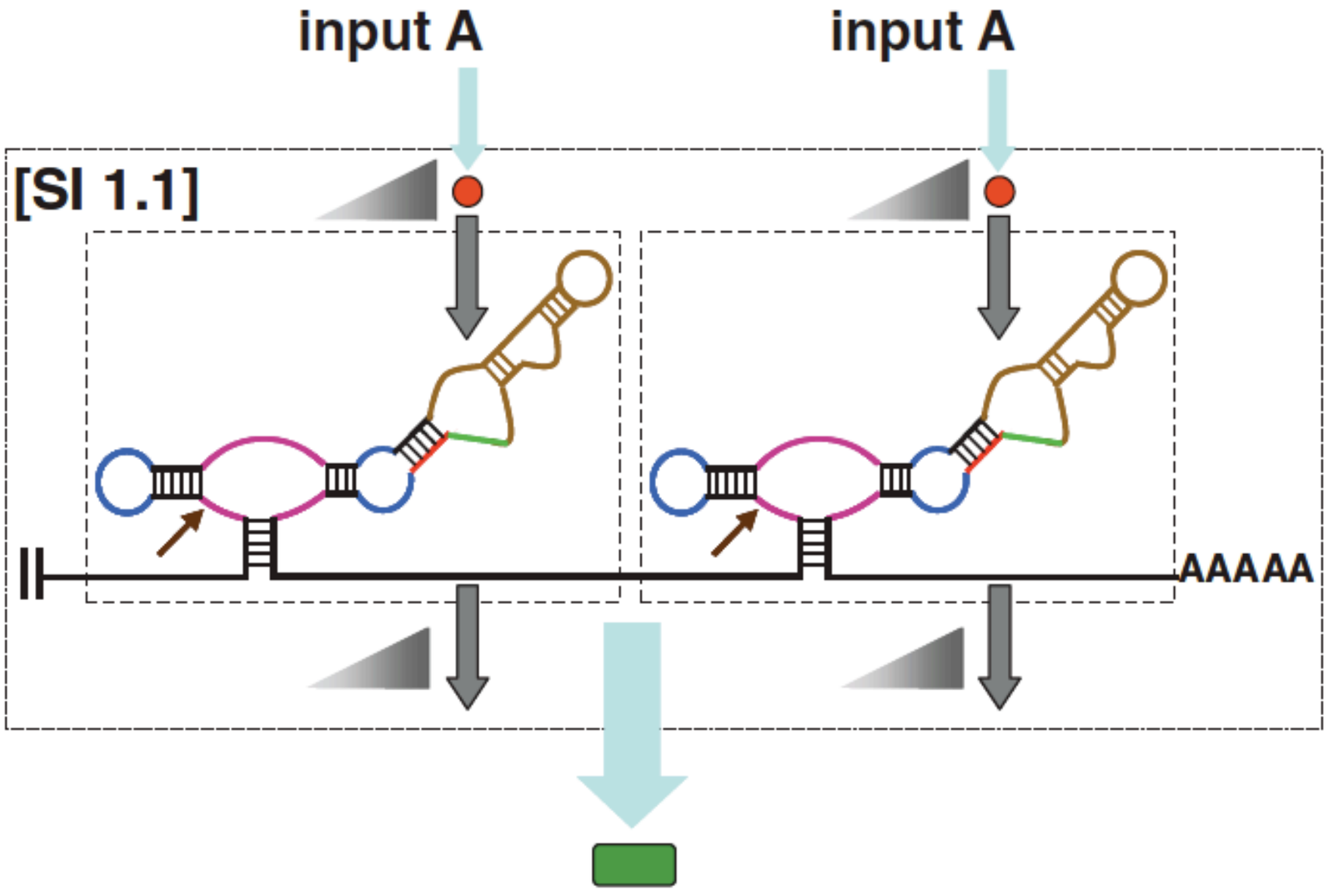
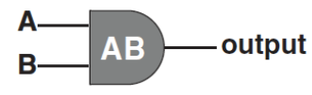
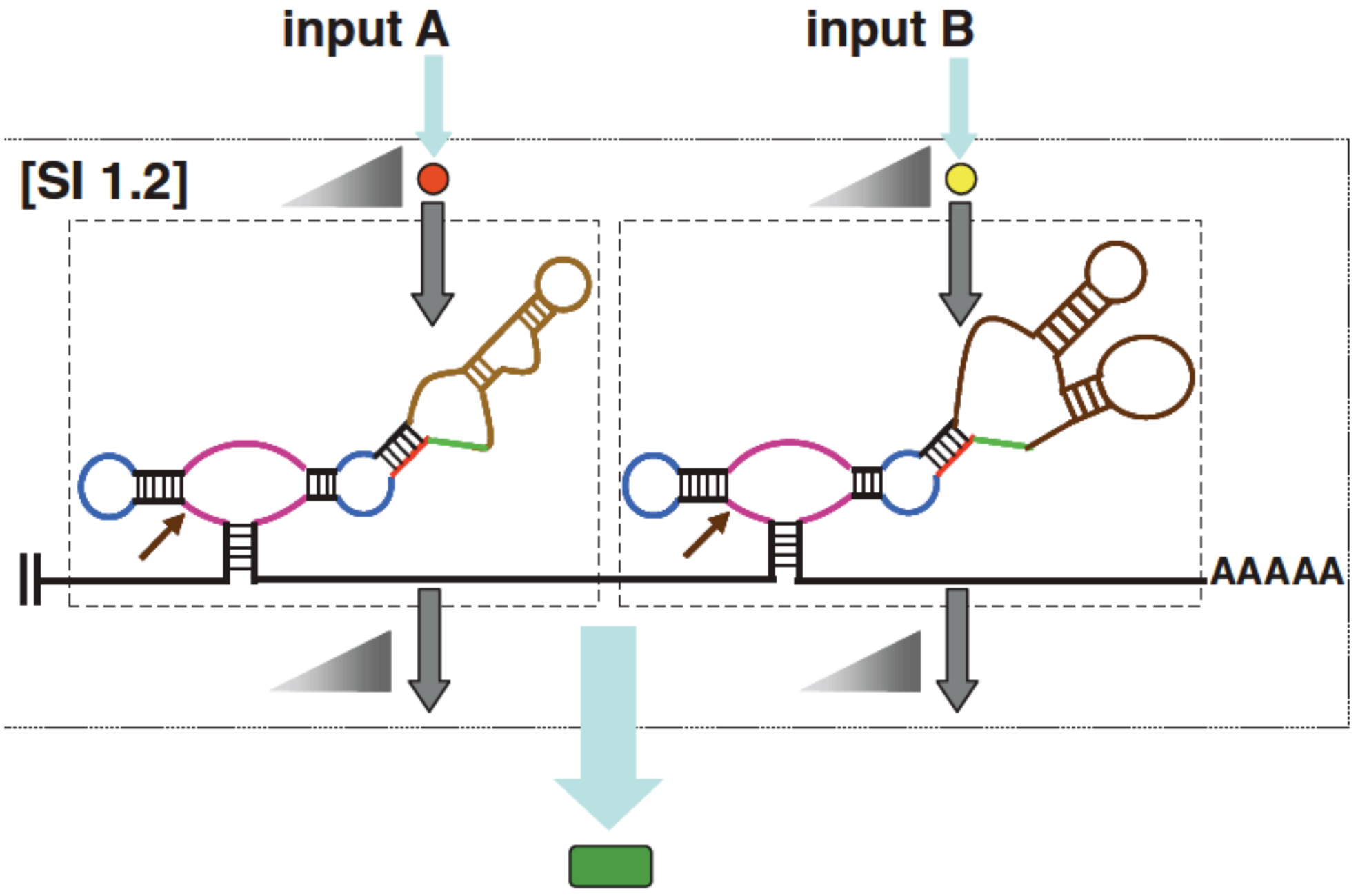
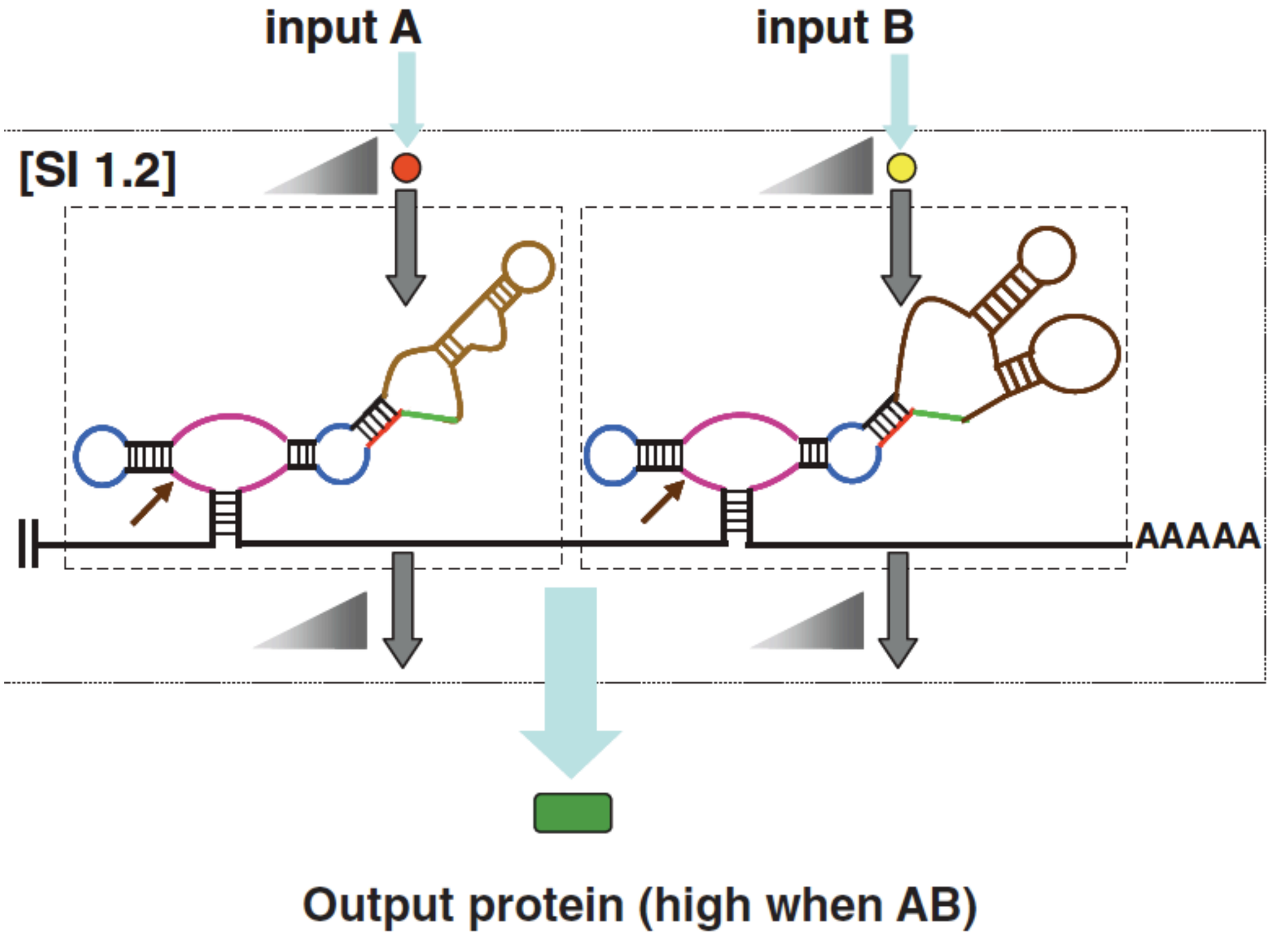


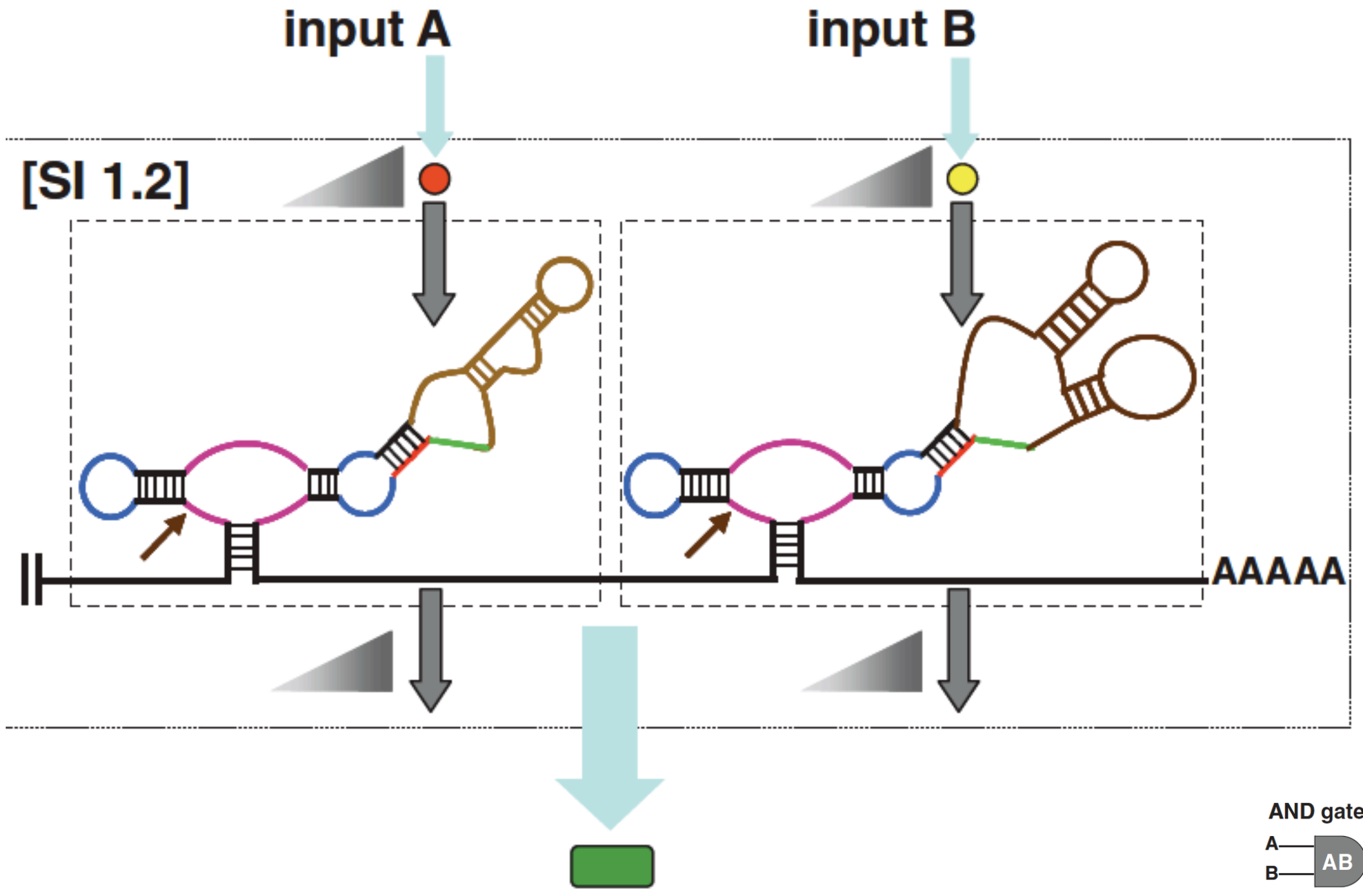
AND gate



A theo	B tc	output GFP
0	0	0
0	1	0
1	0	0
1	1	1


input A
input B
[SI 1.2]
AAAAA


input A
input B
[SI 1.2]
AAAAA
Output protein (high when AB)



Output protein (high when AB)

AND gate

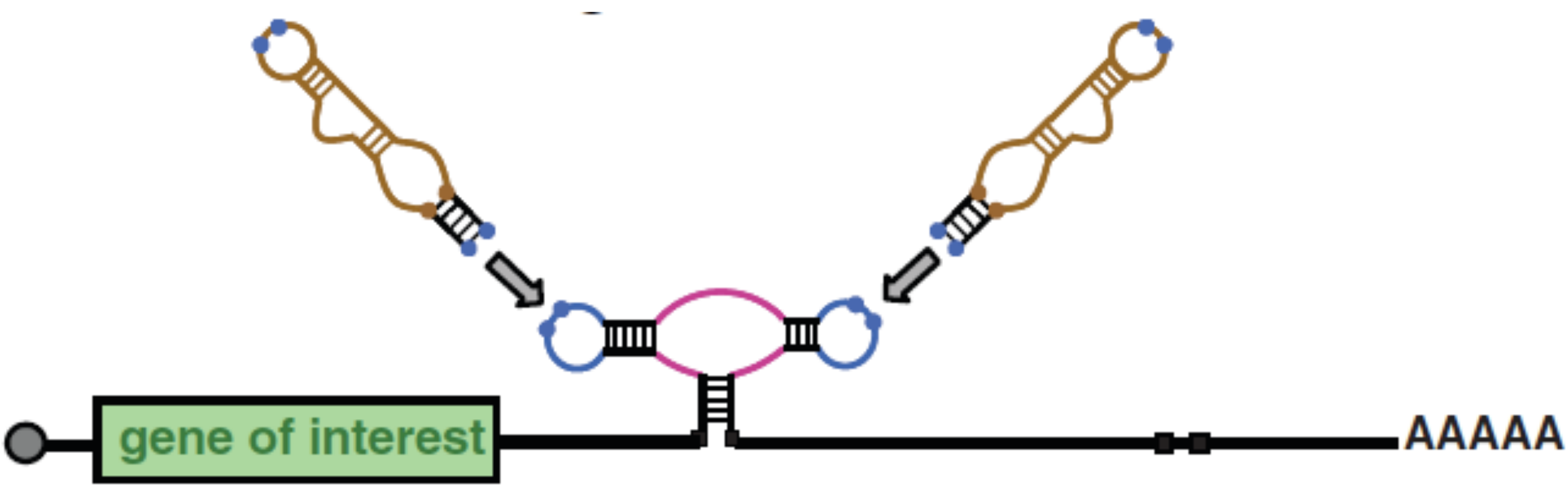
A theo	B tc	output GFP
0	0	0
0	1	0
1	0	0
1	1	1

In both previous examples, actuator was inactivated by input signal.

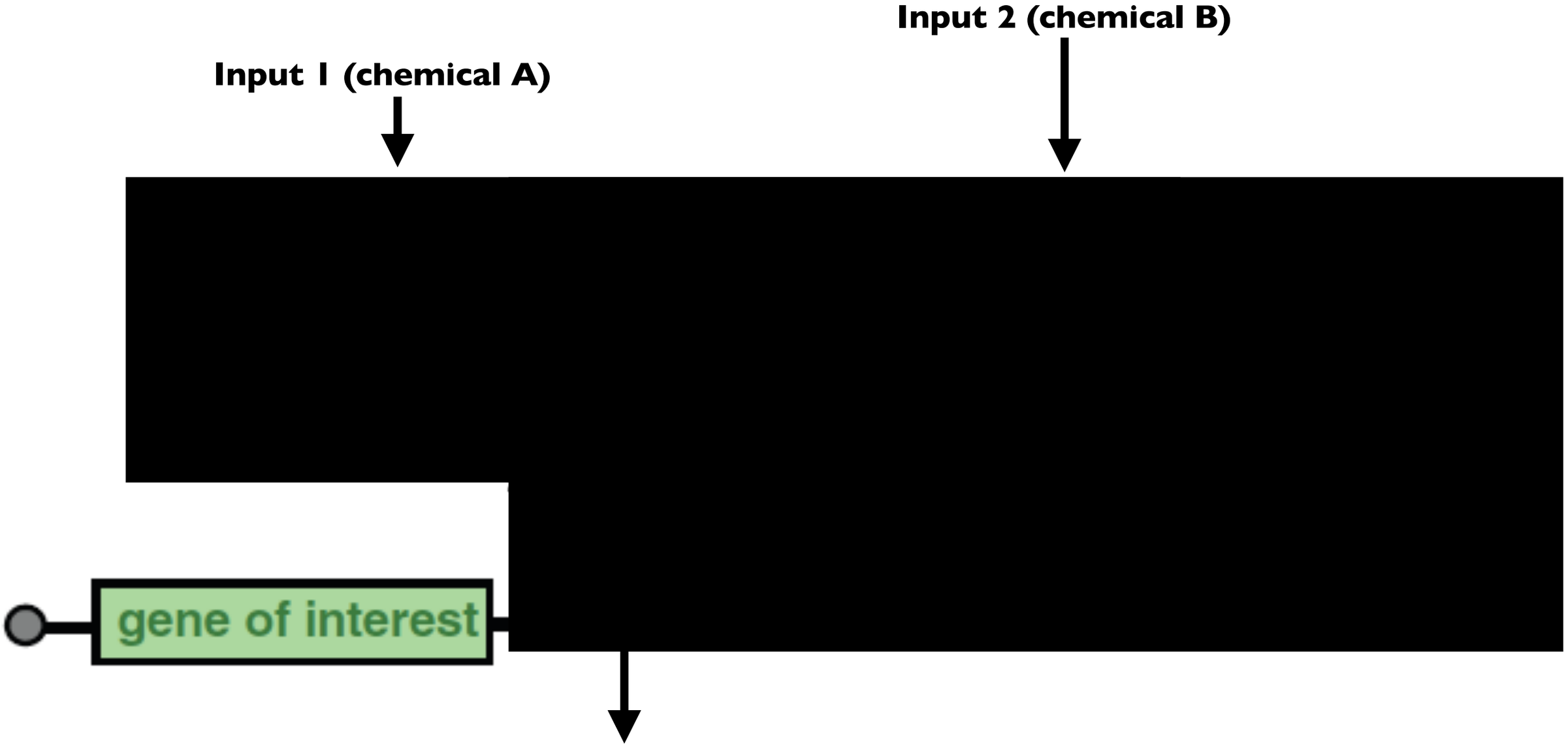
Remember that there are single input gates that have the opposite function (i.e., actuator is enabled by input signal).

Mixing and matching different types of single input gates will produce new types of higher order gates.

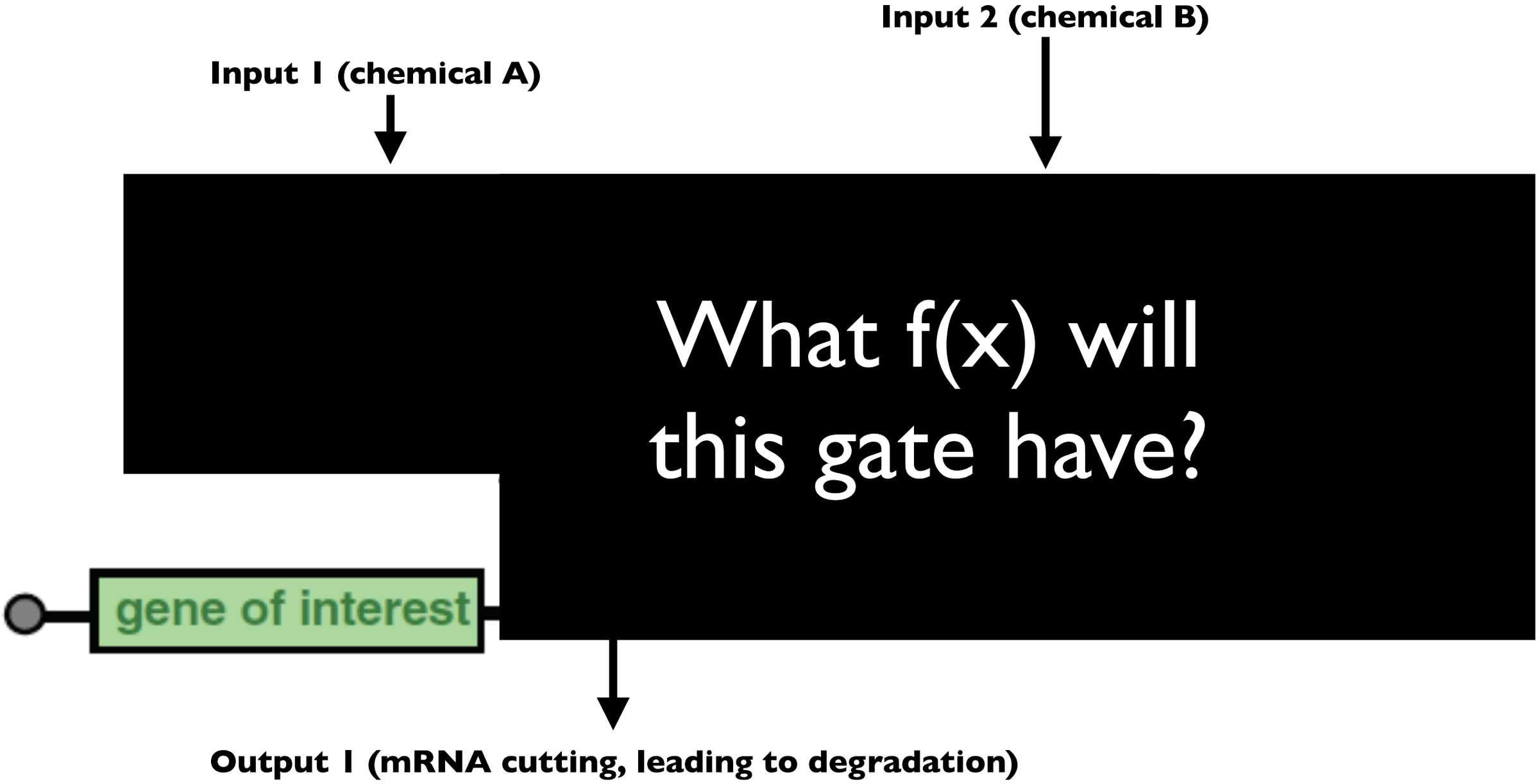
Approach 2: Multiple input domains controlling a single actuator



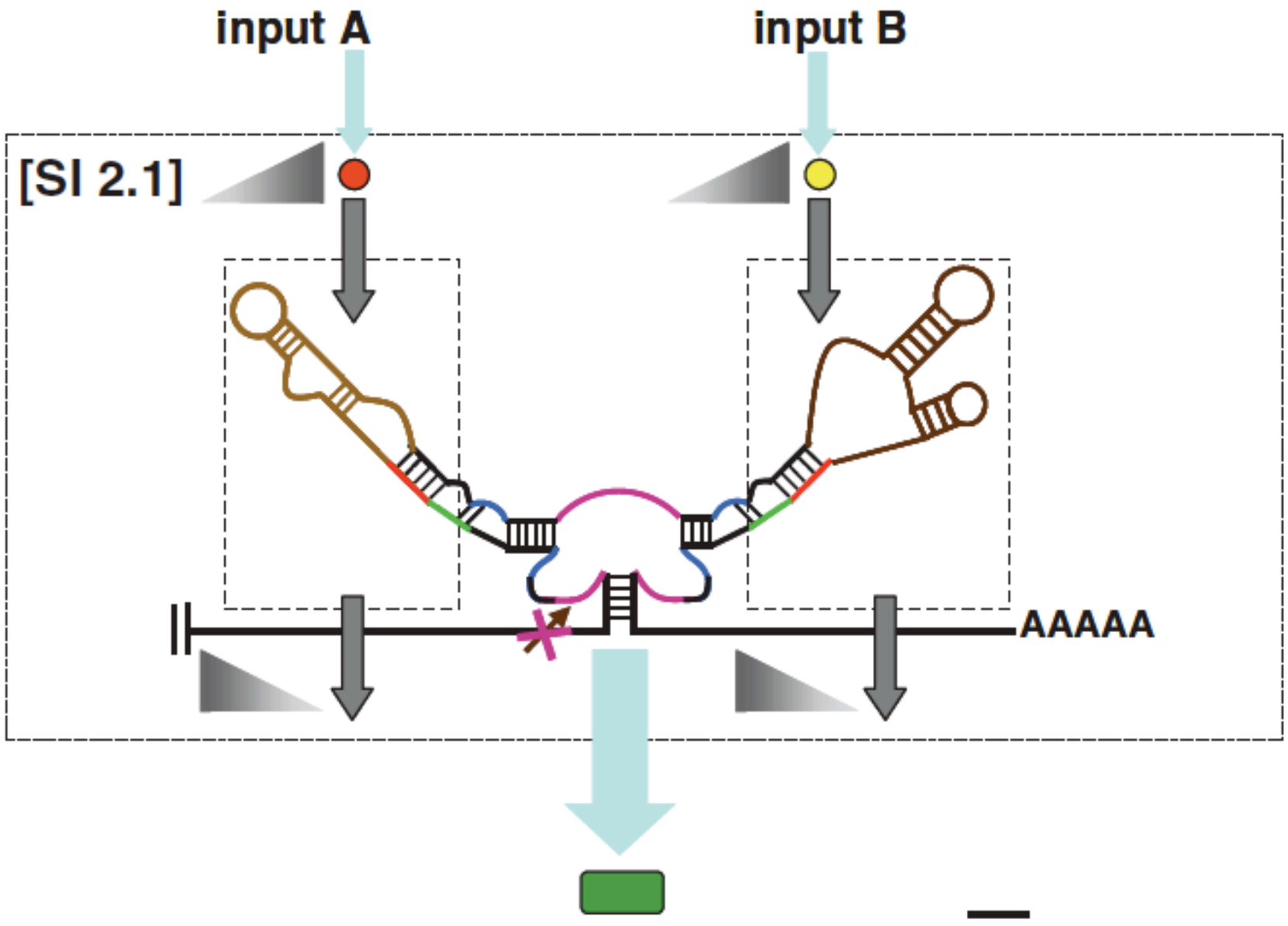
Approach 2: Multiple input domains controlling a single actuator

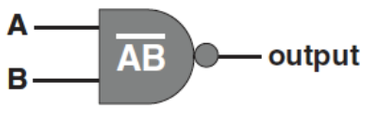


Approach 2: Multiple input domains controlling a single actuator



Again, higher-order function depends on individual gates!

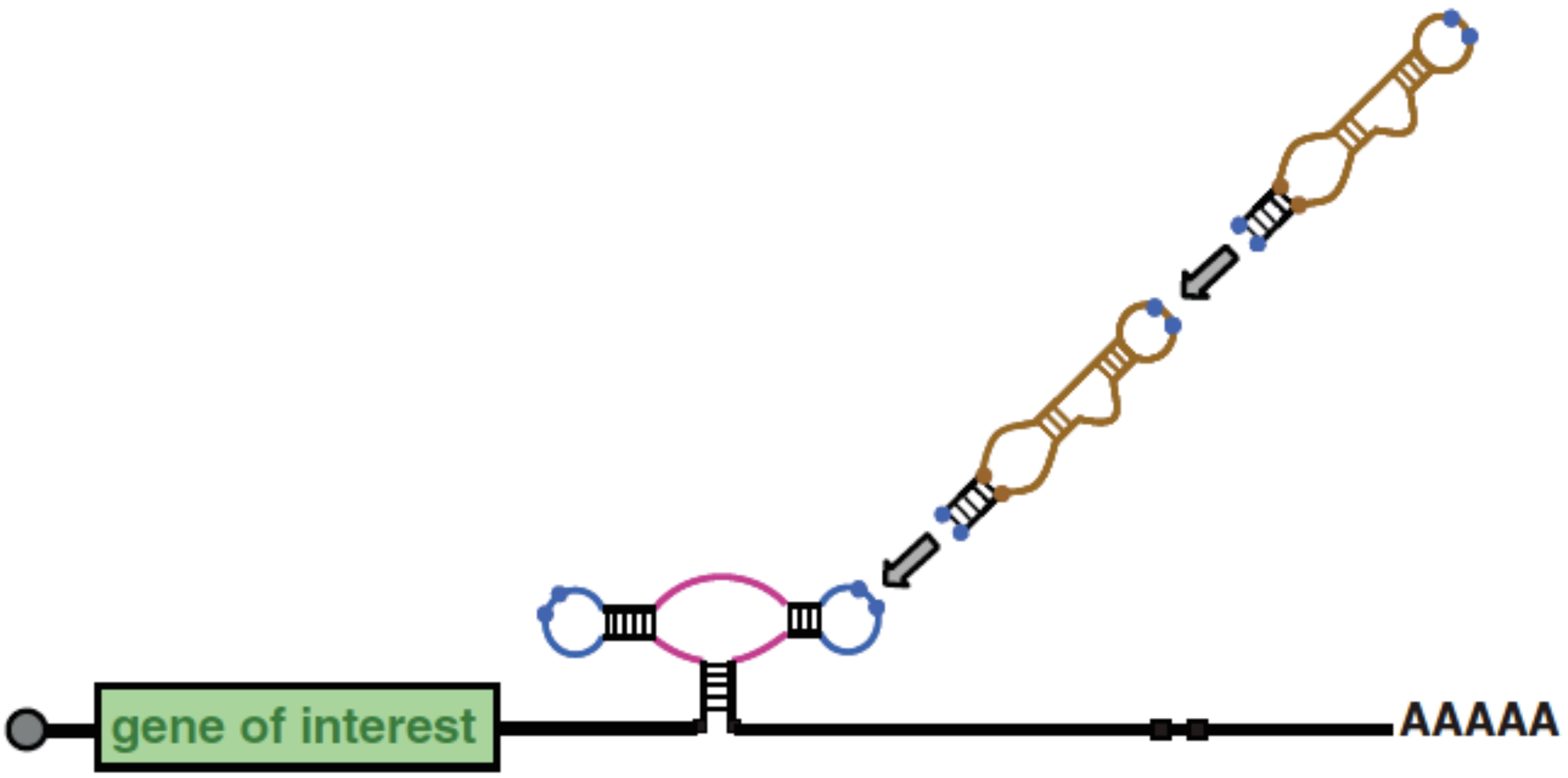




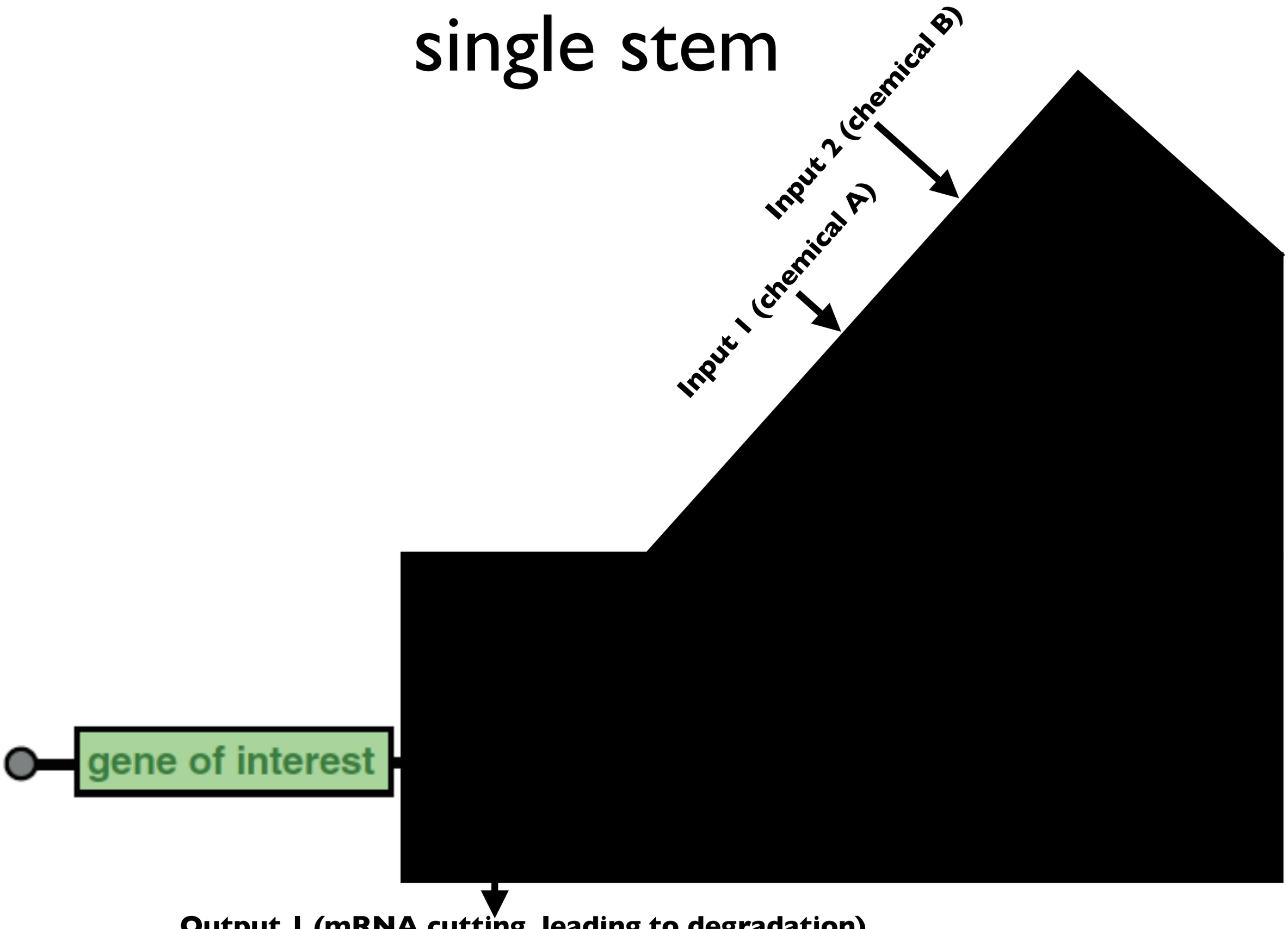
A theo	B tc	output GFP
0	0	1
0	1	1
1	0	1
1	1	0

As with the first approach, mixing and matching different types of single input gates will produce new types of higher order gates.

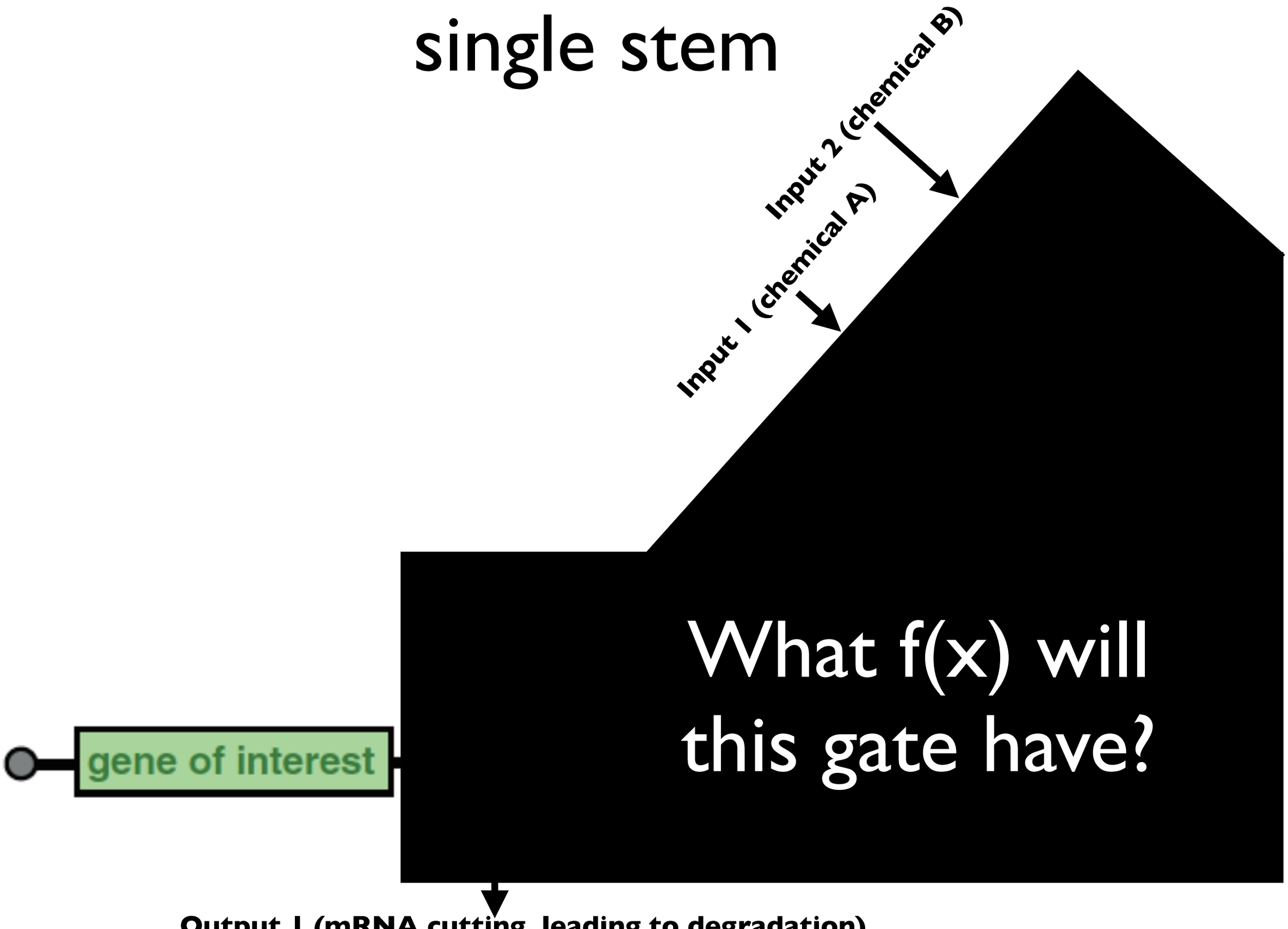
Approach 3: Multiple input gates w/in a single stem

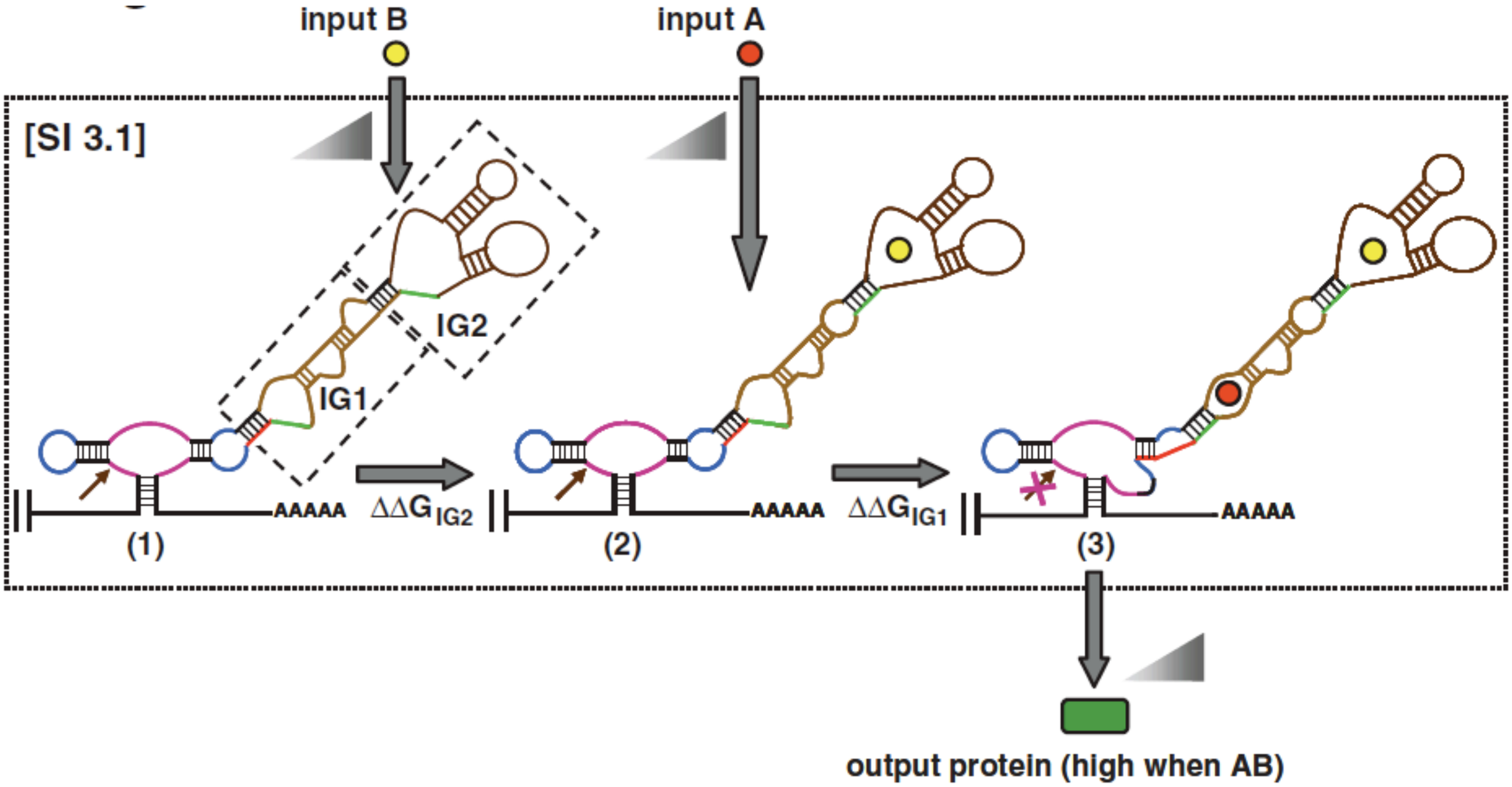


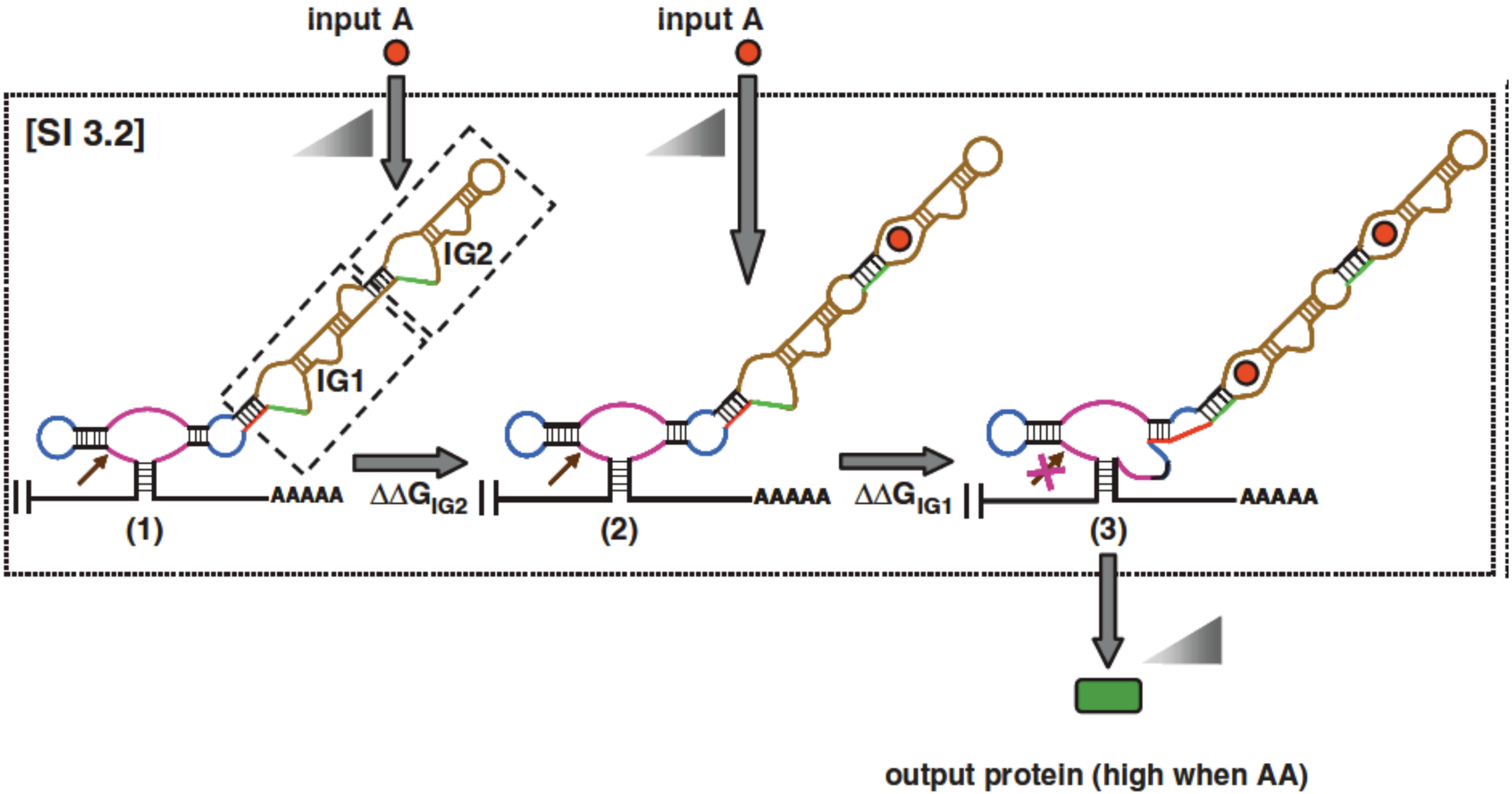
Approach 3: Multiple input gates w/in a single stem



Approach 3: Multiple input gates w/in a single stem




input B
input A
[SI 3.1]
IG2
IG1
AAAAA
$\Delta\Delta G_{IG2}$
AAAAA
$\Delta\Delta G_{IG1}$
AAAAA
(1)
(2)
(3)
output protein (high when AB)


input A
input A
[SI 3.2]
IG2
IG1
AAAAA
AAAAA
AAAAA
ΔΔG_IG2
ΔΔG_IG1
(1)
(2)
(3)
output protein (high when AA)

Questions.

Would it be important to layer gates?

Could you do this?

How could the functioning of one gate control the activity of a following next?