

Herbicides for Invasive Weed Control

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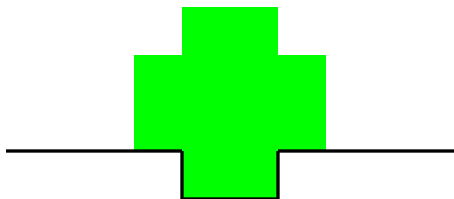
Saskatchewan Agriculture

General Comments about Herbicides

- Each has their own set of benefits and limitations
- Choices should be dictated by land use expectations
- Price does not always reflect the proper fit for a specific situation
- Resistance is evolving in invasive weeds as well
 - Group 4 resistance in spotted knapweed in BC

Herbicides 101

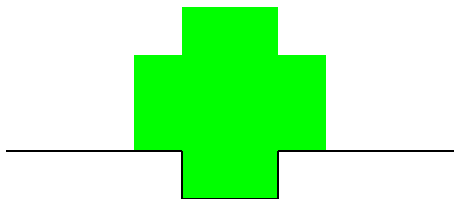
- Mode of Action/Herbicide Resistance Group – the critical pathway in the plant that the herbicide interferes with.
- A ‘Group’ of related herbicides may attack the same site and if the plant modifies that site, all herbicides within that same Herbicide Resistance Group are impacted
 - Herbicide Groups can be identified:
 - By numbers (WSSA/HRAC)



Target Enzyme system



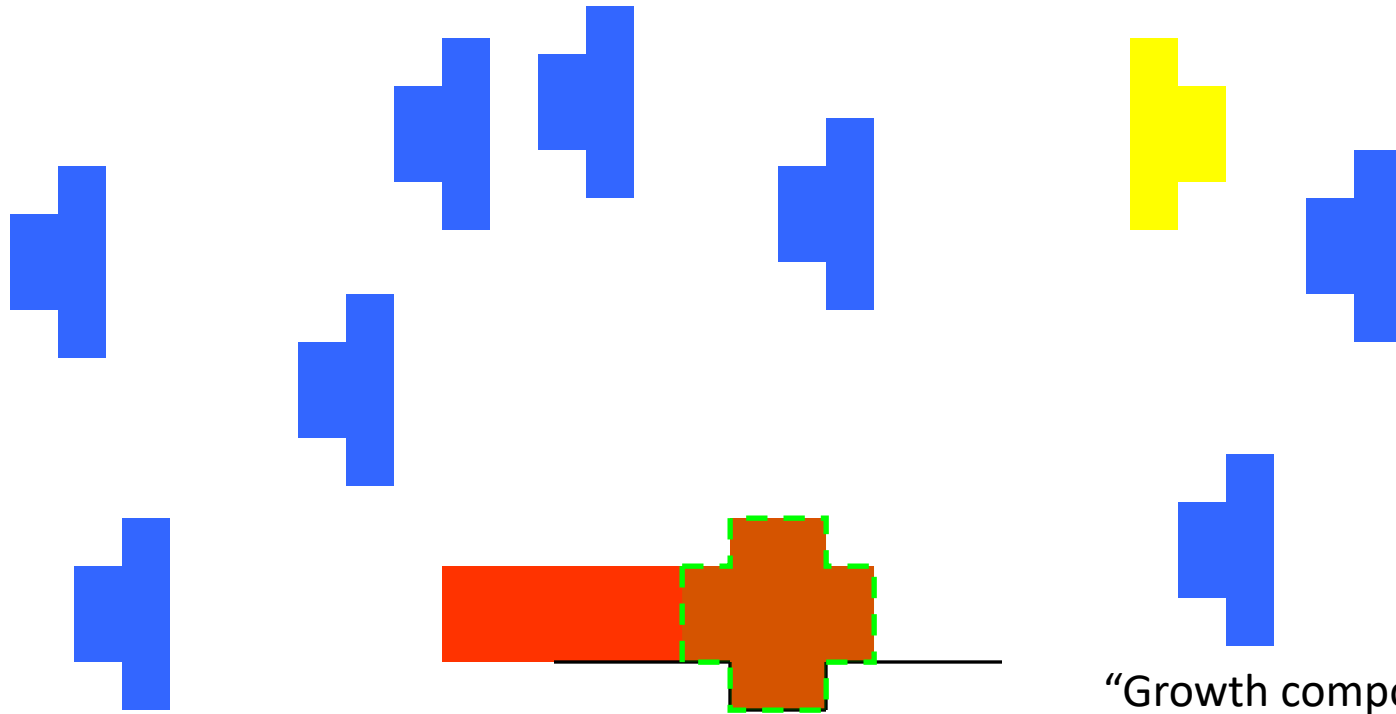
Target Enzyme system



Target Enzyme system



Target Enzyme system



“Membrane disrupting”

Target Site Disrupting

Groups:

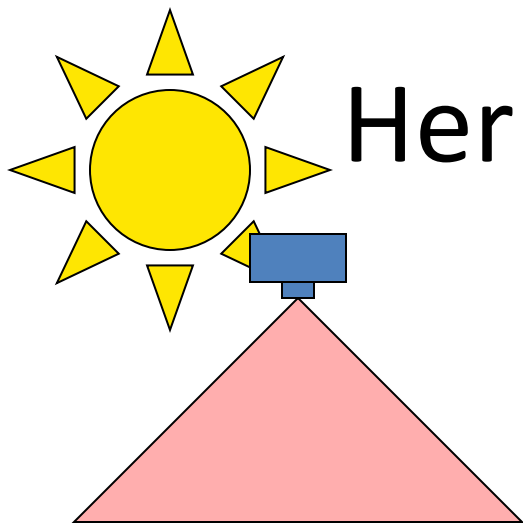
- Group 5
- Group 6
- Group 7
- Group 10*
- Group 14
- Group 22

Target Enzyme system

“Growth component”
inhibiting Target Site

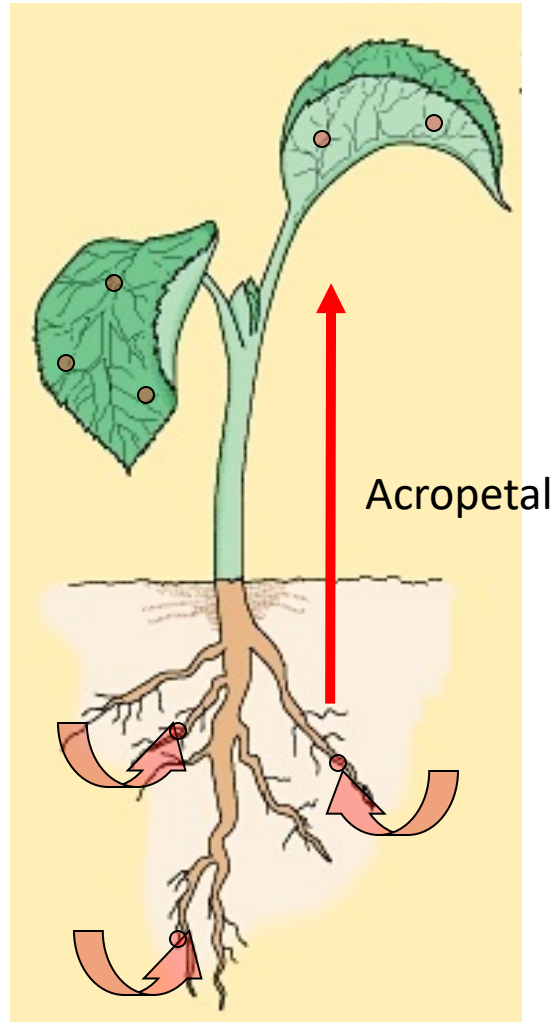
Disrupting Groups:

- Group 1
- Group 2
- Group 8
- Group 9
- Group 10*
- Group 13
- Group 15
- Group 27
- Group 29

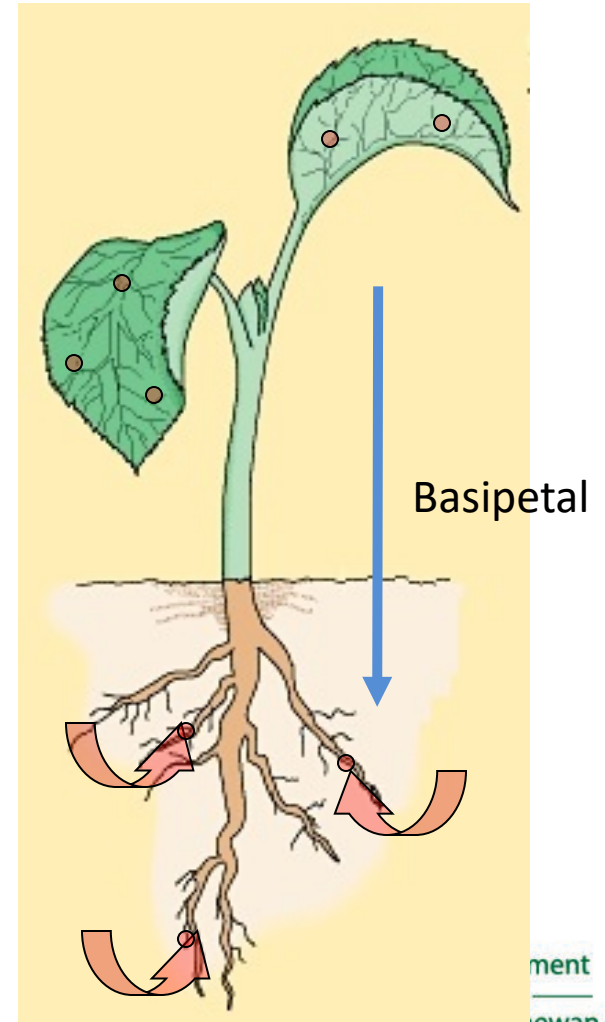


Herbicides movement in plants

Apoplastic



Symplastic



Apoplastic

movement driven
largely by
evapotranspiration
= *passive*

Symplastic movement
driven by plant to
facilitate movement of
building blocks for
growth (i.e. sugar)
= *active*

2,4-D

- Plant hormone (auxin) mimic – Group 4
- Induces growth of unspecialized cells near the base of the plant that block water and sugar flow
- Effective on a wide range of broadleaf weeds - mustards, parsnips, some legumes, some composites (sunflower)
- Grasses tolerant (not resistant) due to physiological differences in their water transport (xylem) tubes – resist pressure
- Relatively inexpensive – foundation product for many other combo products
- Short life in environment – DT50 = 6 days
 - Many habitats ('crops') – cereals, turf, corn, perennial pasture & range, IVM, etc.
- Caution: Amine form may be antagonized by hard or bicarbonate water.

Dichlorprop

- Plant hormone (auxin) mimic – Group 4
- Effective on a wide range of broadleaf weeds - mustards, parsnips, some legumes, some composites (sunflower) as well as woody species
- Low to moderately expensive depending on rate
 - Rates: 0.5 L/acre annual weeds, 1.1 L/acre for perennial weeds in IVM to 2.4 L/acre for woody species in IVM
- Short life in environment – DT50 = 10 days
- Products (combined with 2,4-D):
 - *Estaprop XT, Dichlorprop DX*

Glyphosate

- Inhibits EPSP production responsible for essential amino acids tryptophan, tyrosine and phenylalanine – Group 9
- Broad spectrum grass and broadleaf weed control
- Blocks growth of new tissues
- Relatively inexpensive – many generics
- Bound tightly to soil
- Particularly effective on perennial species at higher rates
- Caution: May be antagonized by hard water (Ca, Mg, Fe and others) – add ammonium sulfate or citric acid to correct antagonism

Dicamba

- Plant hormone (Auxin) mimic – Group 4
- Used for selective BL weed control in permanent grassed areas (pasture, range, roadsides, IVM)
- Strong on legumes (clovers/locoweeds/alfalfa), composites (sunflower/thistle/daisy), polygonums (docks, knotweeds), pigweeds, kochia, field bindweed
- Slightly Persistent – DT50 (half-life) <14 days.
- Potentially mobile in soil (leaching) – lightly bound
- DMA salts are very volatile – prone to vapour drift/inversion. Newer salts (DGA, BAPMA) are less volatile (but still somewhat prone to vapours).
- Moderate to high cost based on rate.
- Products:
 - IVM only – *Banvel VM*
 - R&P & IVM – Many generics, *Engenia*, *Xtendimax*

Metsulfuron

- Inhibits Acetolactate Synthase (Group 2) that drives production of amino acids isoleucine, leucine, and valine important for the production of new plant tissues.
- Used for selective BL weed control in permanent grassed areas (pasture, range, roadsides, IVM)
- Strong on mustards, composites (tansy/thistle/daisy), polygonums (docks, knotweeds), mints, carrots/parsnips, pigweeds, **kochia**, cockles/catchfly, plus woody species like snowberry, rose, poplar/aspen, willow, cherry
- Moderately Persistent – DT50 (half-life) ~ 30 days. More persistent in high pH soils where acid hydrolysis breakdown pathway is slow.
- Potentially mobile in soil (leaching) – lightly bound
- Moderate to high cost based on rate.
- Products:
 - R&P & IVM – *Escort*

Tribenuron

- Inhibits Acetolactate Synthase (Group 2) that drives production of amino acids isoleucine, leucine, and valine important for the production of new plant tissues.
- Used for selective BL weed control in annual crops and permanent grassed areas (pasture, range)
- Strong on mustards, composites (dandelion/tansy/thistle/chamomile), polygonums (buckwheat, knotweeds), mints, pigweeds, ~~kochia~~, cockles/catchfly, buttercups
- Slightly-Persistent – DT50 (half-life) ~ 10 days. Slightly more persistent in high pH soils where acid hydrolysis breakdown pathway is slow. Also breaks down via microbial degradation.
- Low Potentially mobile in soil (leaching) – lightly bound
- Low to moderate cost based on rate.
- Products:
 - R&P – *Express SG*

Aminopyralid

- Plant hormone (Auxin) mimic – Group 4
- Used for selective BL weed control in permanent grassed areas (pasture, range, roadsides, IVM)
- Strong on legumes (clovers/locoweeds/alfalfa), composites (sunflower/thistle/daisy), polygonums (docks, knotweeds)
- Moderately Persistent – DT50 (half-life) = Avg 32 days.
- Potentially mobile in soil (leaching) – lightly bound
- Moderate to high cost based on rate.
- Products:
 - IVM - *Milestone, Clearview* (w metsulfuron)
 - R&P - *Restore II* (w 2,4-D), *Reclaim II* (w metsulfuron+2,4-D)

Clopyralid

- Plant hormone (Auxin) mimic – Group 4
- Used for selective BL weed control in permanent grassed areas (pasture, range, roadsides, IVM, annual crops)
 - Many tolerant crops/trees
- Strong on legumes (clovers/locoweeds/alfalfa), composites (sunflower/thistle/daisy – specifically knapweeds), polygonums (docks, knotweeds)
- Moderately Persistent – DT50 (half-life) = Avg 40 days.
- Potentially mobile in soil (leaching) – lightly bound
- Moderate to high cost based on rate.
- Products:
 - *Lontrel* (many generics)

Aminocyclopyrachlor

- Plant hormone (Auxin) mimic – Group 4
- Used for selective BL weed & brush control in permanent grassed areas (pasture, range, roadsides, IVM)
- Strong on legumes (clovers/locoweeds/alfalfa), composites (sunflower/thistle/daisy), polygonums (docks, knotweeds), leafy spurge, buttercup
- Moderately Persistent – DT50 (half-life) = 21 to 31 days
- Potentially highly mobile in soil (leaching) – lightly bound
- Products:
 - IVM & R&P – *Navius FLEX*
 - *R&P only* – *TruRange*
- Moderate to high cost based on rate. Reduced cost on *TruRange* vs. *Navius FLEX*

Picloram

- Plant hormone (Auxin) mimic – Group 4
- Used for selective BL weed & brush control in permanent grassed areas (pasture, range, roadsides, IVM)
- Strong on legumes (clovers/locoweeds/alfalfa), composites (sunflower/thistle/daisy), polygonums (docks, knotweeds), leafy spurge, buttercup
- Very Persistent – DT50 (half-life) = Avg. 90 days
- Potentially highly mobile in soil (leaching) – lightly bound
- Products:
 - IVM & R&P – *Tordon 22K*, *Grazon XC* (w 2,4-D)
 - IVM only – *Aspect* (w 2,4-D)
- Moderate to high cost based on rate of picloram.

Diflufenzopyr

- Plant hormone (Auxin) transport inhibitor – Group 19
- Used for selective BL weed & brush control in permanent grassed areas (pasture, range, roadsides, IVM) and fallow
- Diflufenzopyr does have some herbicide activity of its own but primary use is as a synergist of dicamba and other Group 4 herbicides – essentially doubles activity
- Prevents movement of auxins (natural or herbicide) from growing points and results in accumulation in growing points.
- Not Persistent – DT50 (half-life) = Avg. 4 days
- Potentially slightly mobile in soil (non-leaching) – lightly bound
- Products:
 - IVM & R&P – *OverDrive* (w dicamba)
 - Ag fallow, corn and burnoff – *Distinct* (w dicamba)
- Low to Moderate cost.

Herbicide Persistence

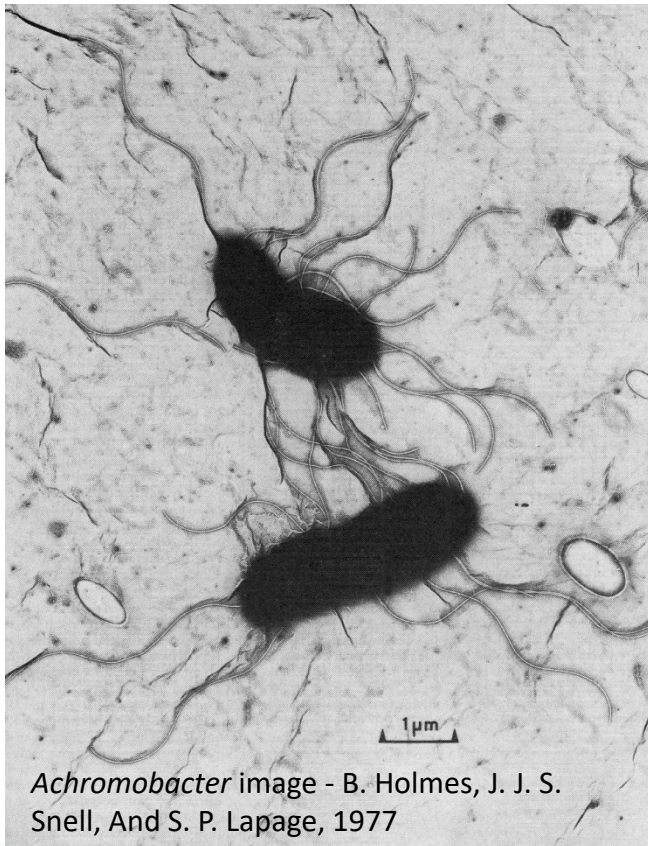
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Microbial activity

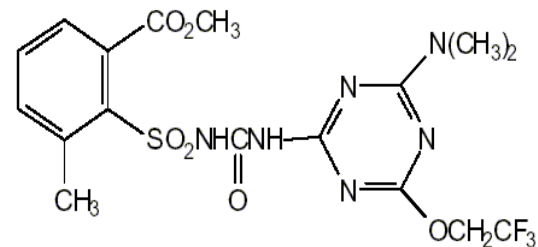
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- Requires soil moisture

Chemical Hydrolysis

- plays important part in decay of Groups 2 & 5
- Requires soil water for chemical activity to take place



Achromobacter image - B. Holmes, J. J. S. Snell, And S. P. Lapage, 1977



H₂O

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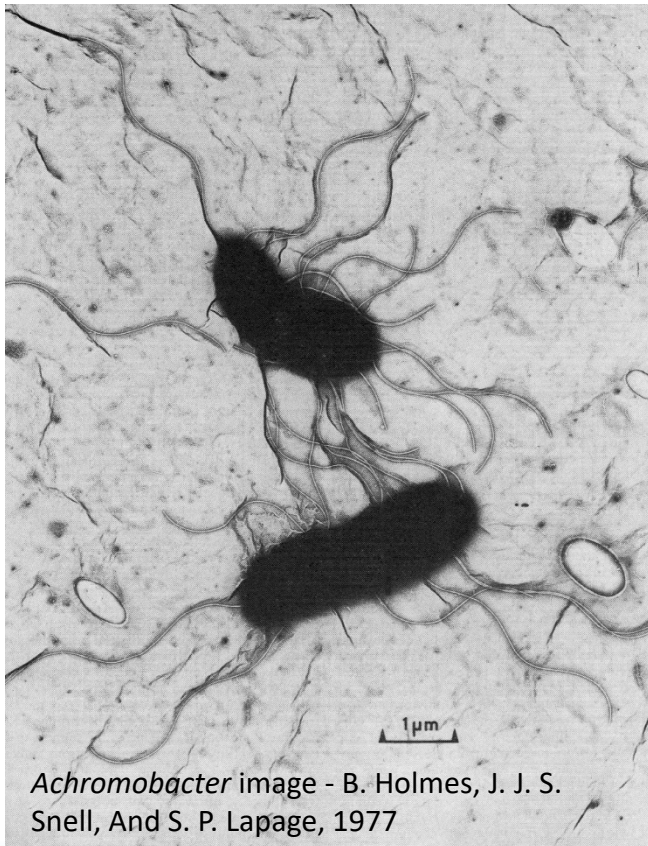
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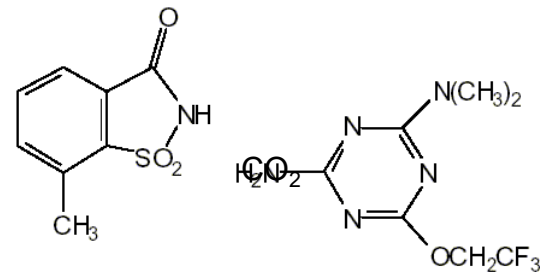
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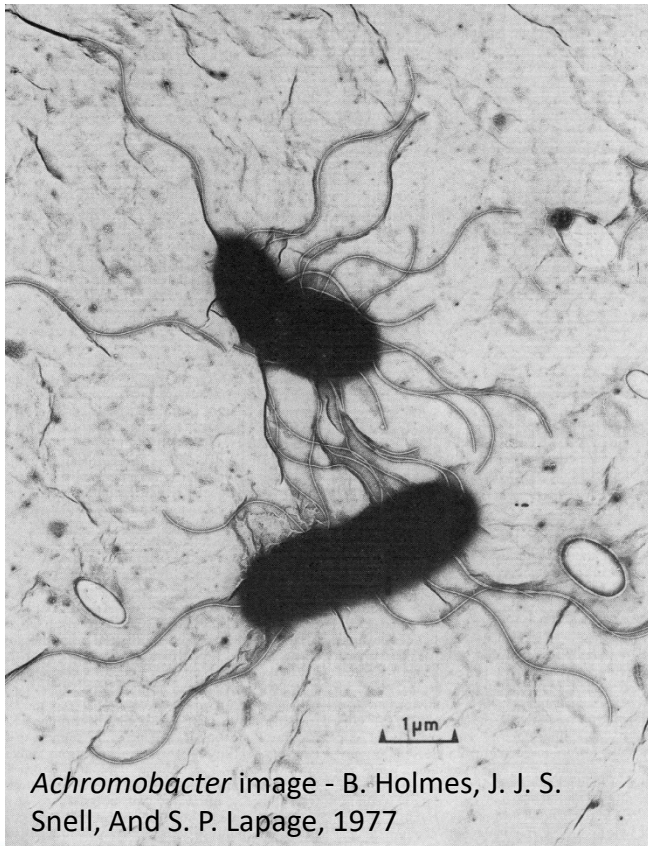
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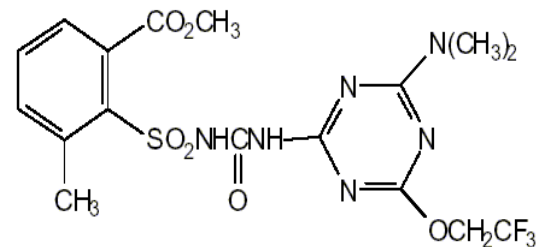
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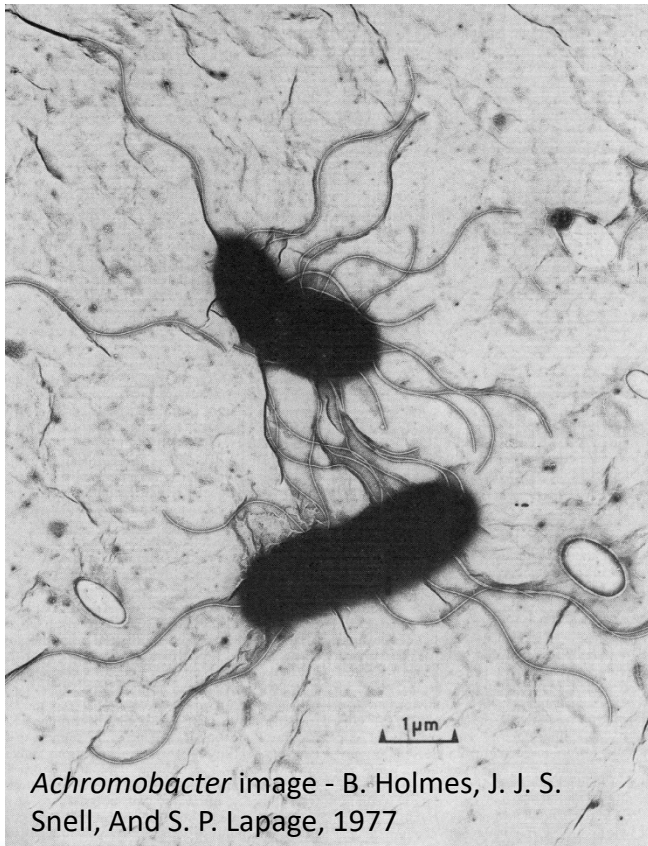
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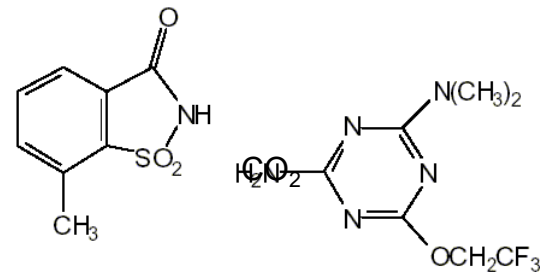
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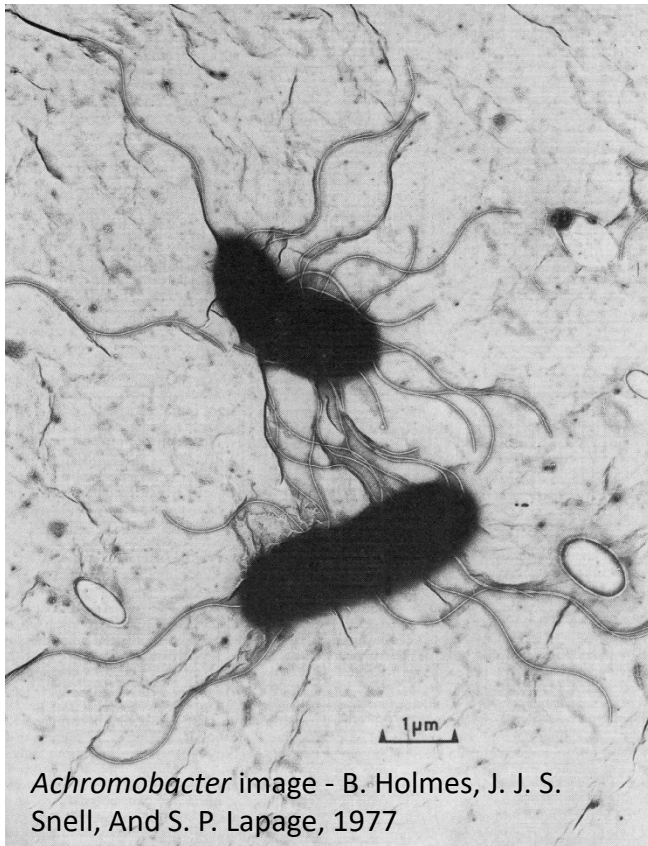
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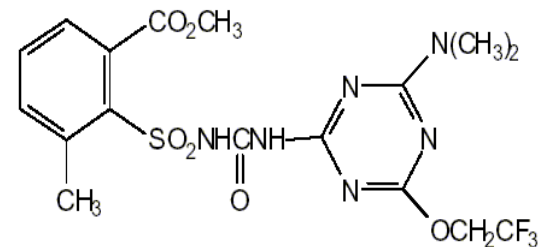
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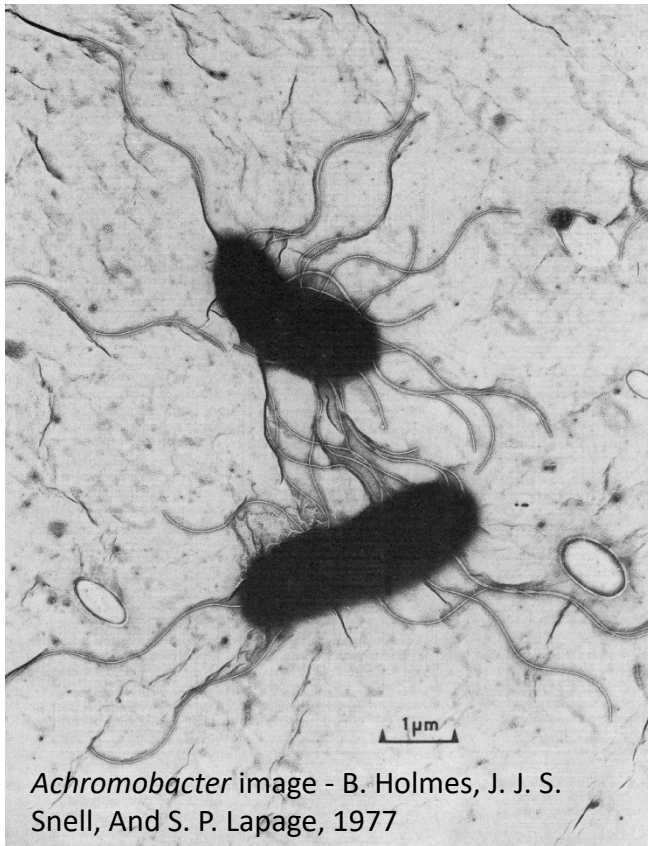
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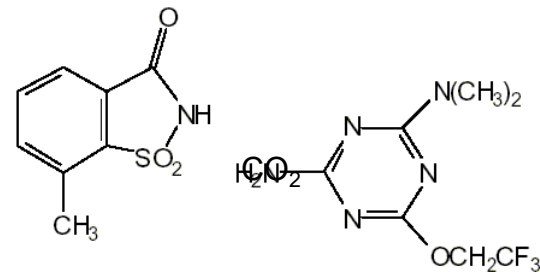
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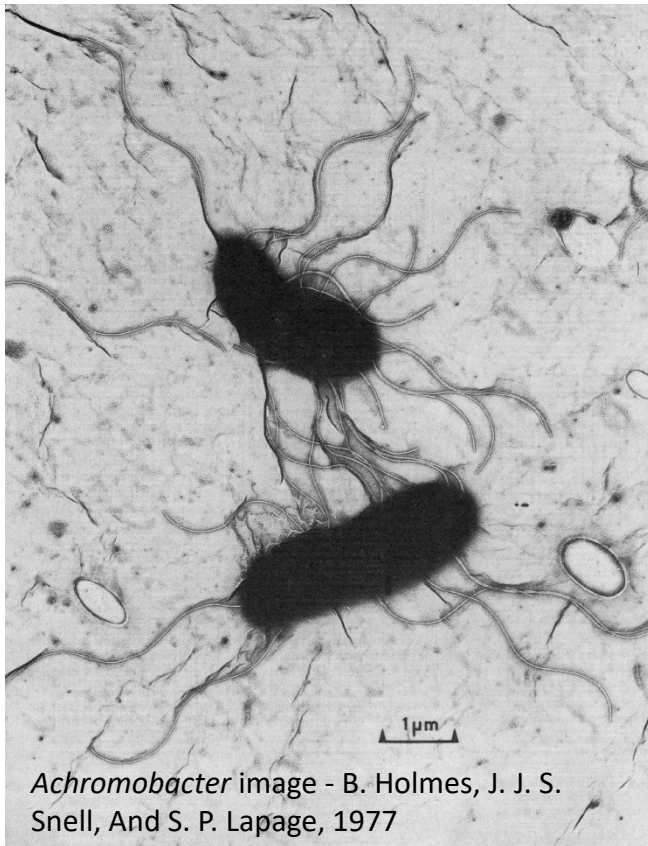
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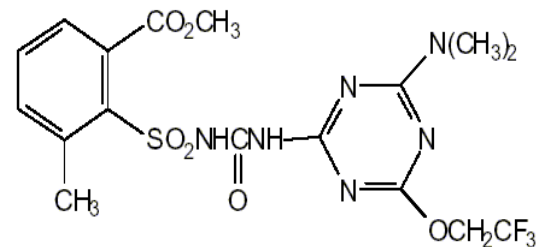
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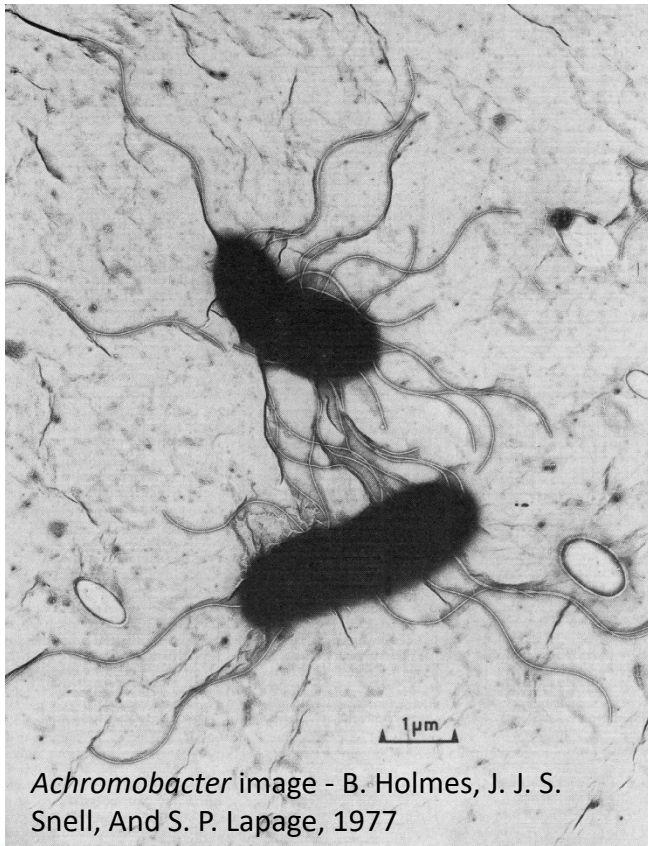
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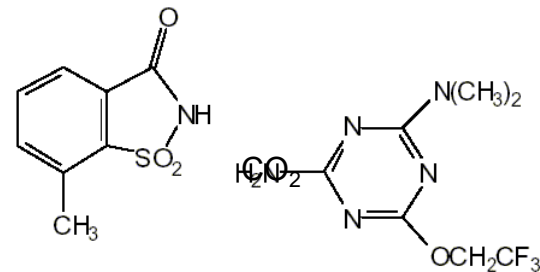
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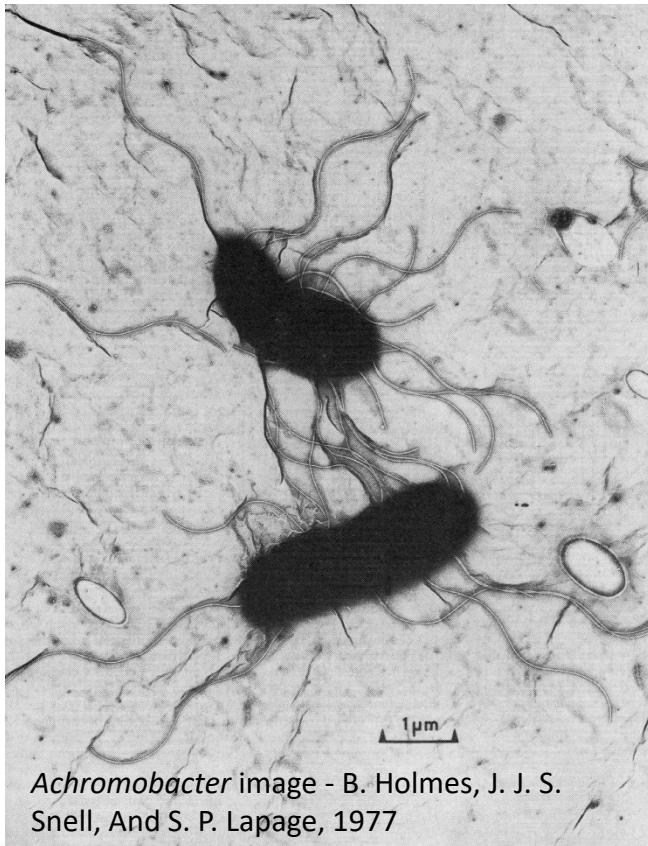
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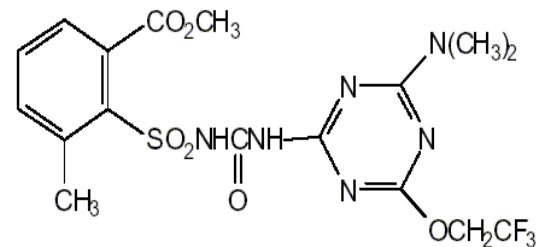
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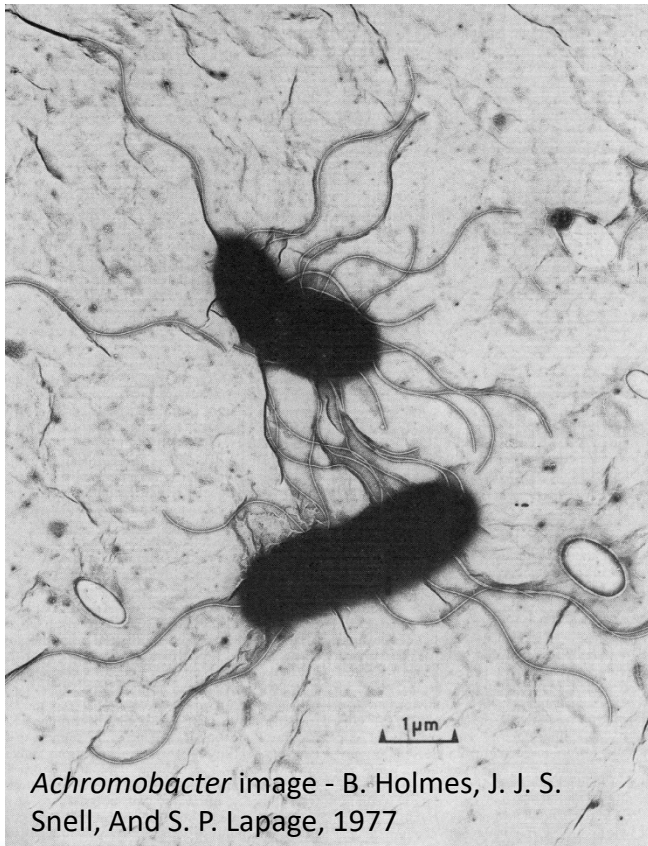
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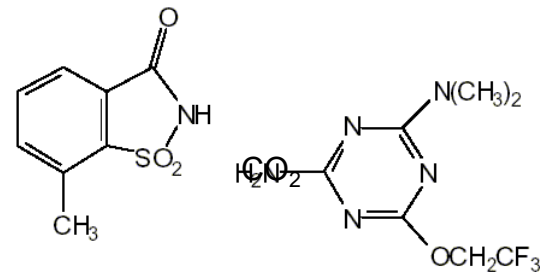
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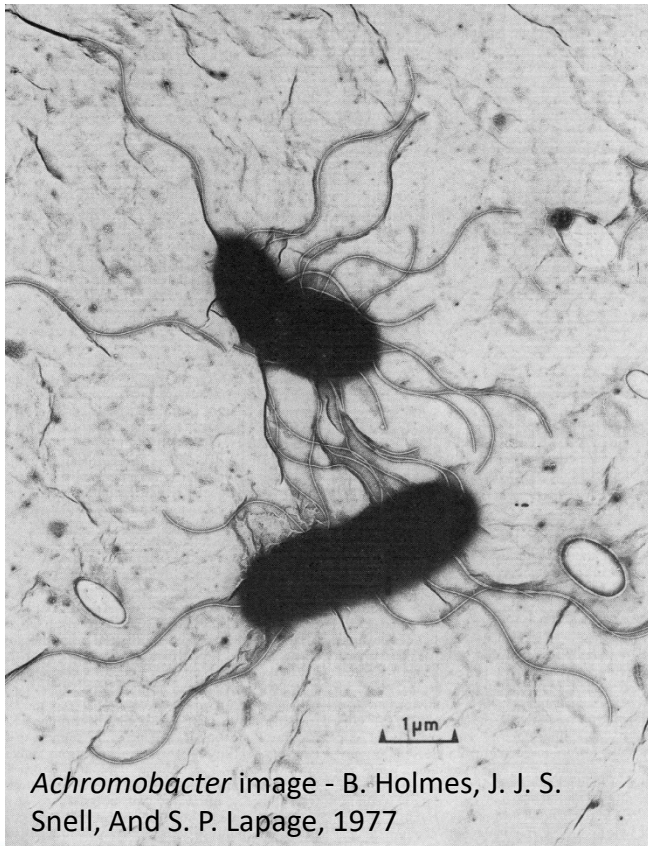
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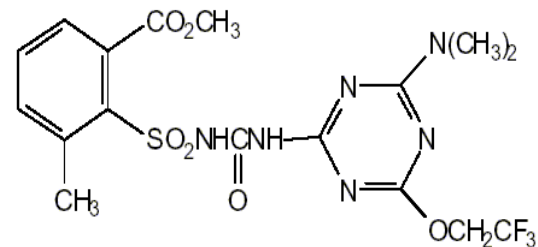
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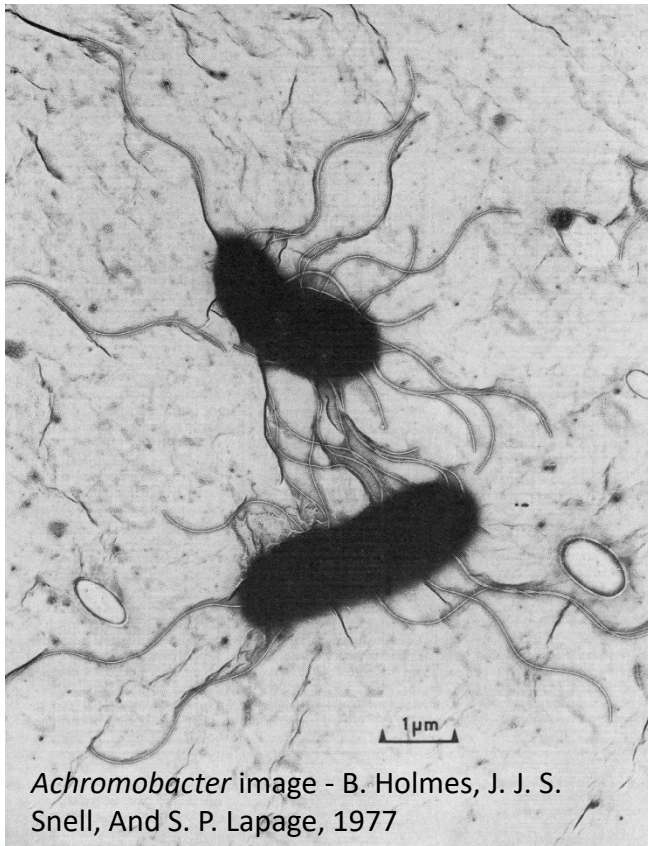
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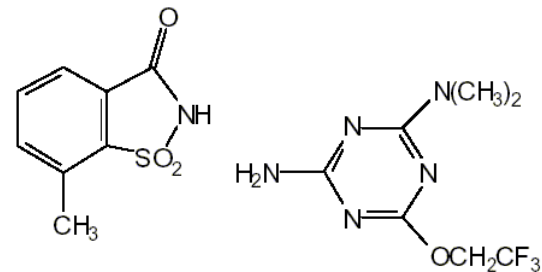
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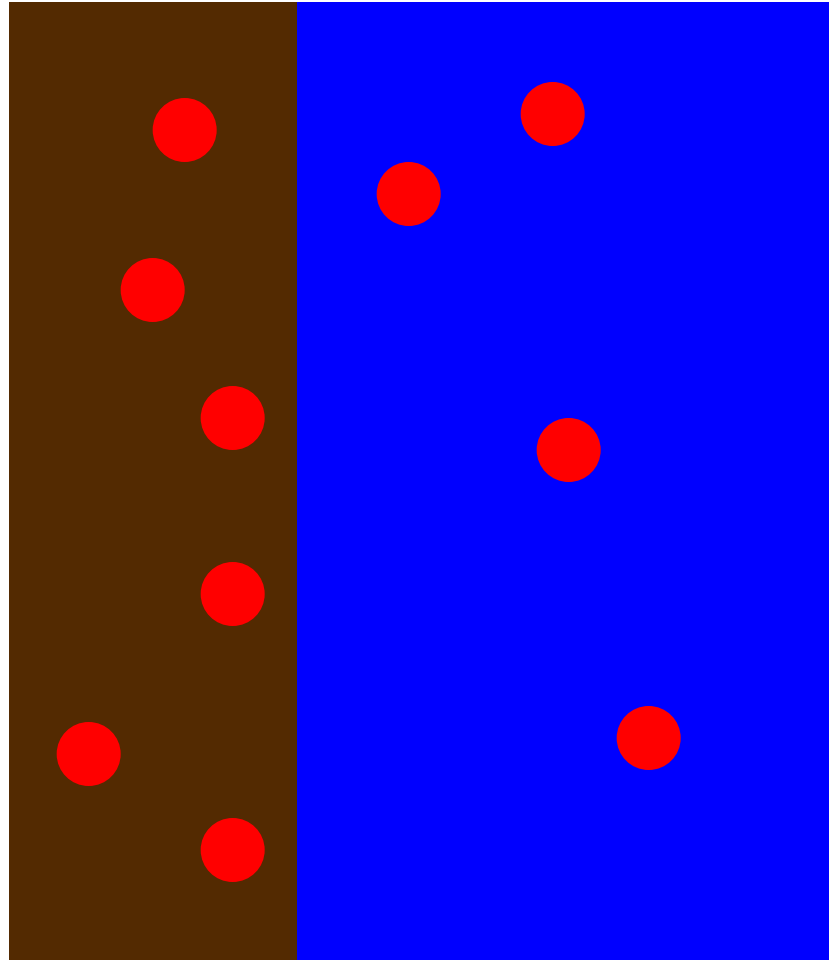
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CO₂

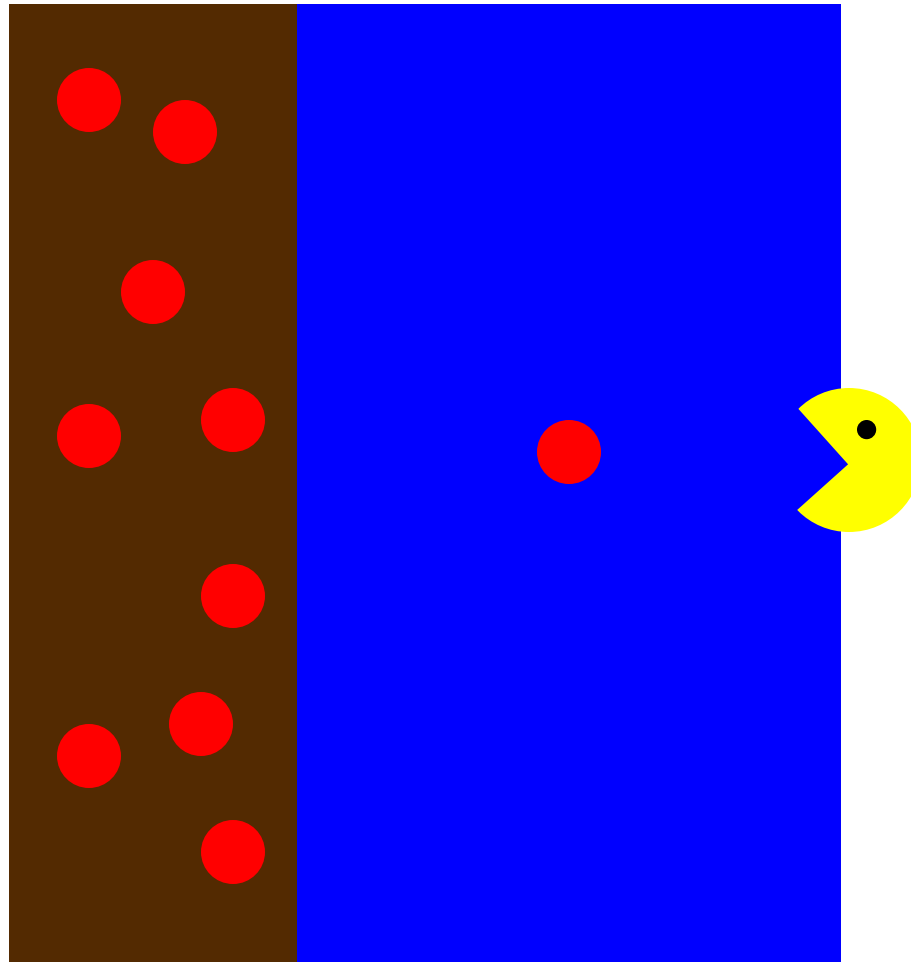
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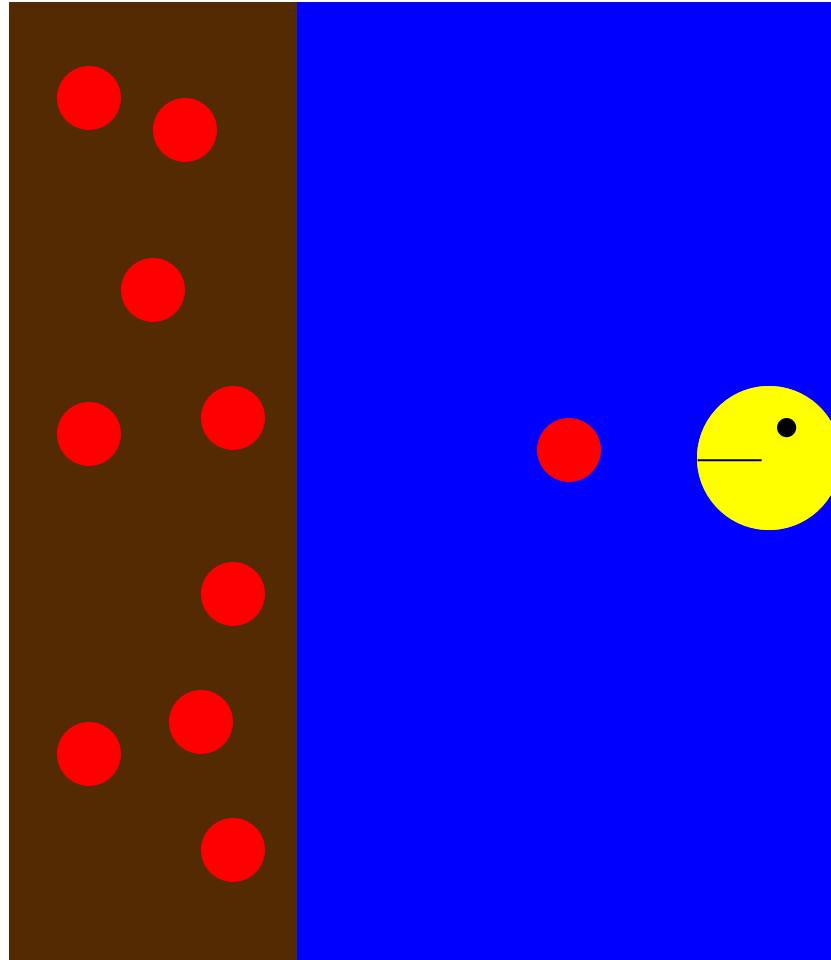
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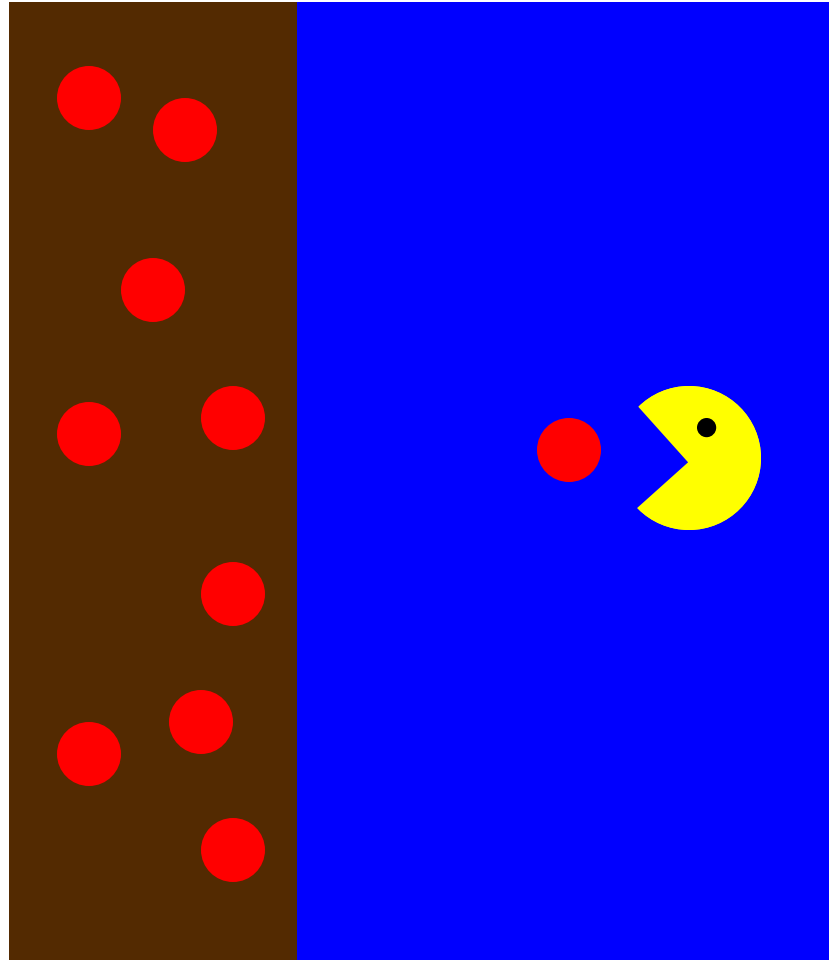
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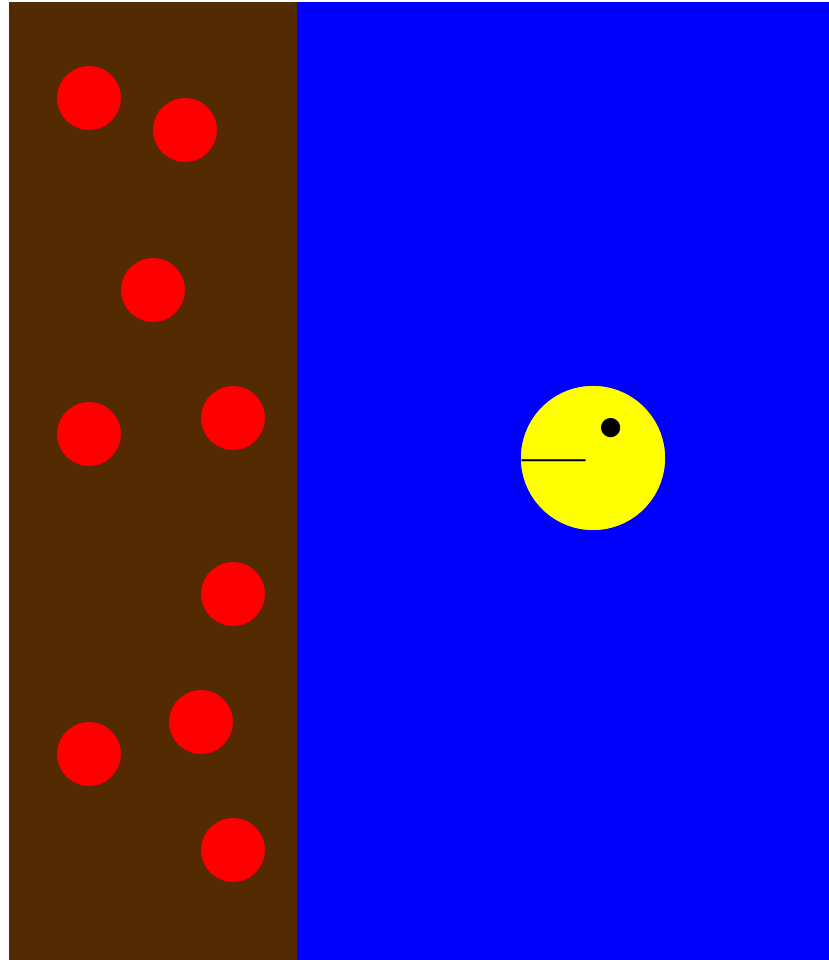
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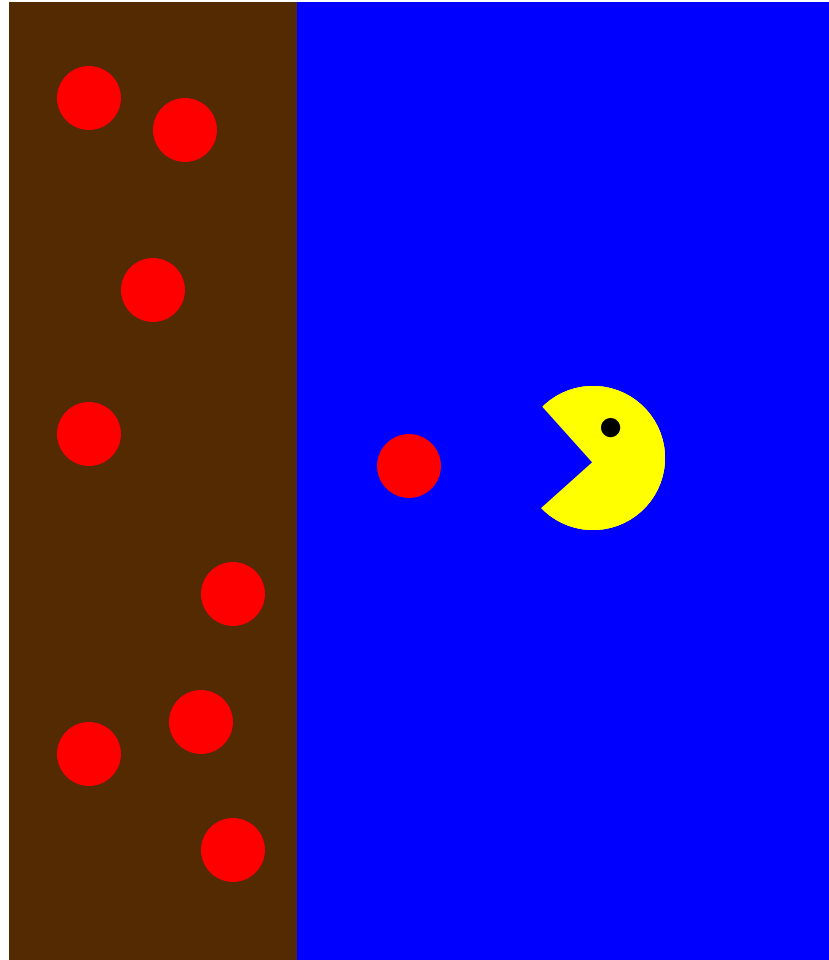
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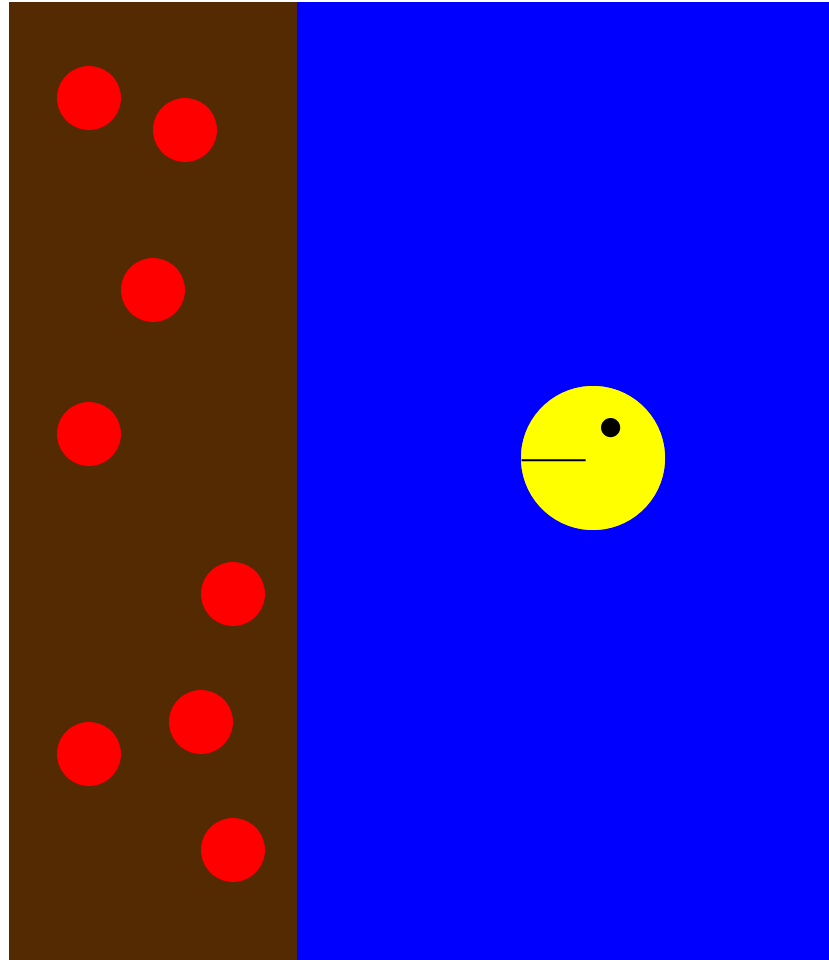
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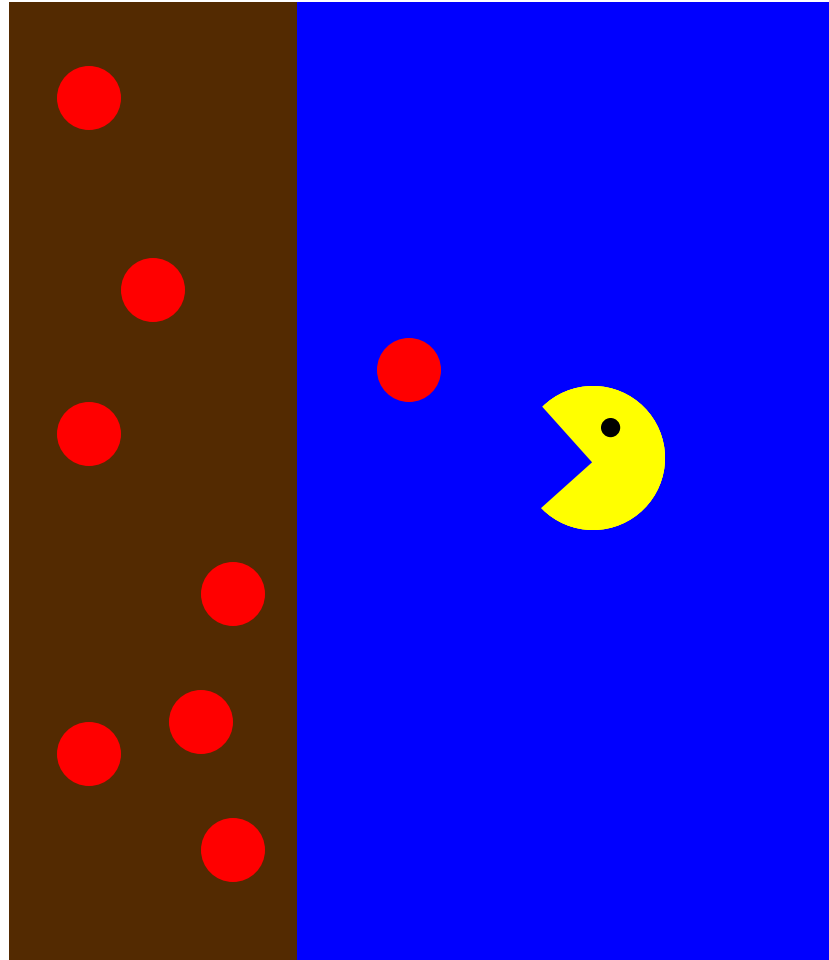
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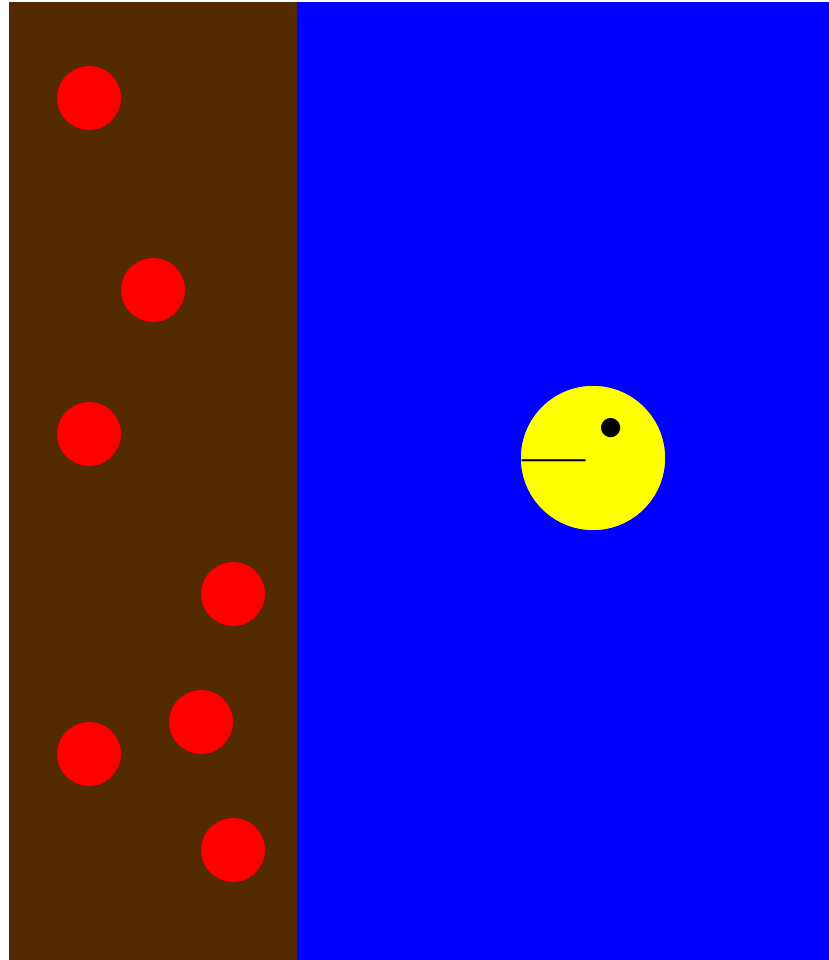
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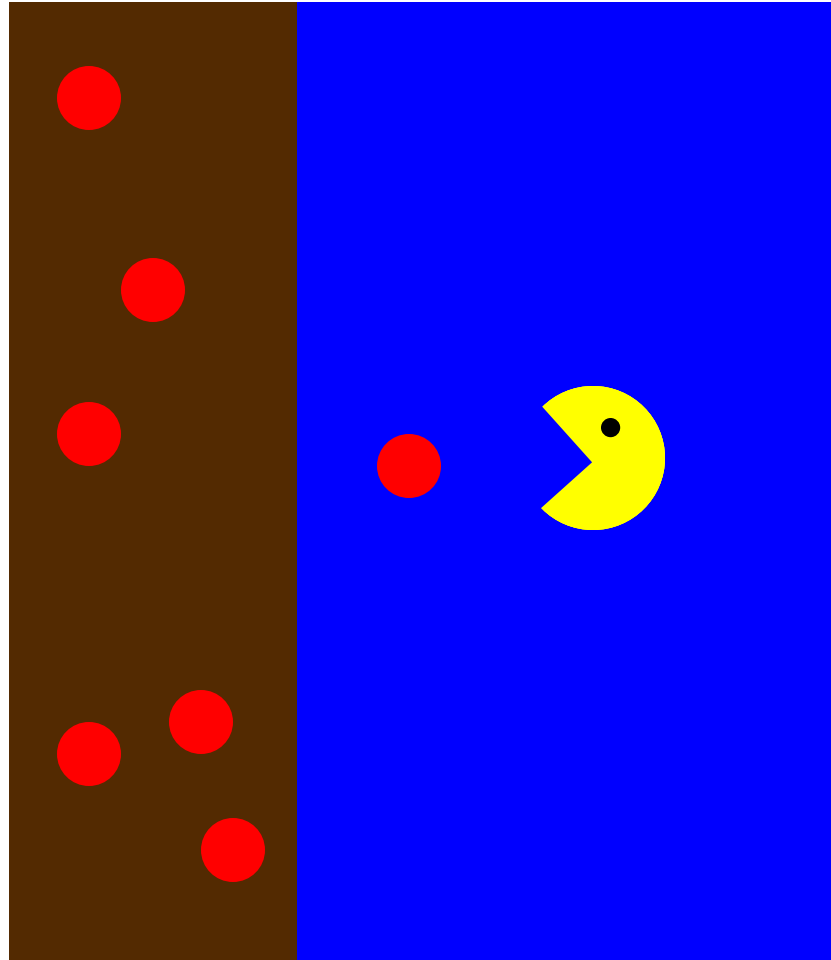
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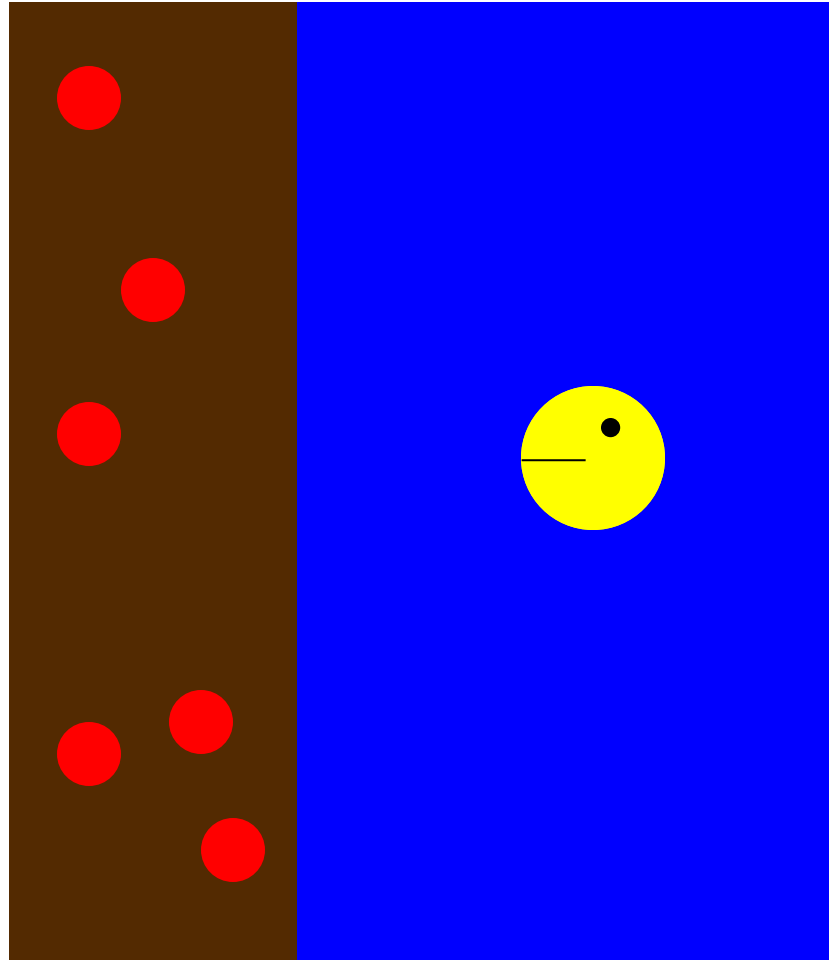
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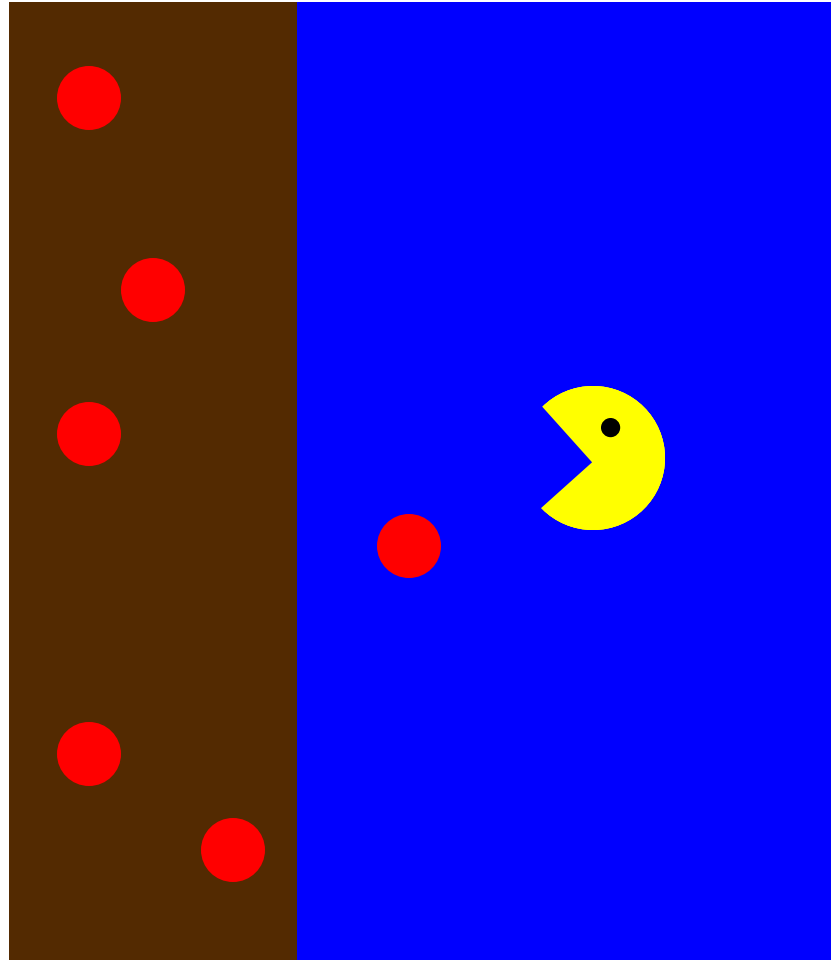
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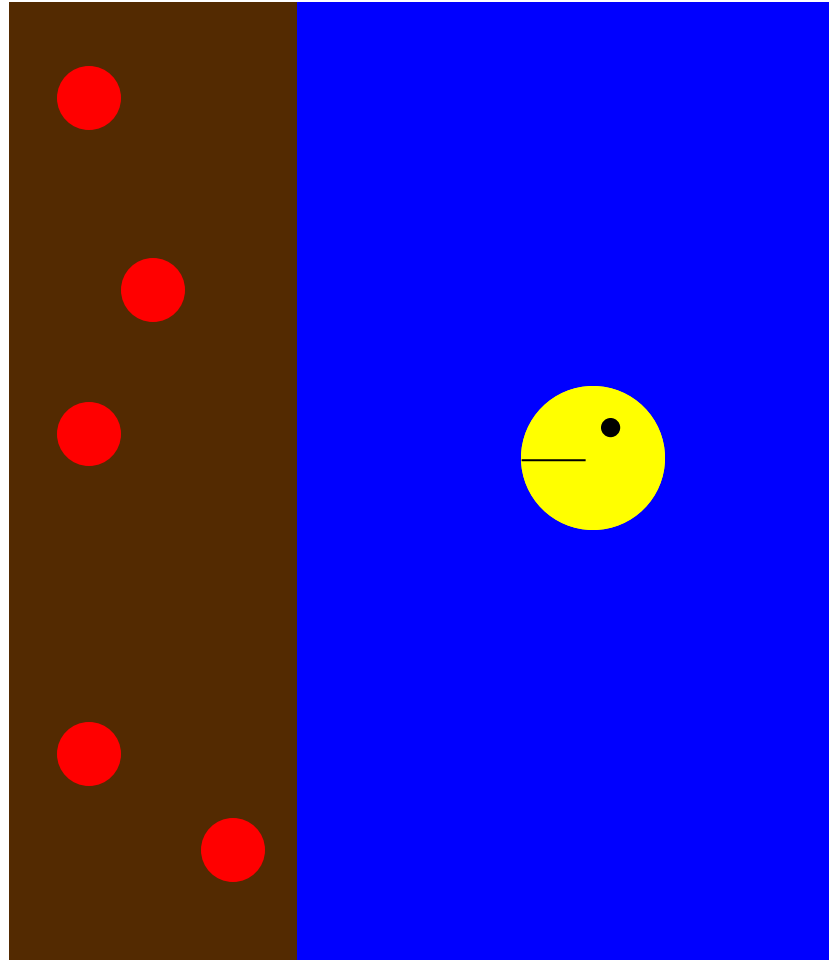
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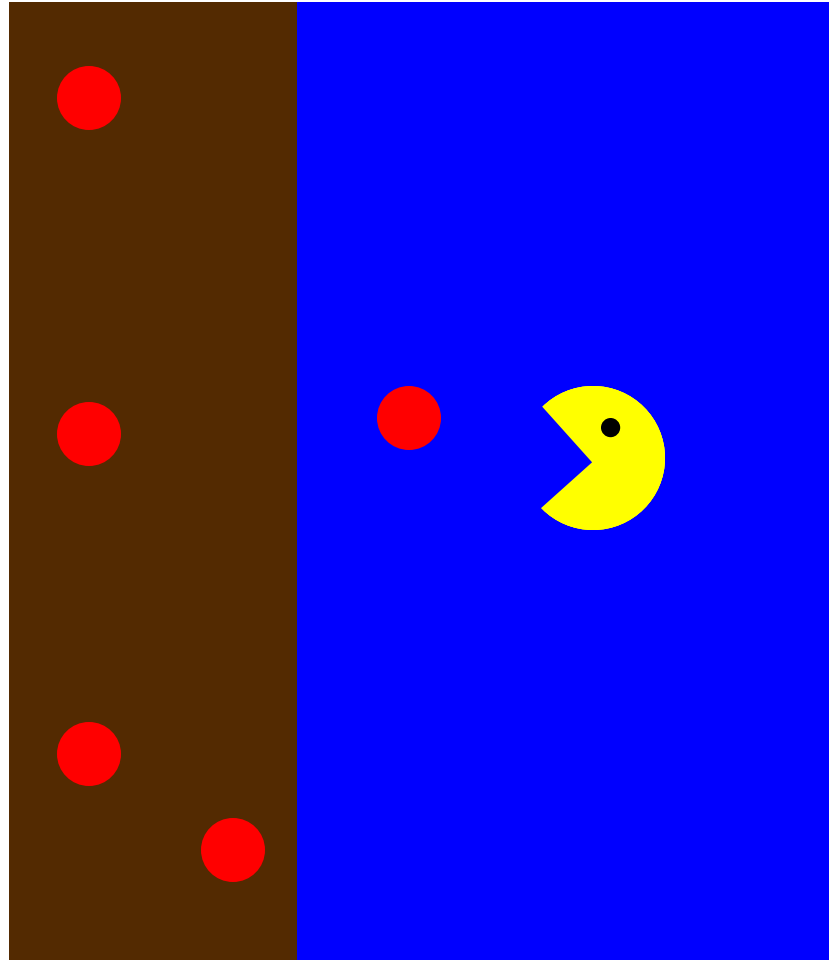
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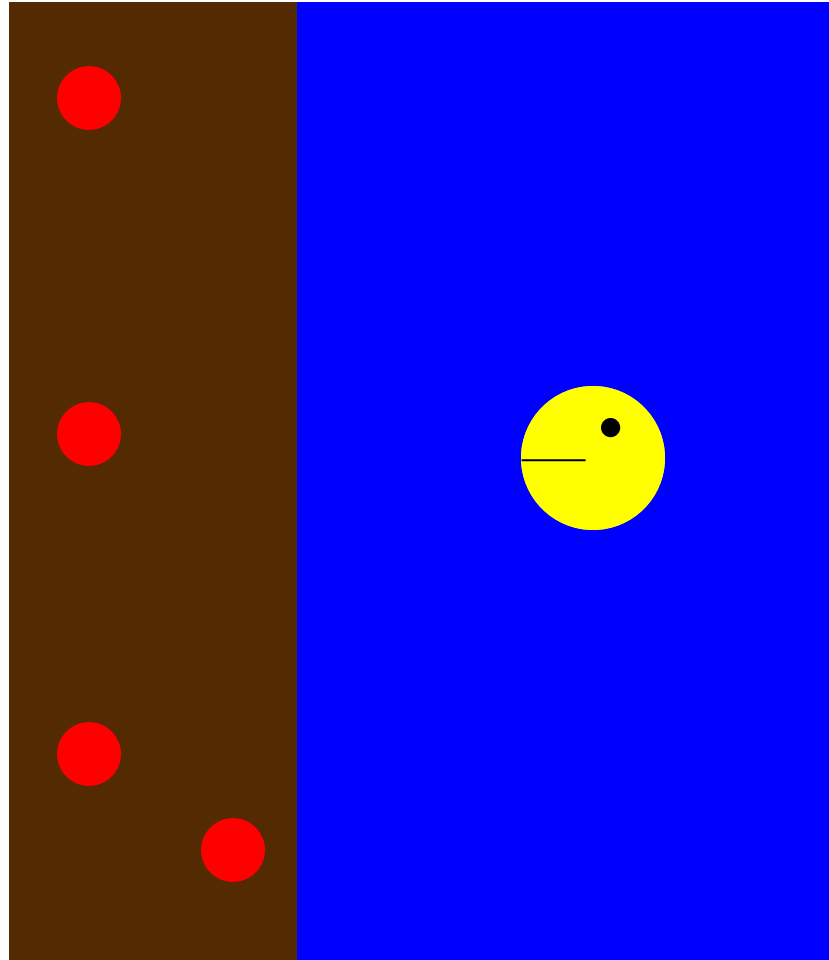
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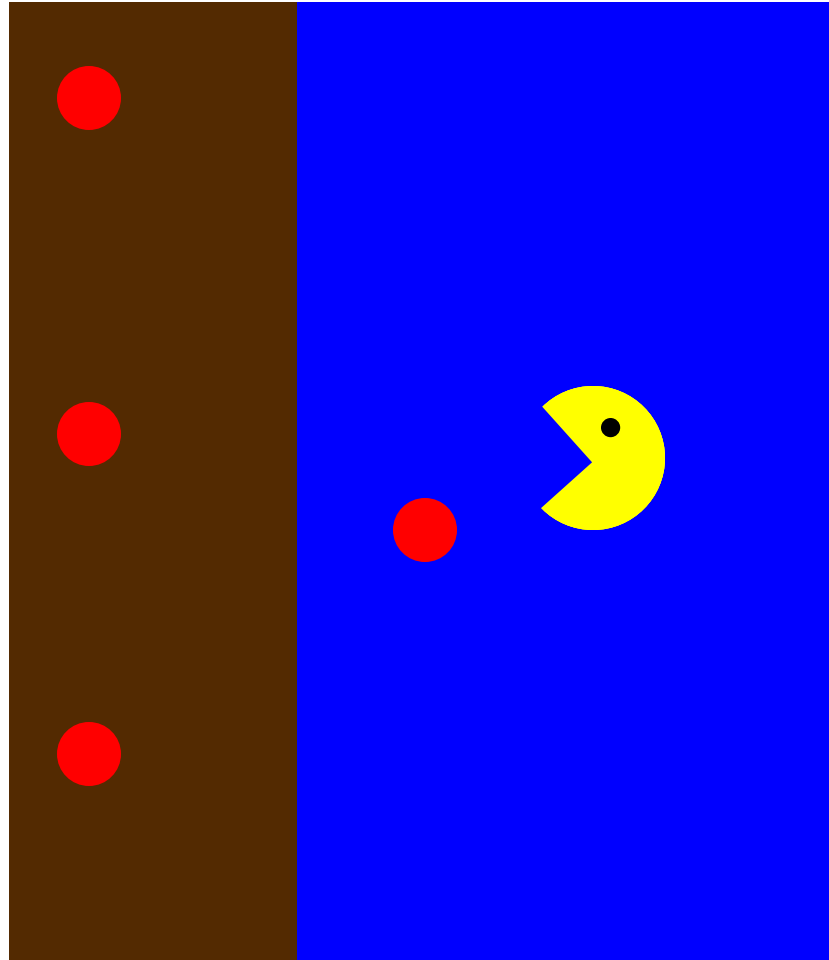
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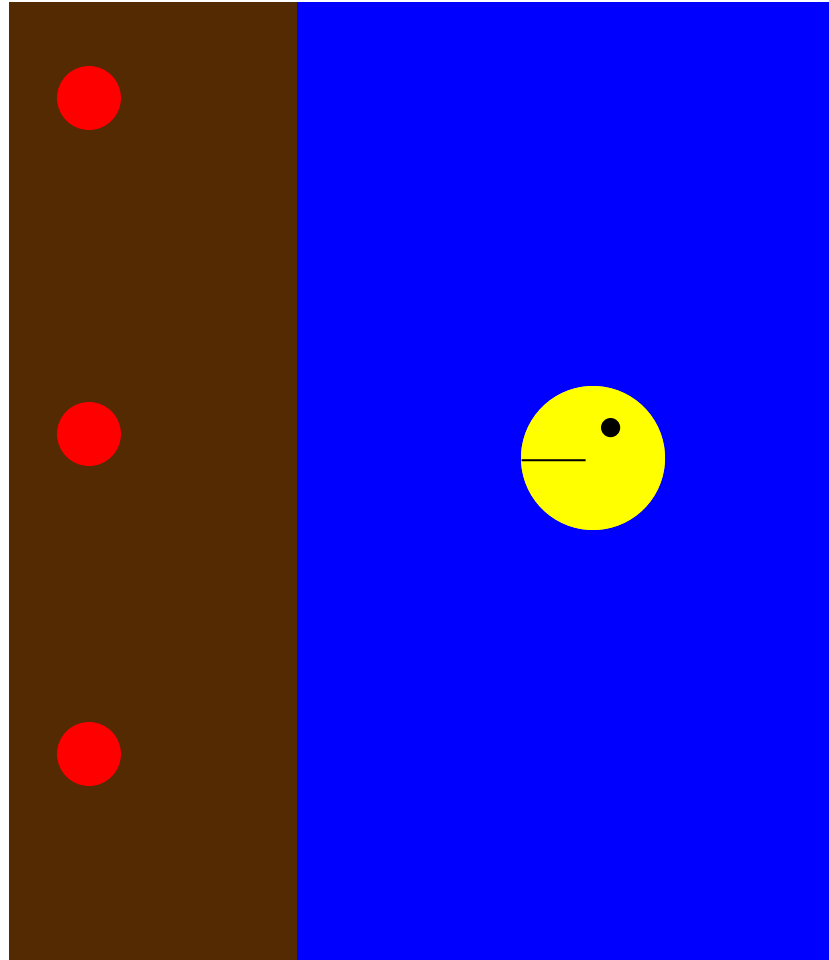
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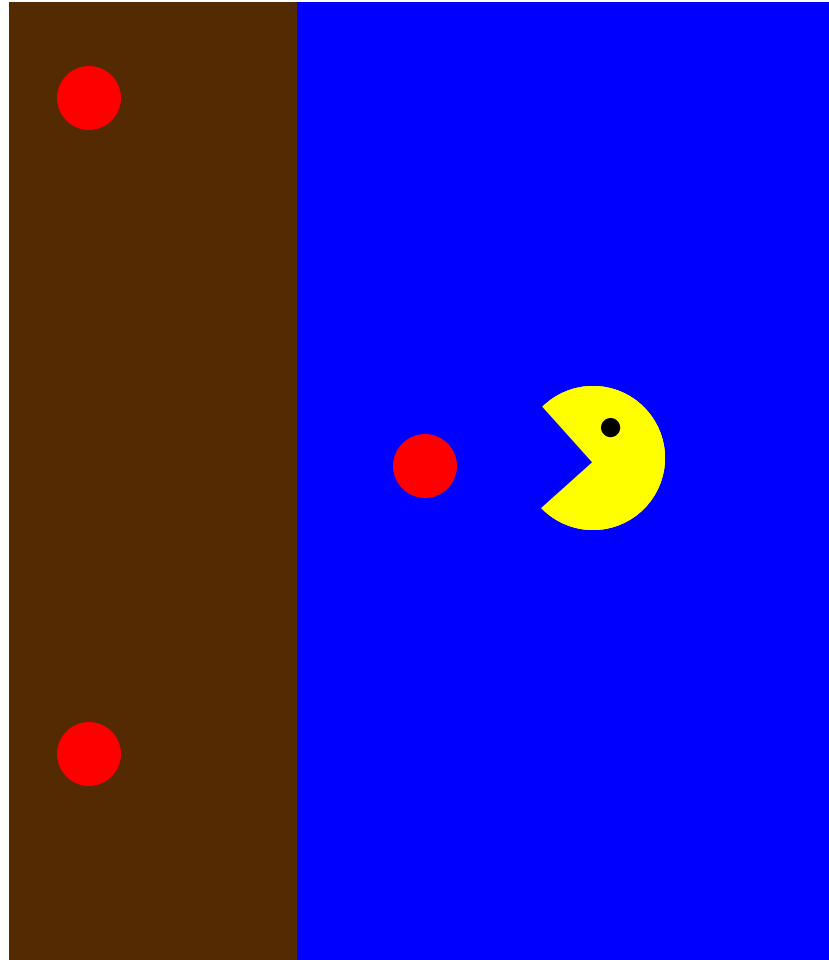
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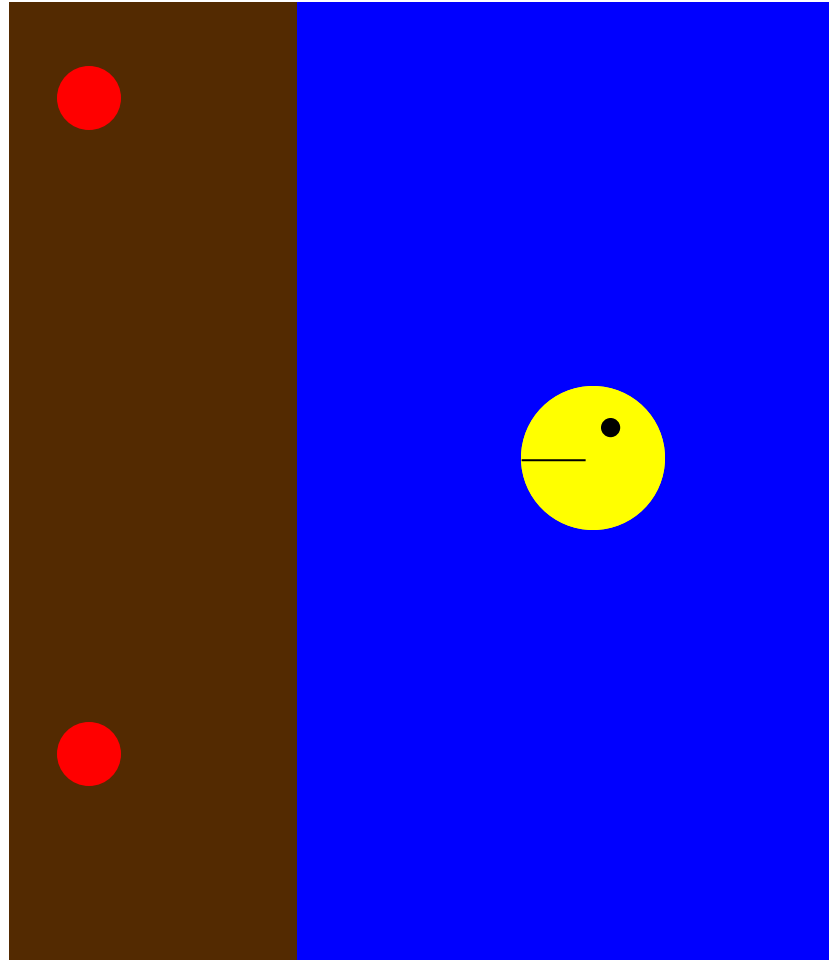
Herbicide Persistence

Persistence of Herbicides affected by several factors:



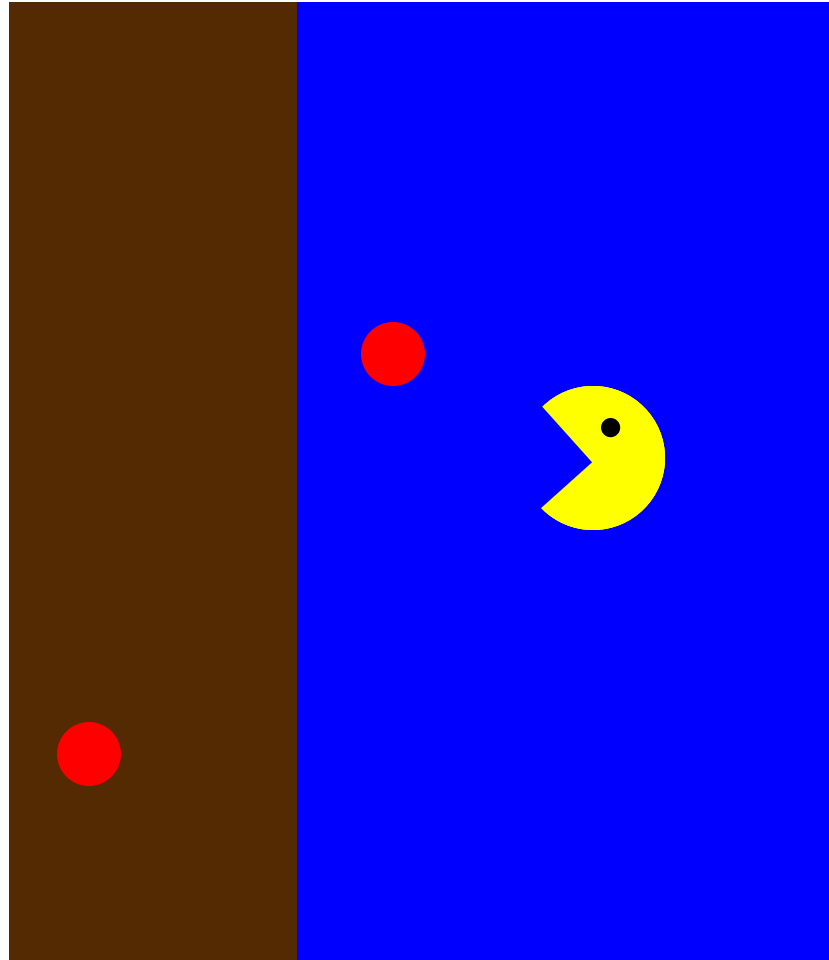
Herbicide Persistence

Persistence of Herbicides affected by several factors:



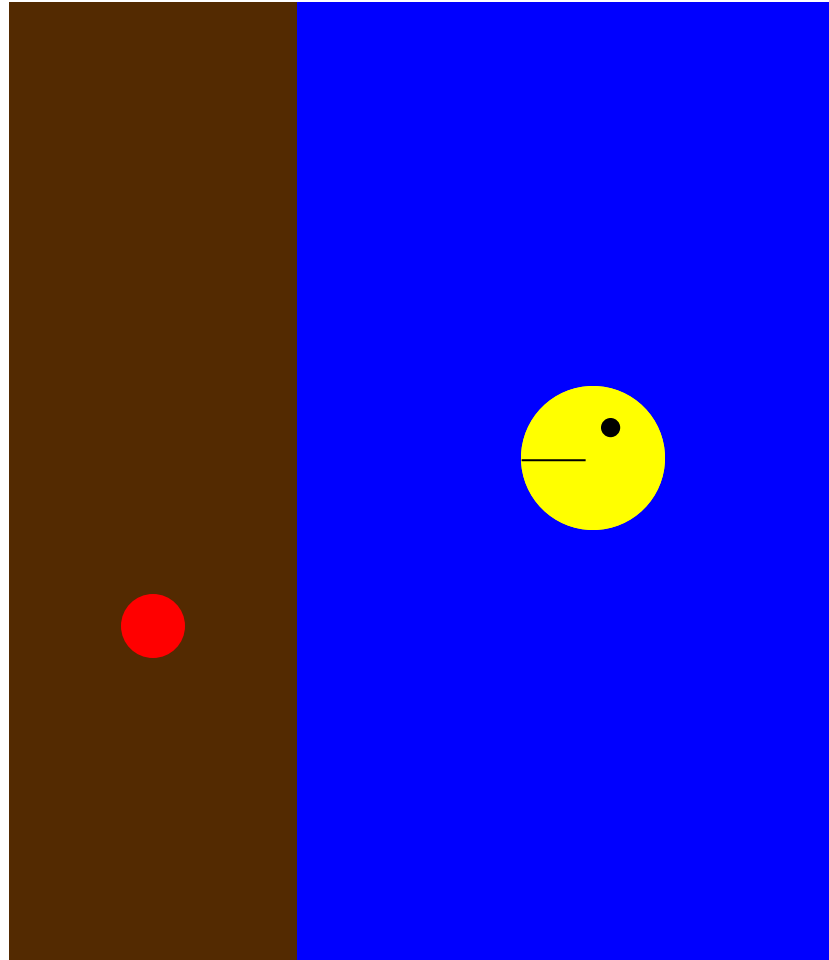
Herbicide Persistence

Persistence of Herbicides affected by several factors:



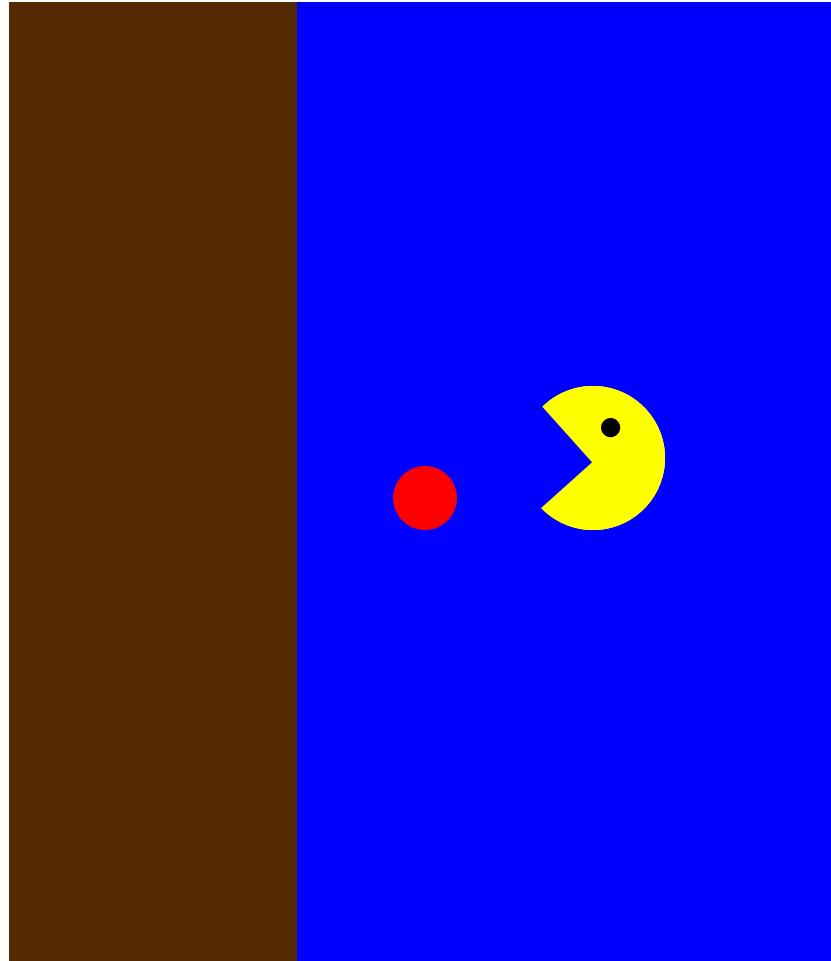
Herbicide Persistence

Persistence of Herbicides affected by several factors:



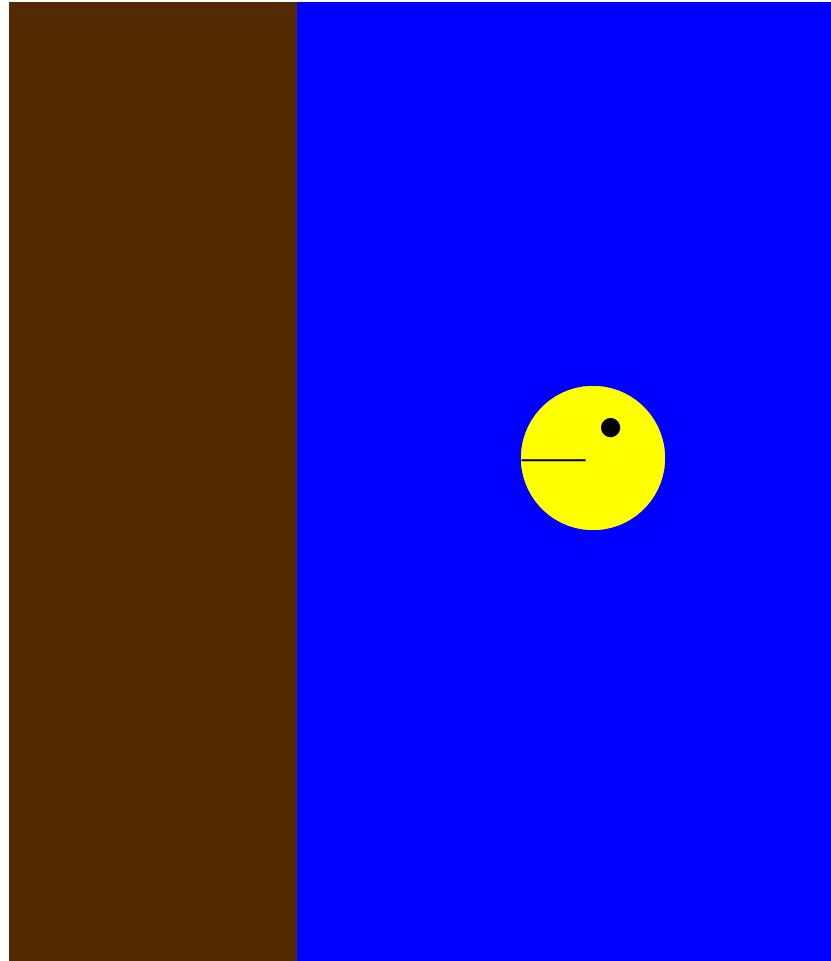
Herbicide Persistence

Persistence of Herbicides affected by several factors:



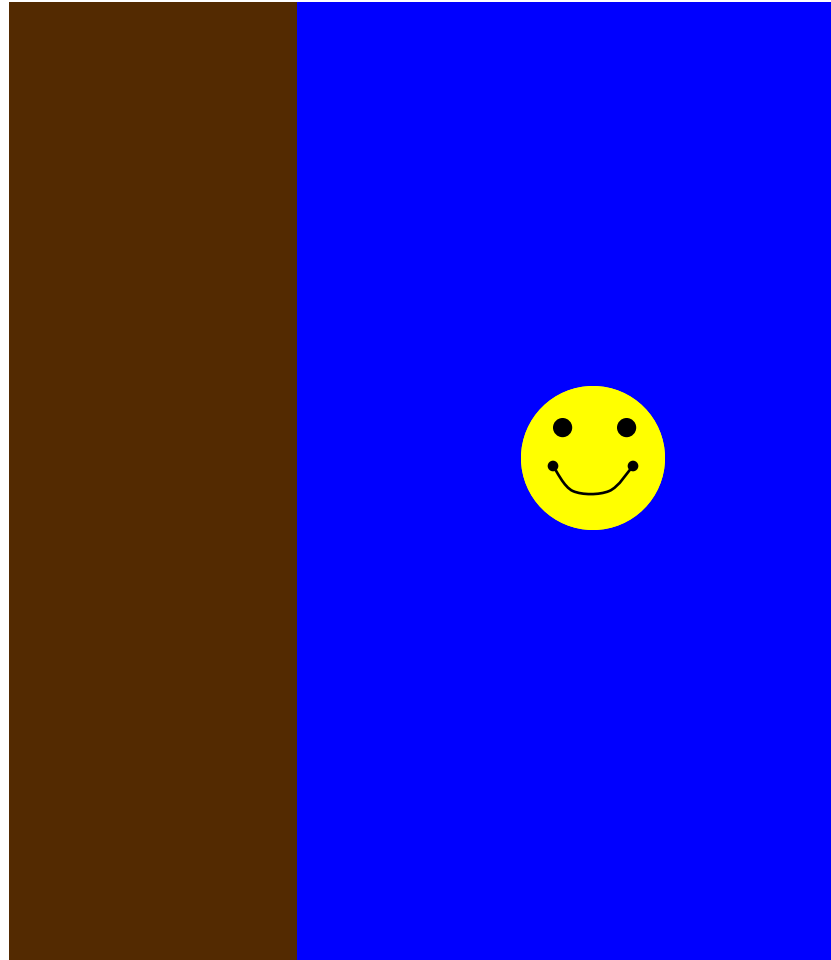
Herbicide Persistence

Persistence of Herbicides affected by several factors:



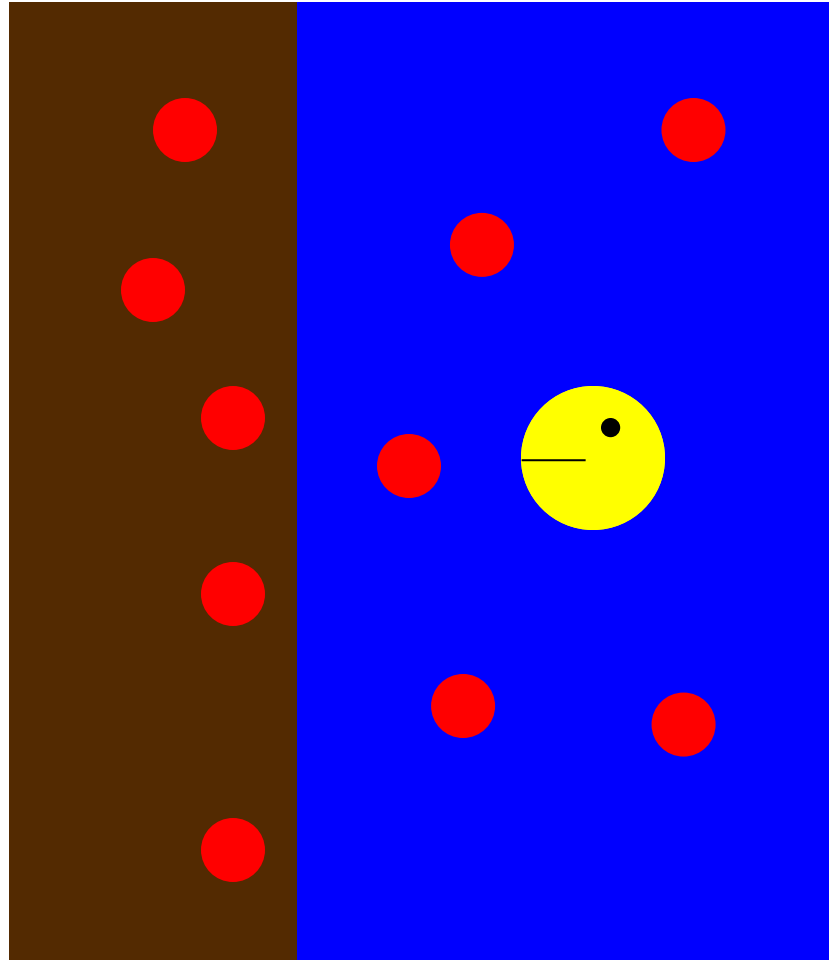
Herbicide Persistence

Persistence of Herbicides affected by several factors:



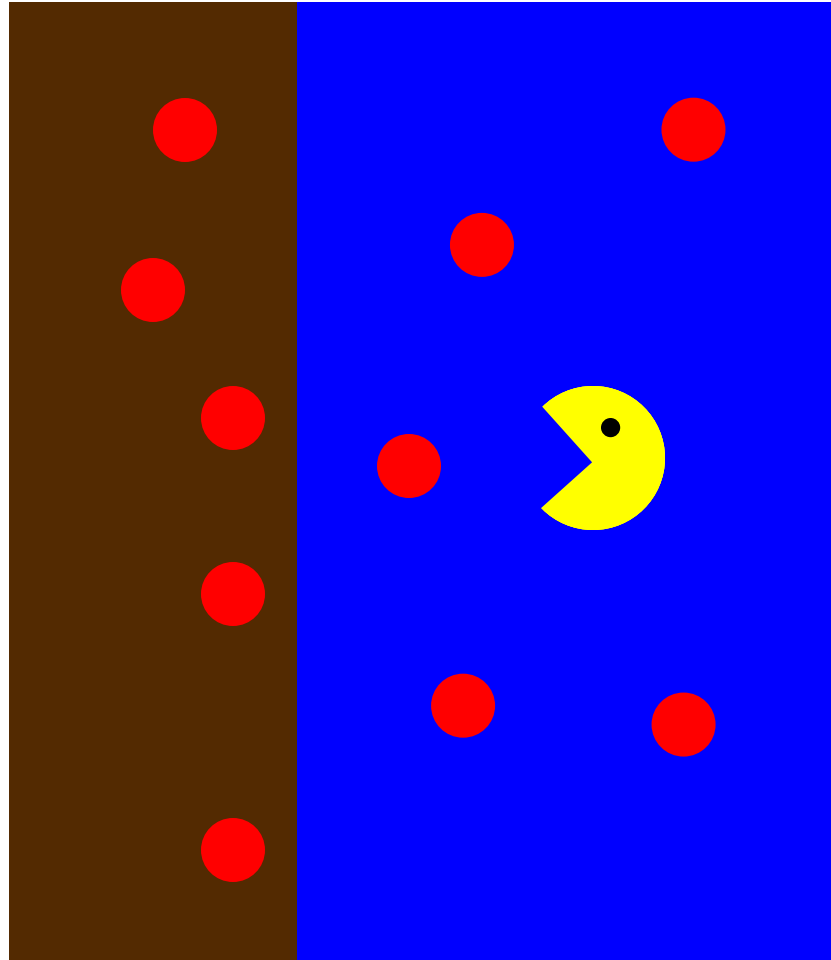
Herbicide Persistence

Persistence of Herbicides affected by several factors:



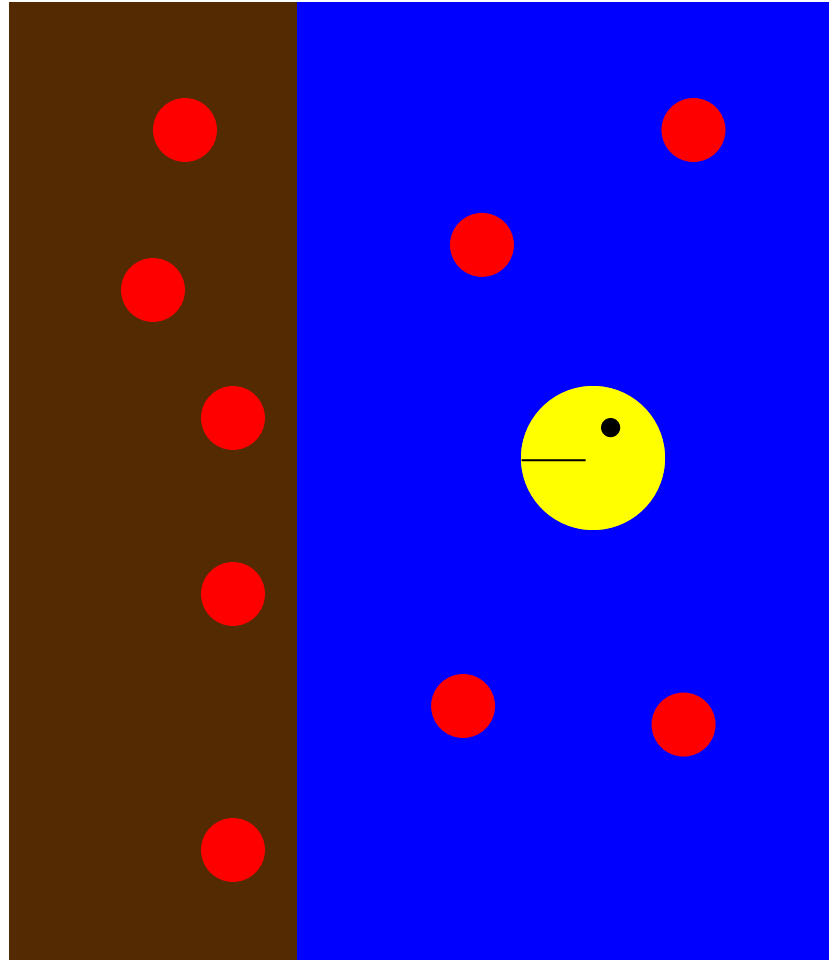
Herbicide Persistence

Persistence of Herbicides affected by several factors:



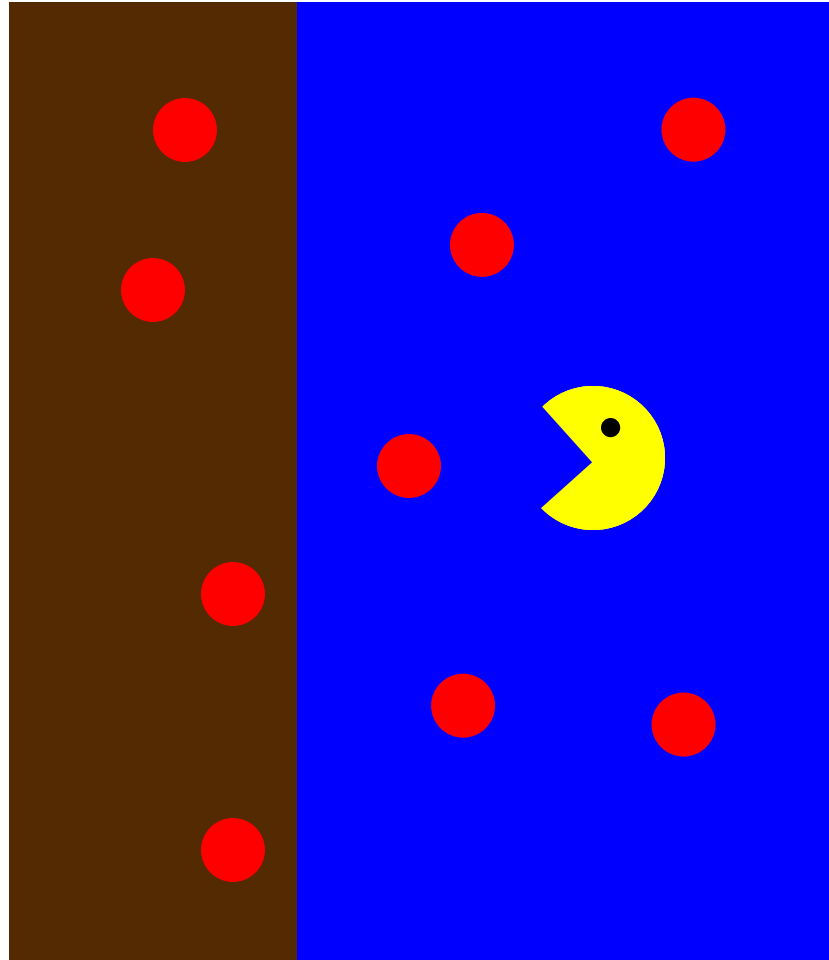
Herbicide Persistence

Persistence of Herbicides affected by several factors:



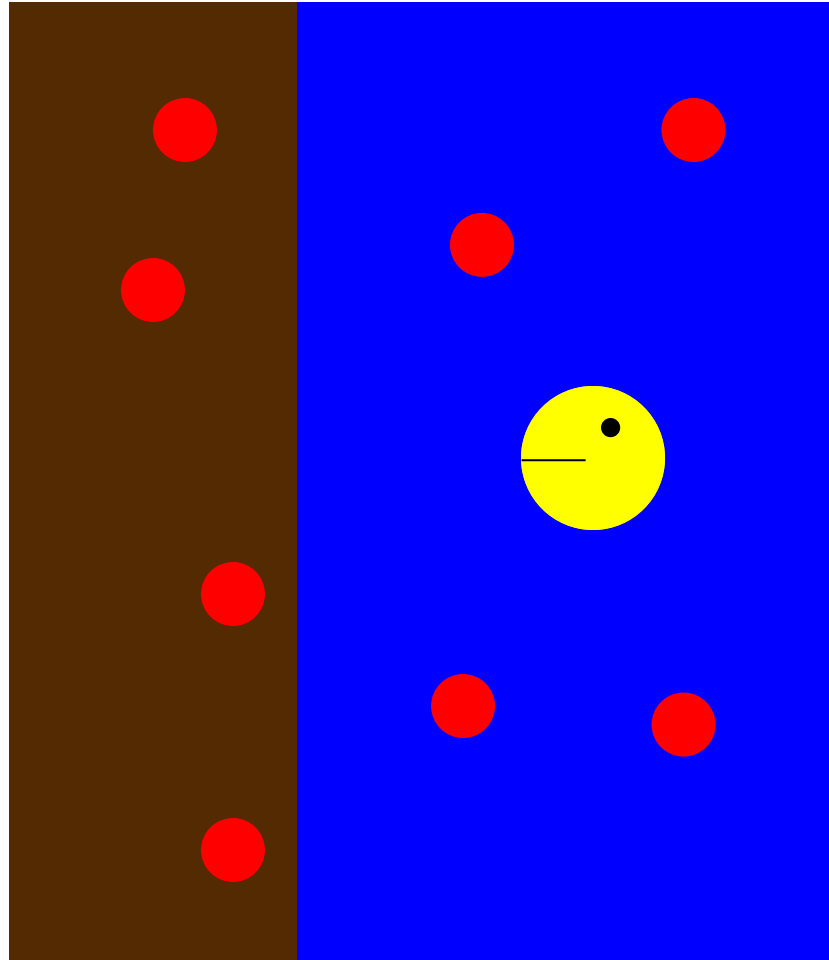
Herbicide Persistence

Persistence of Herbicides affected by several factors:



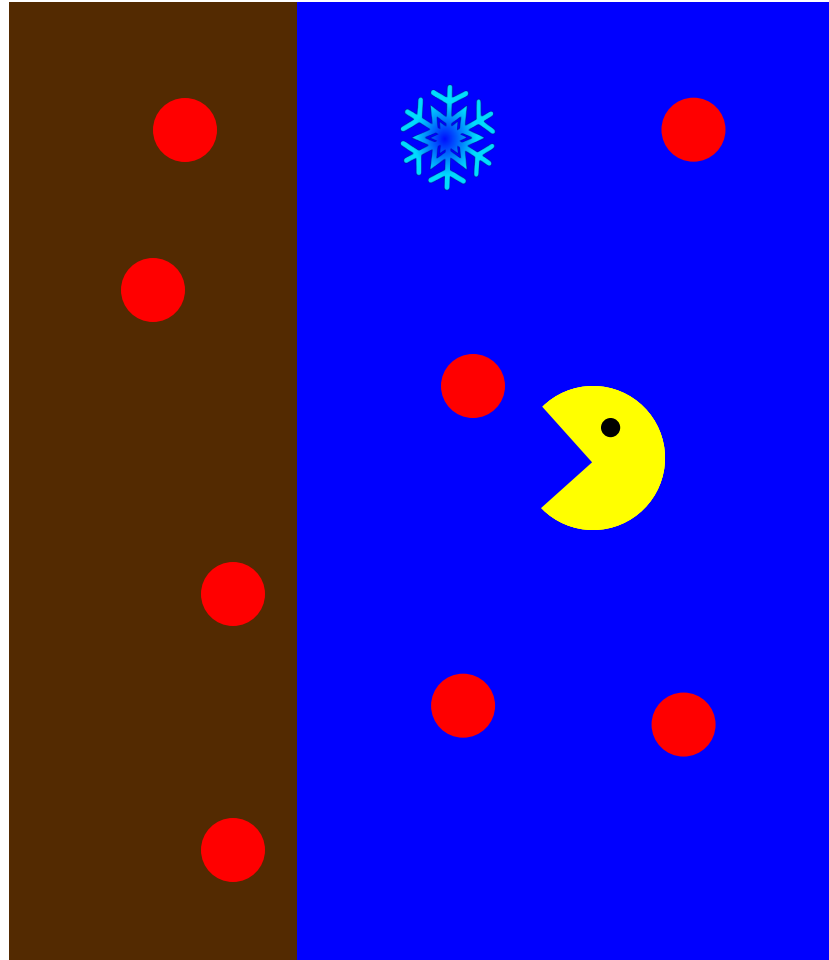
Herbicide Persistence

Persistence of Herbicides affected by several factors:



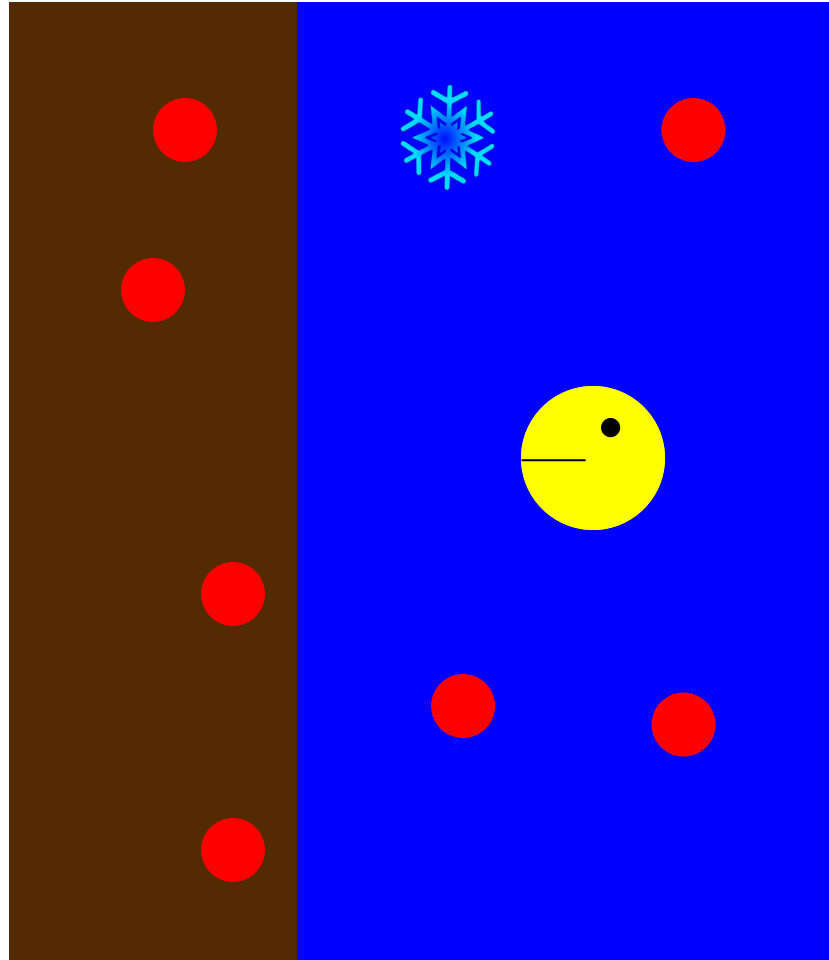
Herbicide Persistence

Persistence of Herbicides affected by several factors:



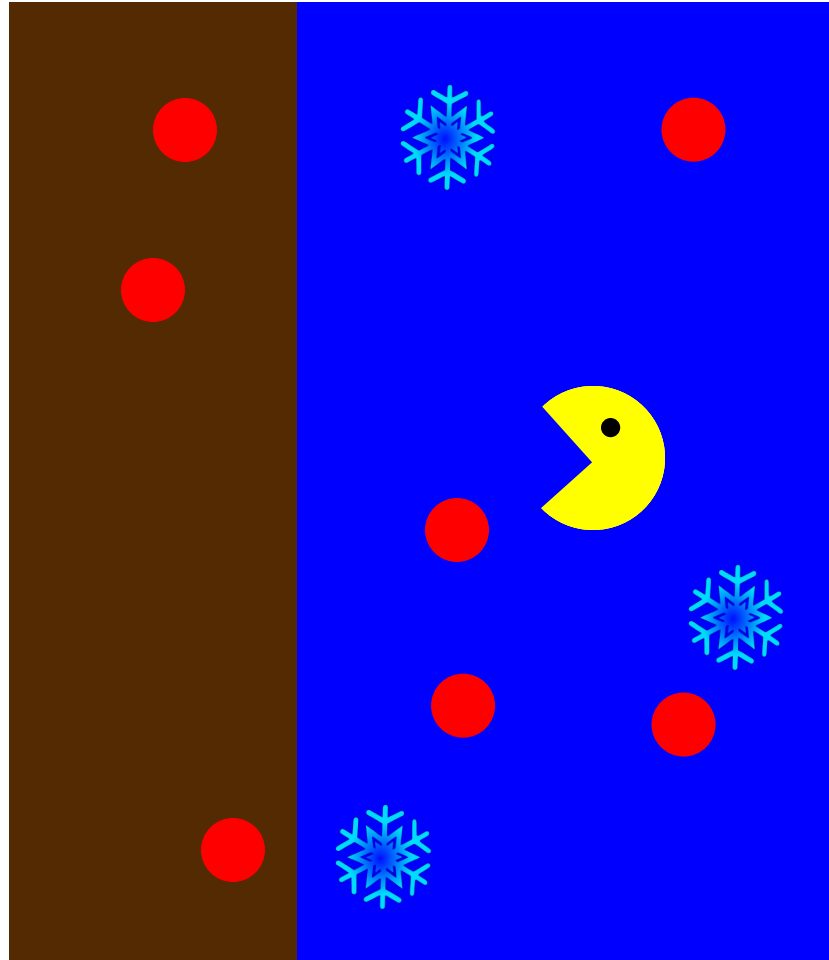
Herbicide Persistence

Persistence of Herbicides affected by several factors:



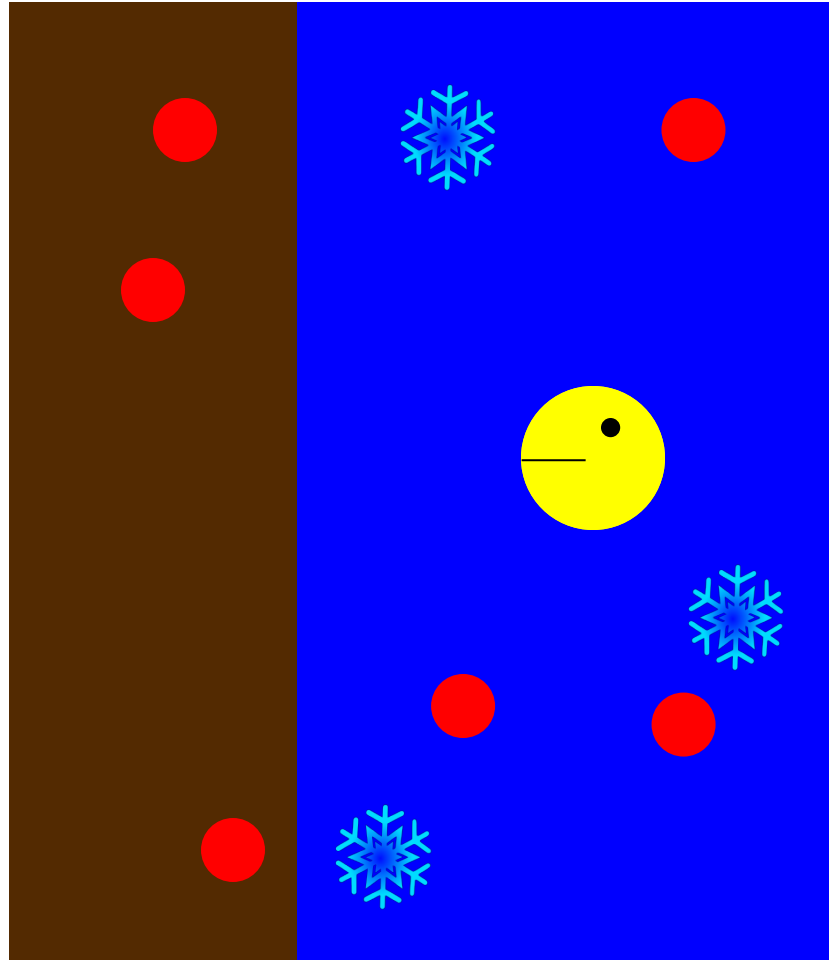
Herbicide Persistence

Persistence of Herbicides affected by several factors:



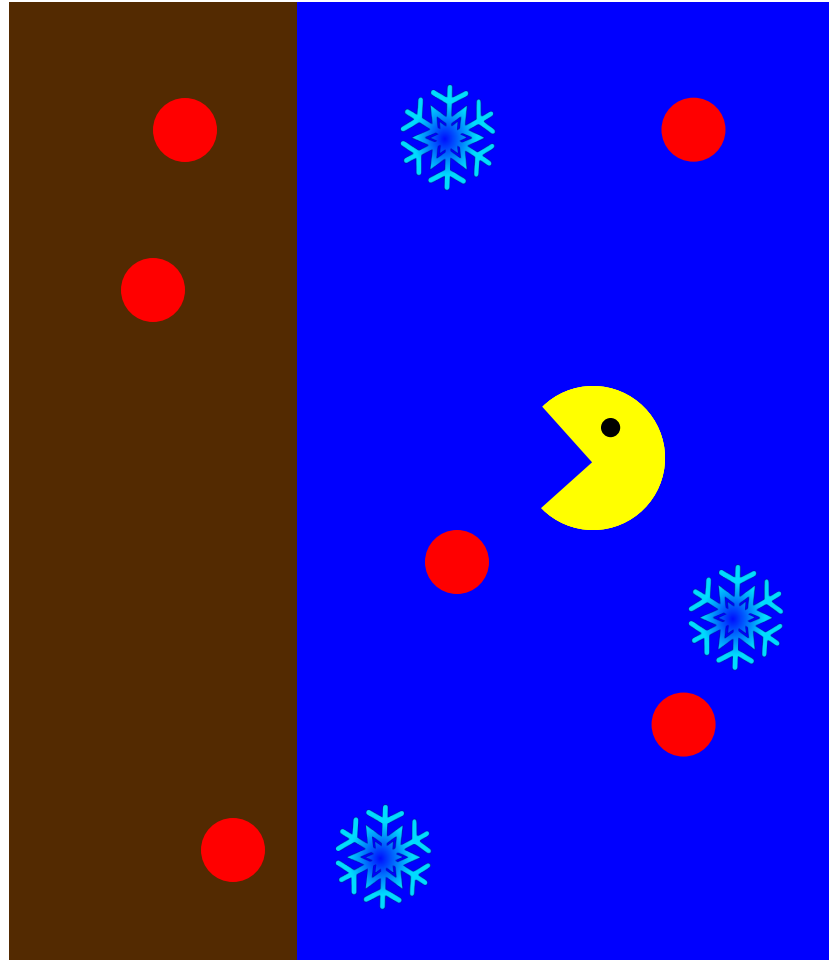
Herbicide Persistence

Persistence of Herbicides affected by several factors:



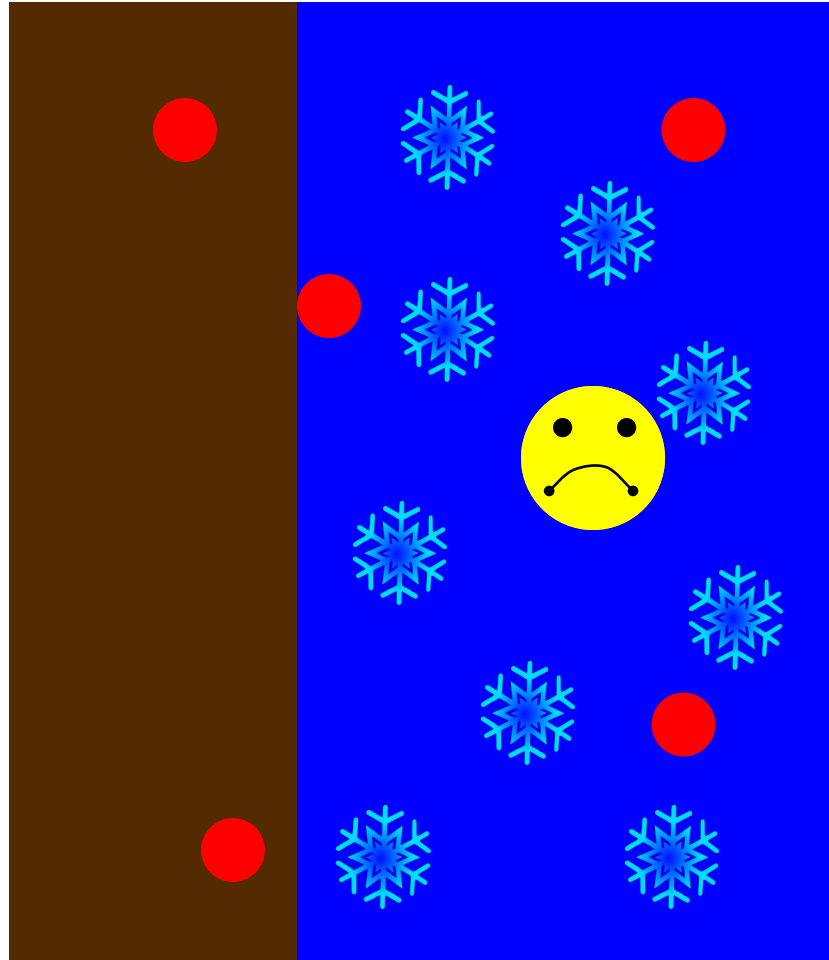
Herbicide Persistence

Persistence of Herbicides affected by several factors:



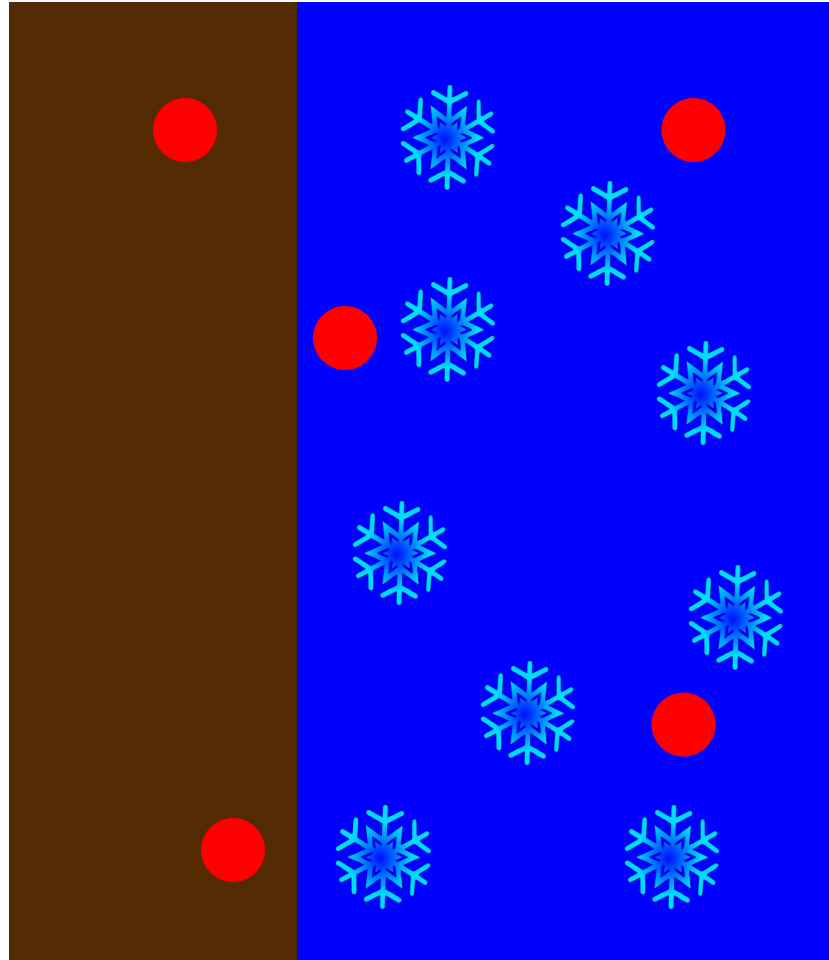
Herbicide Persistence

Persistence of Herbicides affected by several factors:



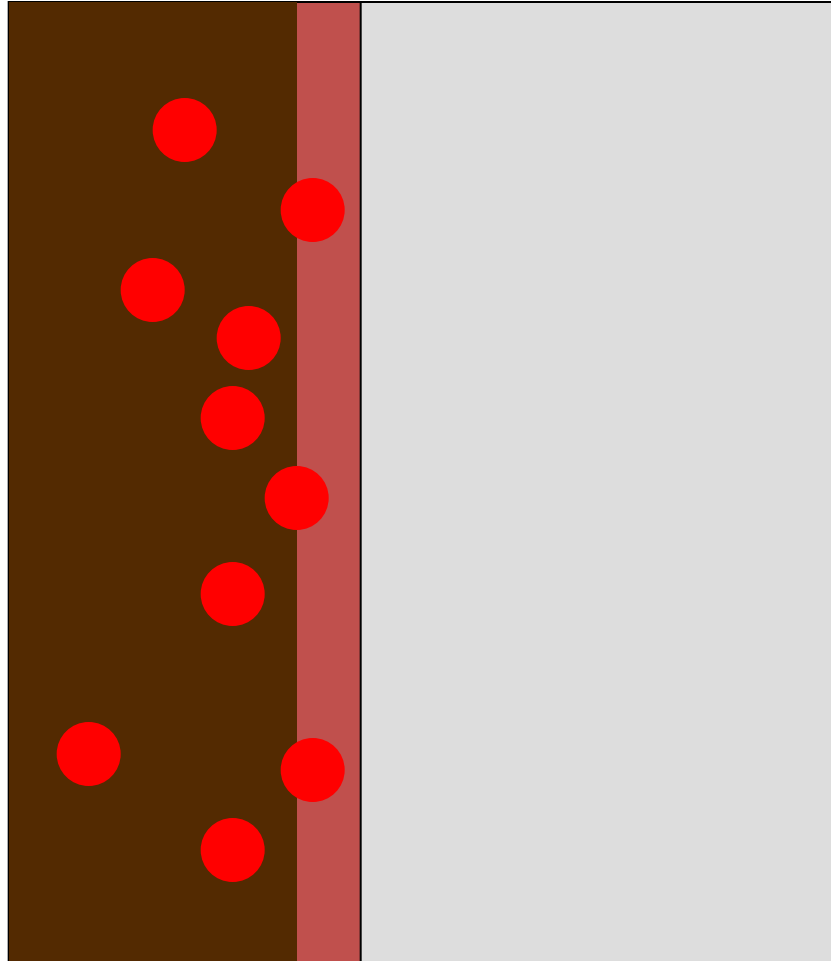
Herbicide Persistence

Persistence of Herbicides affected by several factors:

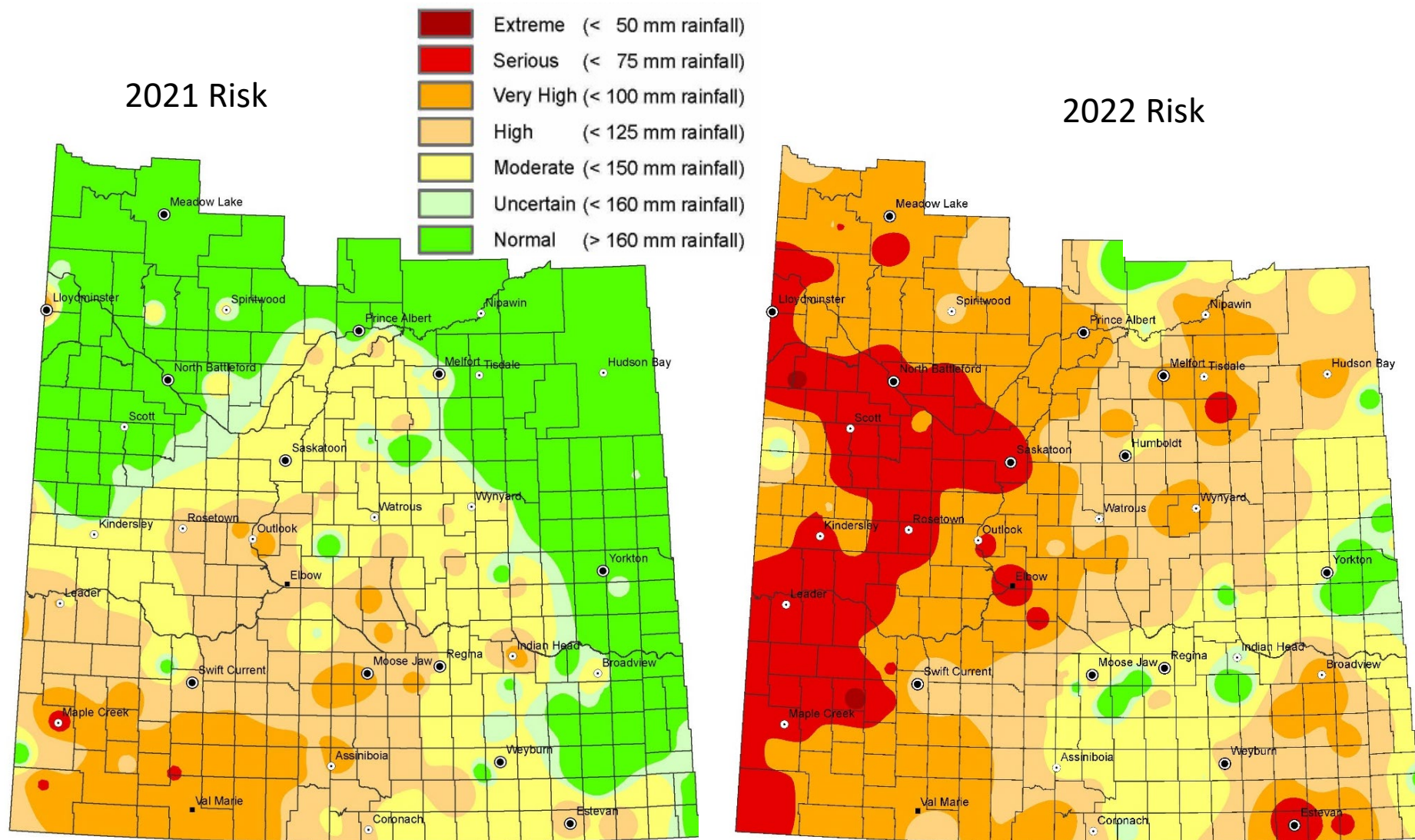


Herbicide Persistence

Persistence of Herbicides affected by several factors:



Risk of Greater than expected Herbicide Carryover in 2022



Based on Rainfall from mid-June
to mid-September 2020

Based on Rainfall from June to
September 2021

Questions?

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