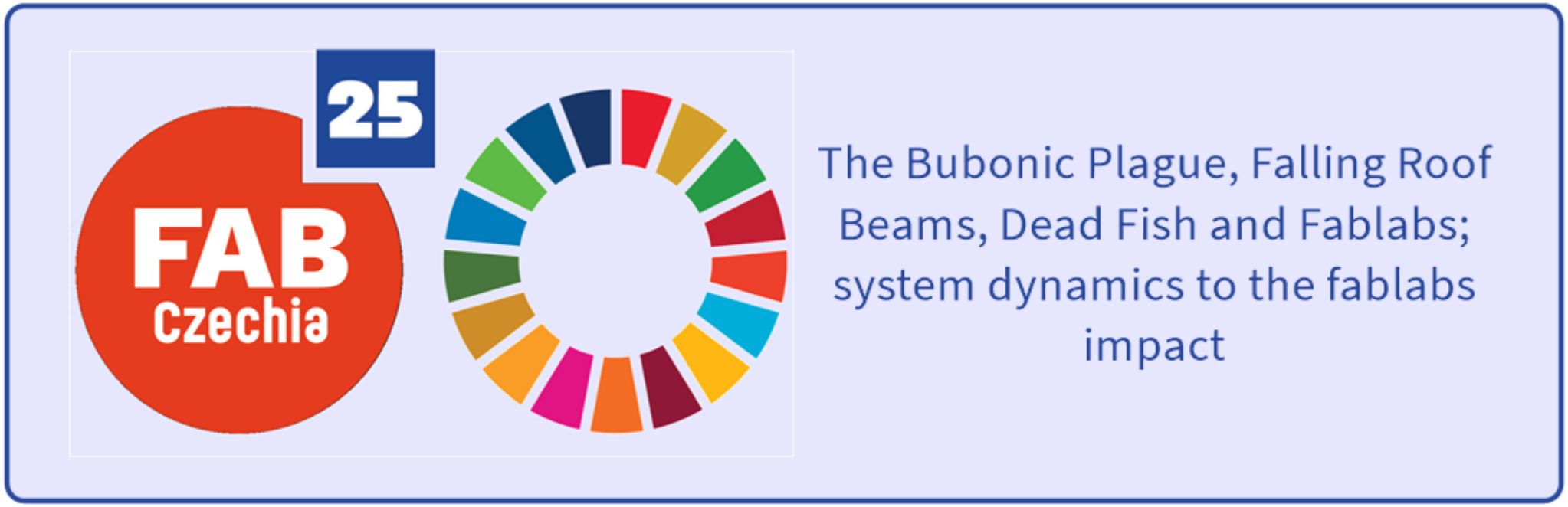


Pieter van der Hijden (pvdh@sofos.nl)

Calling the fablabs

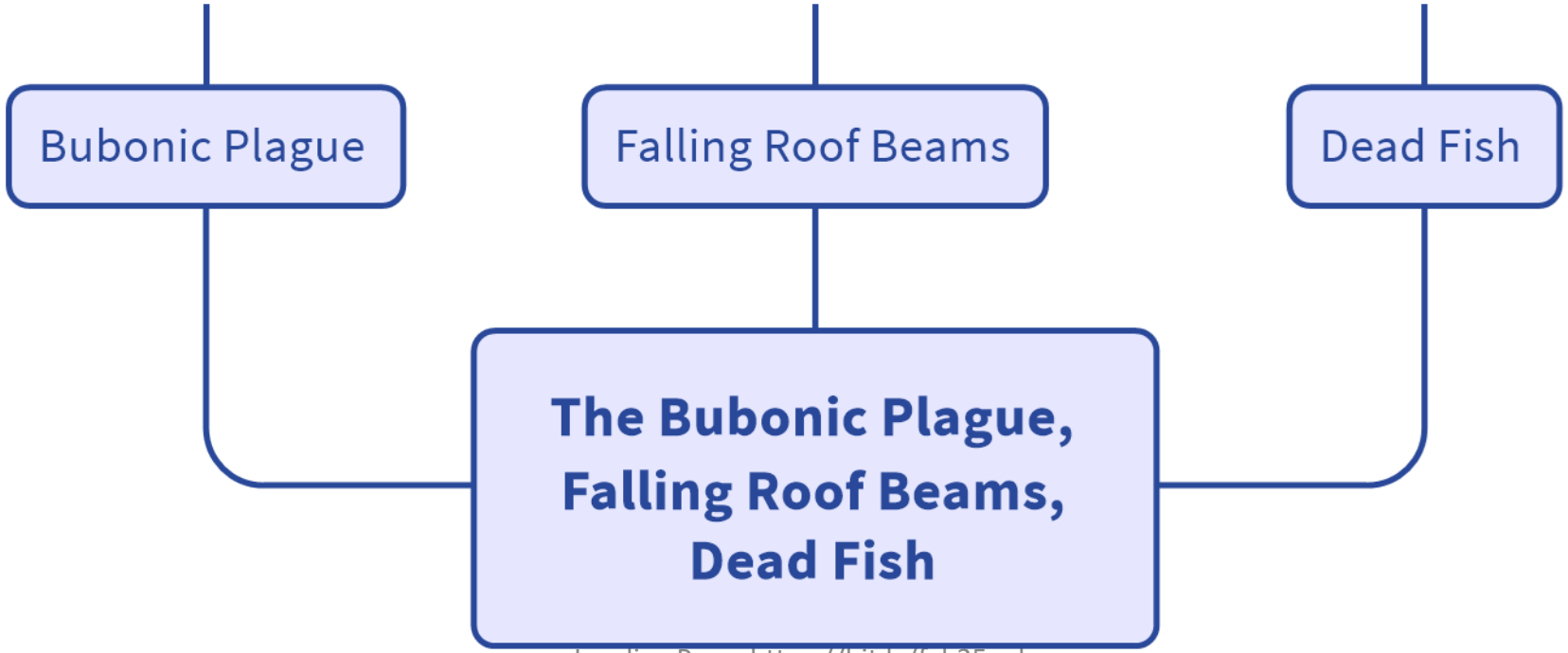
The island of Borneo, described as "a green jewel in the blue sea," has all of a sudden been beset with a multitude of seemingly unrelated problems. The villagers have begun dying of bubonic plague, the roofs of their huts have begun crashing down, and there are swarms of dead fish washing up on the banks of their rivers!

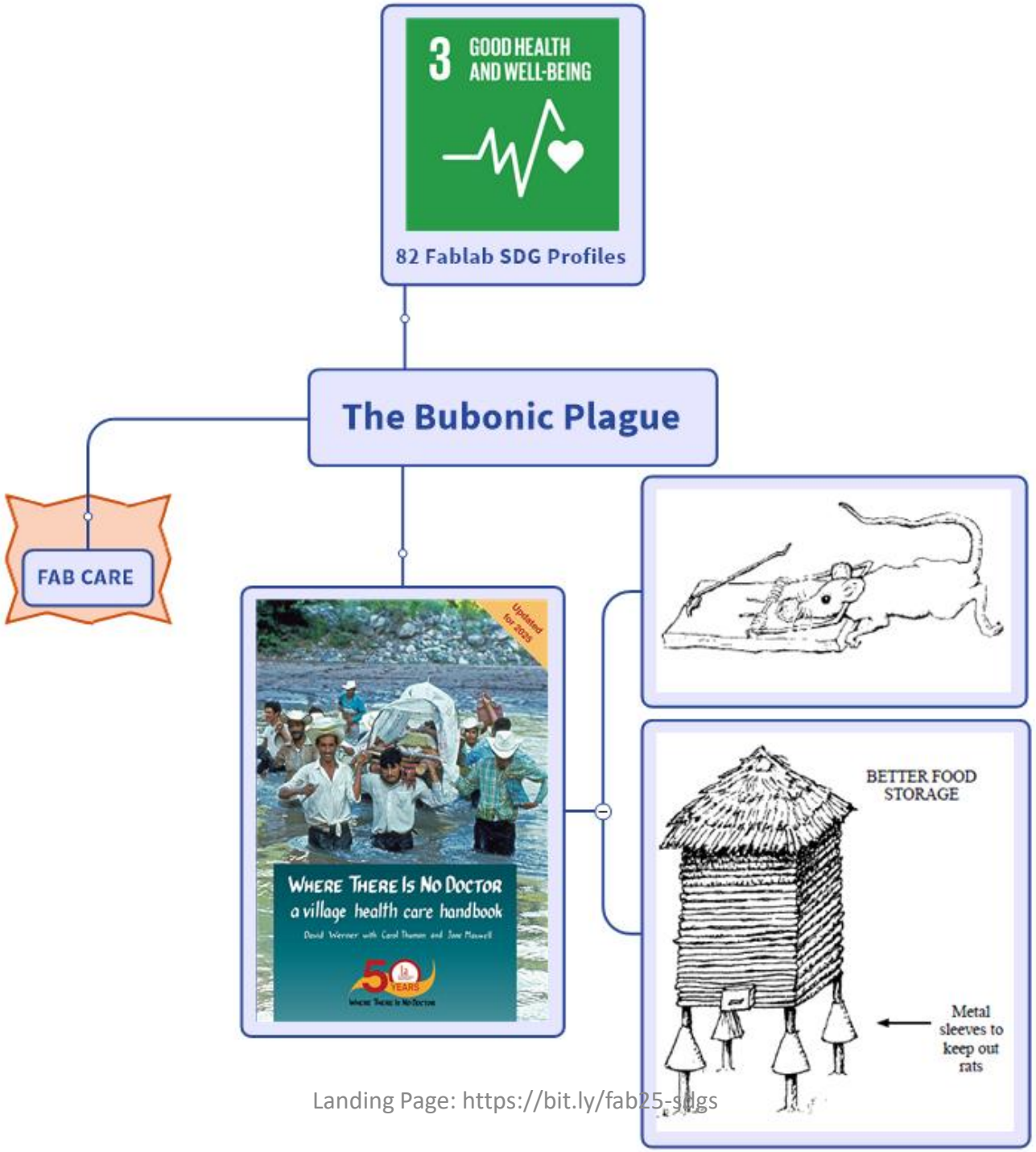
Action

3
GOOD HEALTH
AND WELL-BEING

11
SUSTAINABLE CITIES
AND COMMUNITIES

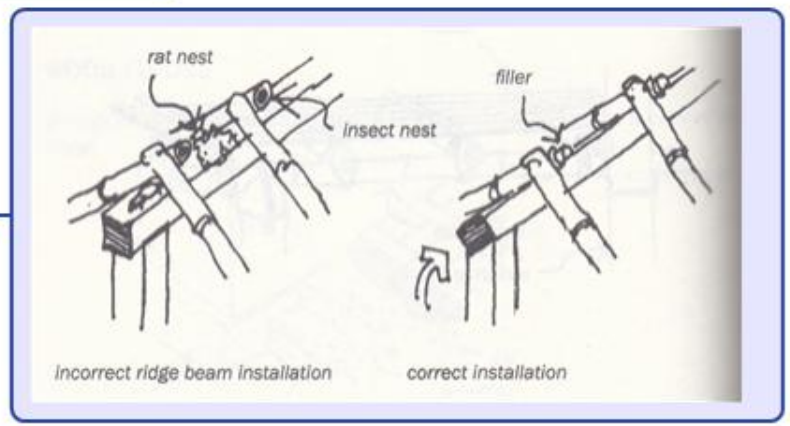
14
LIFE
BELOW WATER

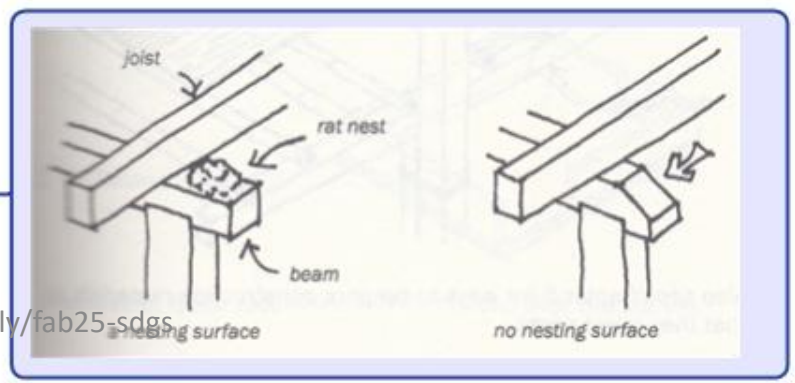

Bubonic Plague
Falling Roof Beams
Dead Fish
The Bubonic Plague, Falling Roof Beams, Dead Fish

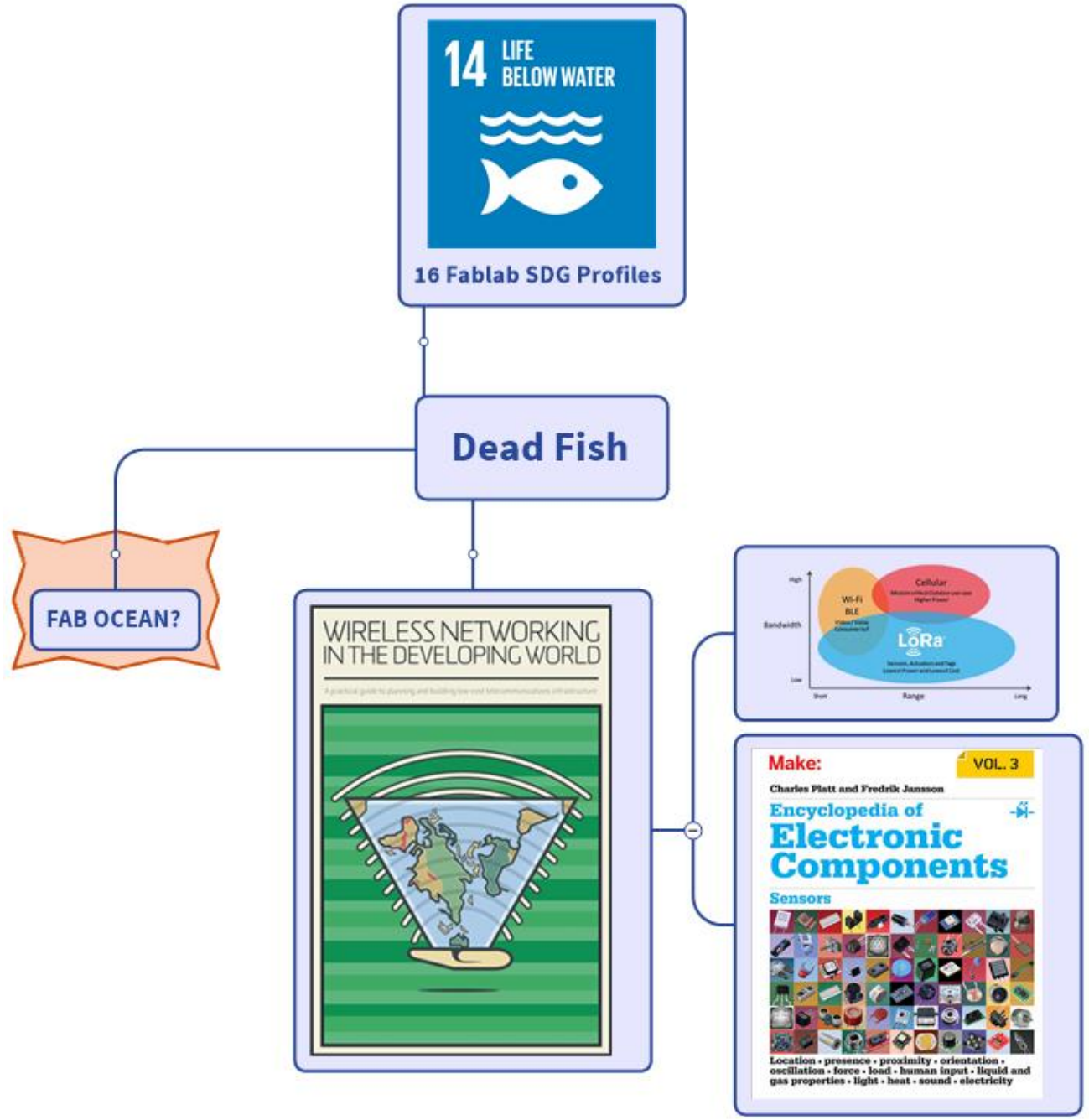

3 GOOD HEALTH AND WELL-BEING
82 Fablab SDG Profiles
The Bubonic Plague
FAB CARE
Updated for 2025
WHERE THERE IS NO DOCTOR
a village health care handbook
David Werner with Carol Thuman and Jane Maxwell
50 YEARS
BETTER FOOD STORAGE
Metal sleeves to keep out rats

Falling Roof Beams

FAB CITY NETWORK






14 LIFE BELOW WATER
16 Fablab SDG Profiles
Dead Fish
FAB OCEAN?
WIRELESS NETWORKING IN THE DEVELOPING WORLD
Wi-Fi
BLE
Cellular
LoRa
Bandwidth
Range
Make:
VOL. 3
Charles Platt and Fredrik Jansson
Encyclopedia of
Electronic Components
Sensors
Location • presence • proximity • orientation • oscillation • force • load • human input • liquid and gas properties • light • heat • sound • electricity

Action

Conclusions:

- Ad hoc solutions
- Silo thinking
- Symptom control

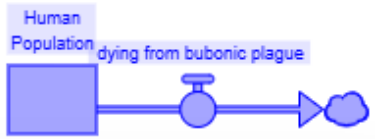
Systems Thinking

Fasten your seat belts!

The island of Borneo, described as "a green jewel in the blue sea," has all of a sudden been beset with a multitude of seemingly unrelated problems. The villagers have begun dying of bubonic plague, the roofs of their huts have begun crashing down, and there are swarms of dead fish washing up on the banks of their rivers!

They are wondering why all of these strange things are happening all at once, and what they might do about them. This story will help to untangle the mysterious goings on on the island of Borneo.

Press the spacebar to unfurl each piece of the story, one chunk at a time...



We begin our story with the first component of the mystery: A human population that is dying from a bubonic plague outbreak.

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The next part of the mystery, seemingly far away and unrelated, is the roof beams in the villagers' huts that have, all of a sudden, begun falling down.

Fallen Beams

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Dead
Fish

The final piece of the strange goings on is the swarms of dead fish which have begun to appear on Borneo's river banks.

Fallen
Beams

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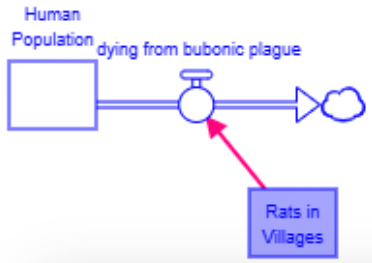

Let's look first at what's causing the plague outbreak. It's rats! Rats have begun to invade the villages. Rats carry the plague and transmit it via biting people.

Dead Fish

Fallen Beams

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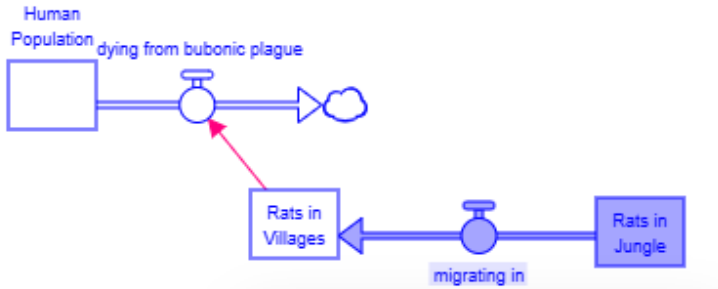
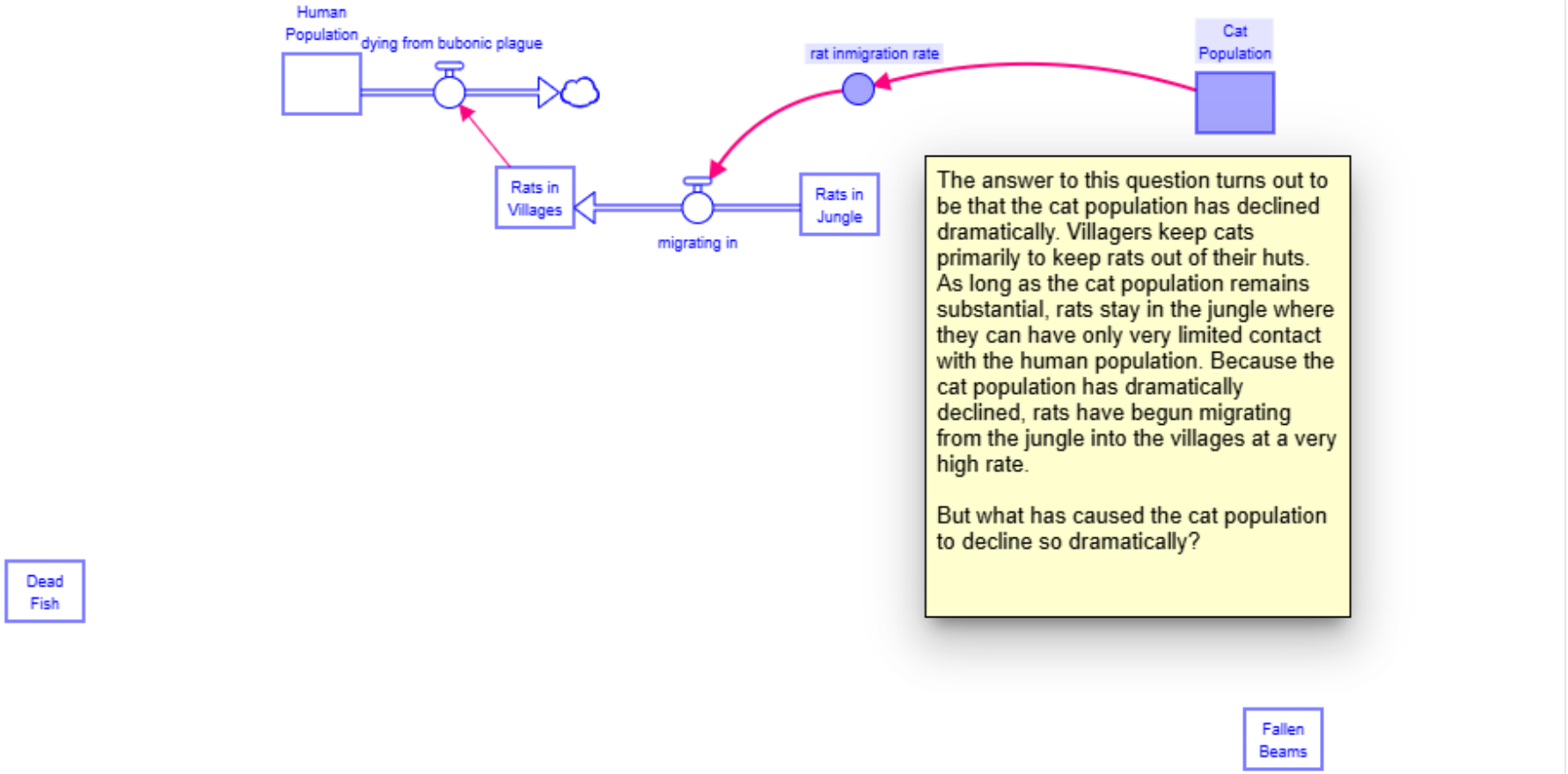


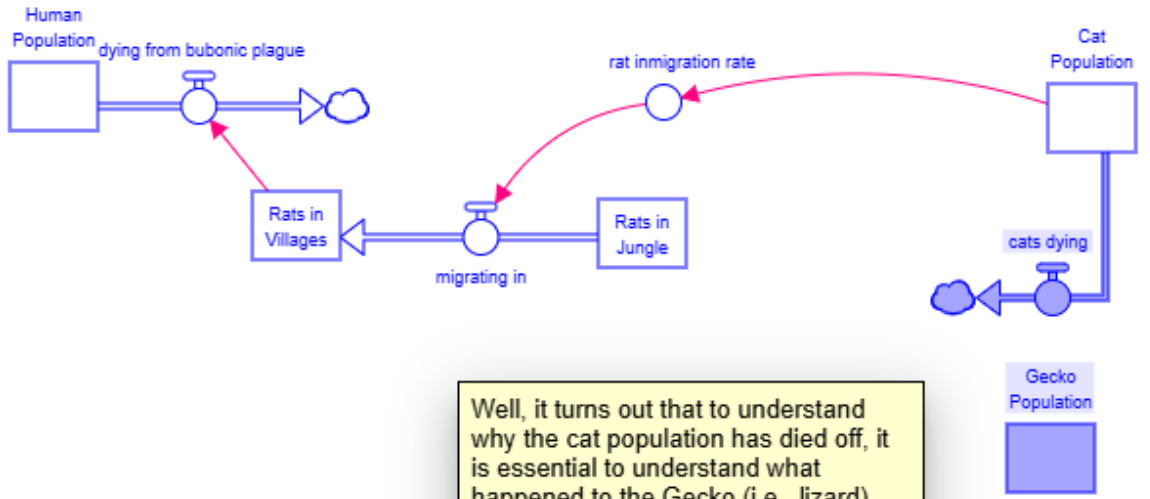
A good question to ask is...Where are the rats coming from?! And, as you can see, the answer is..."from the jungle!"

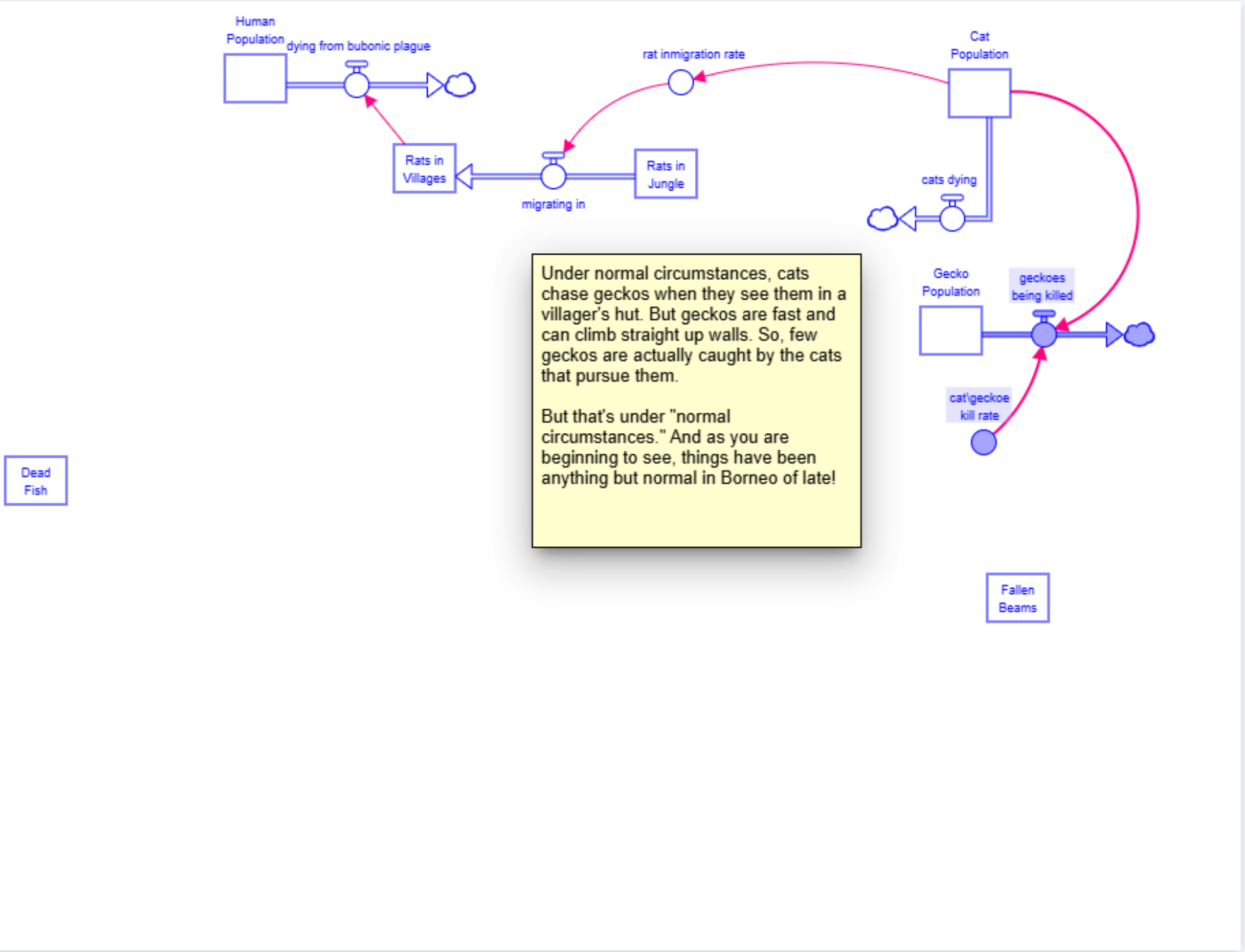
But why, now? Rats have been in the jungle forever. Why are they invading the villages at this point in time?

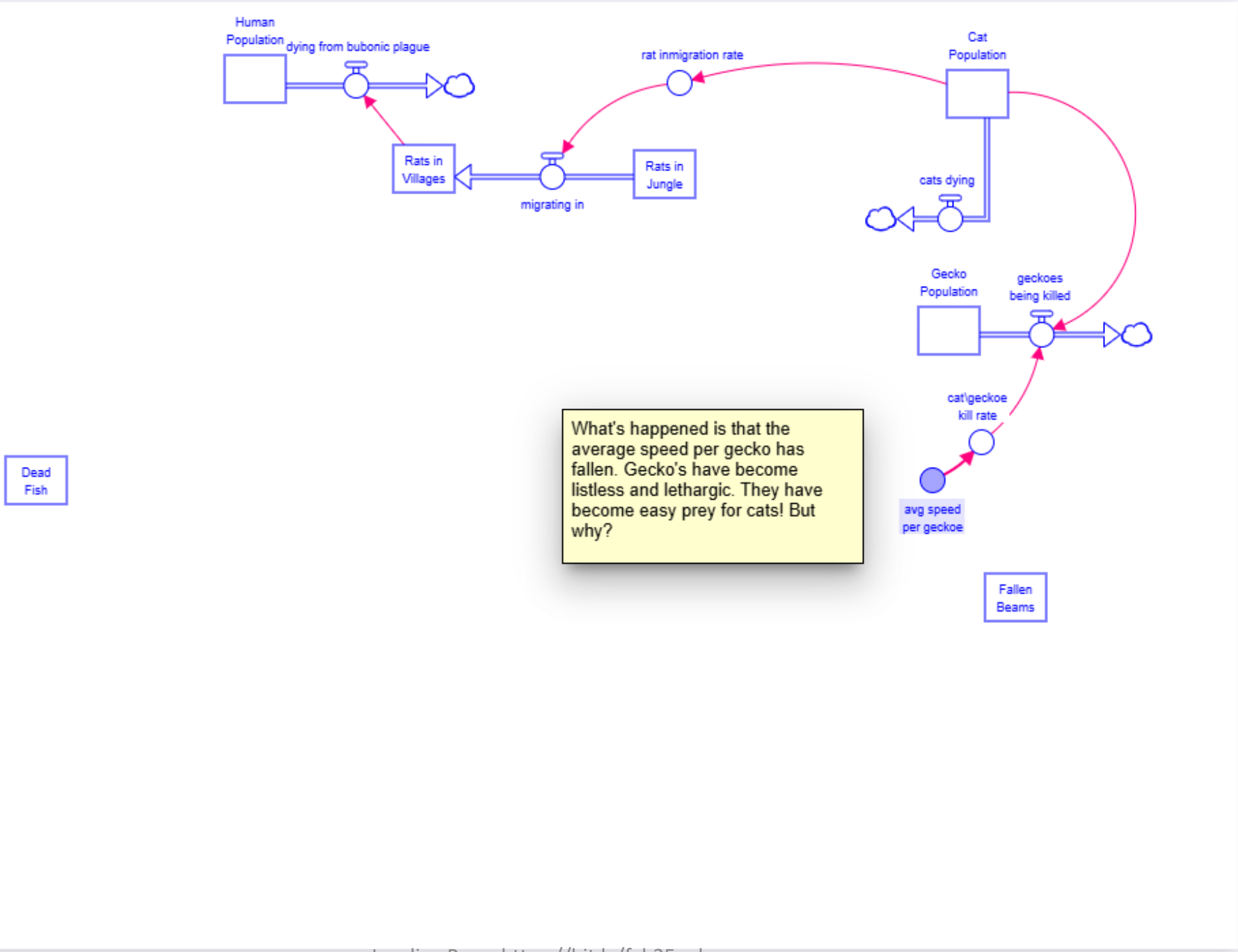
Dead Fish

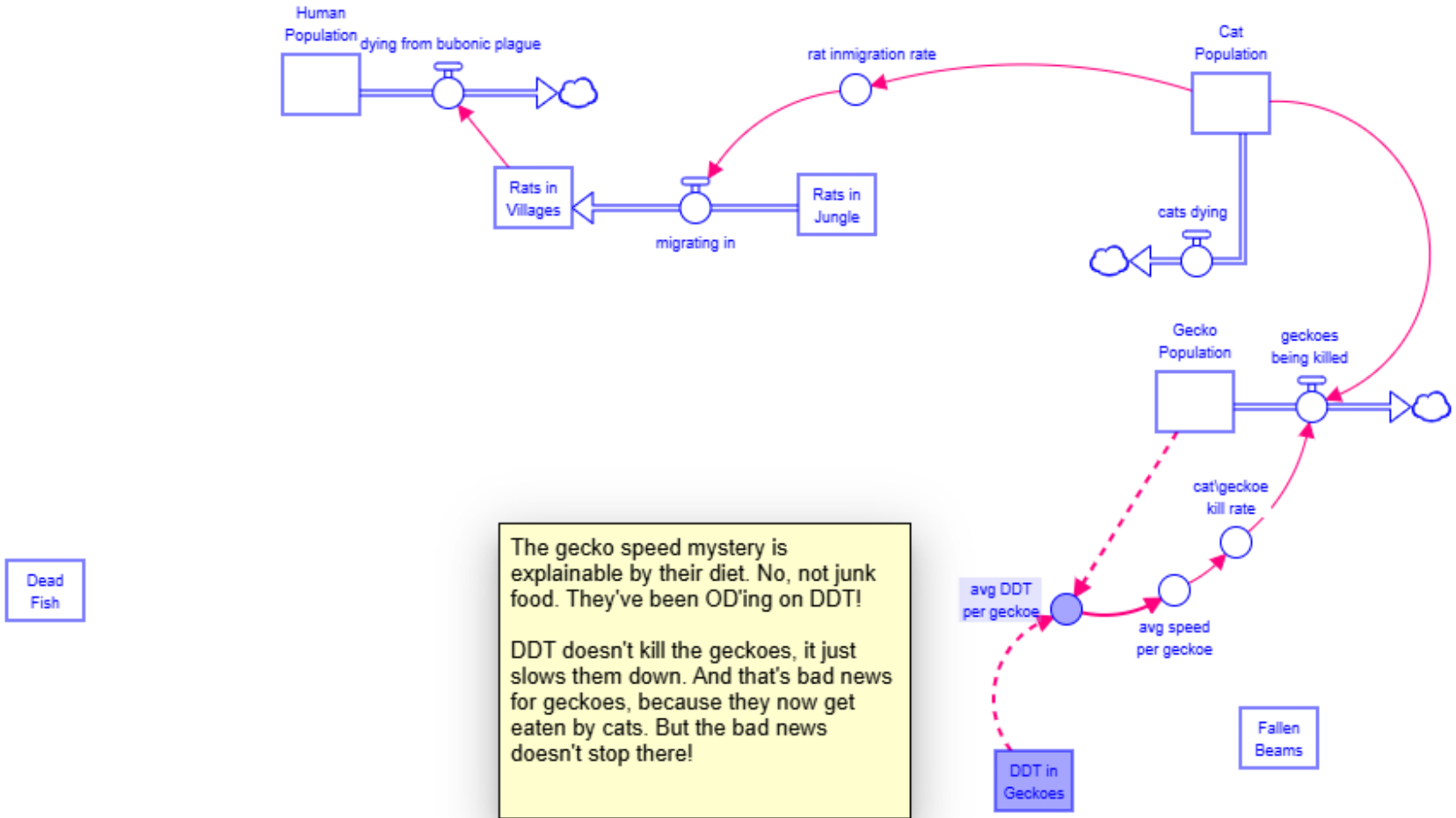
Fallen Beams

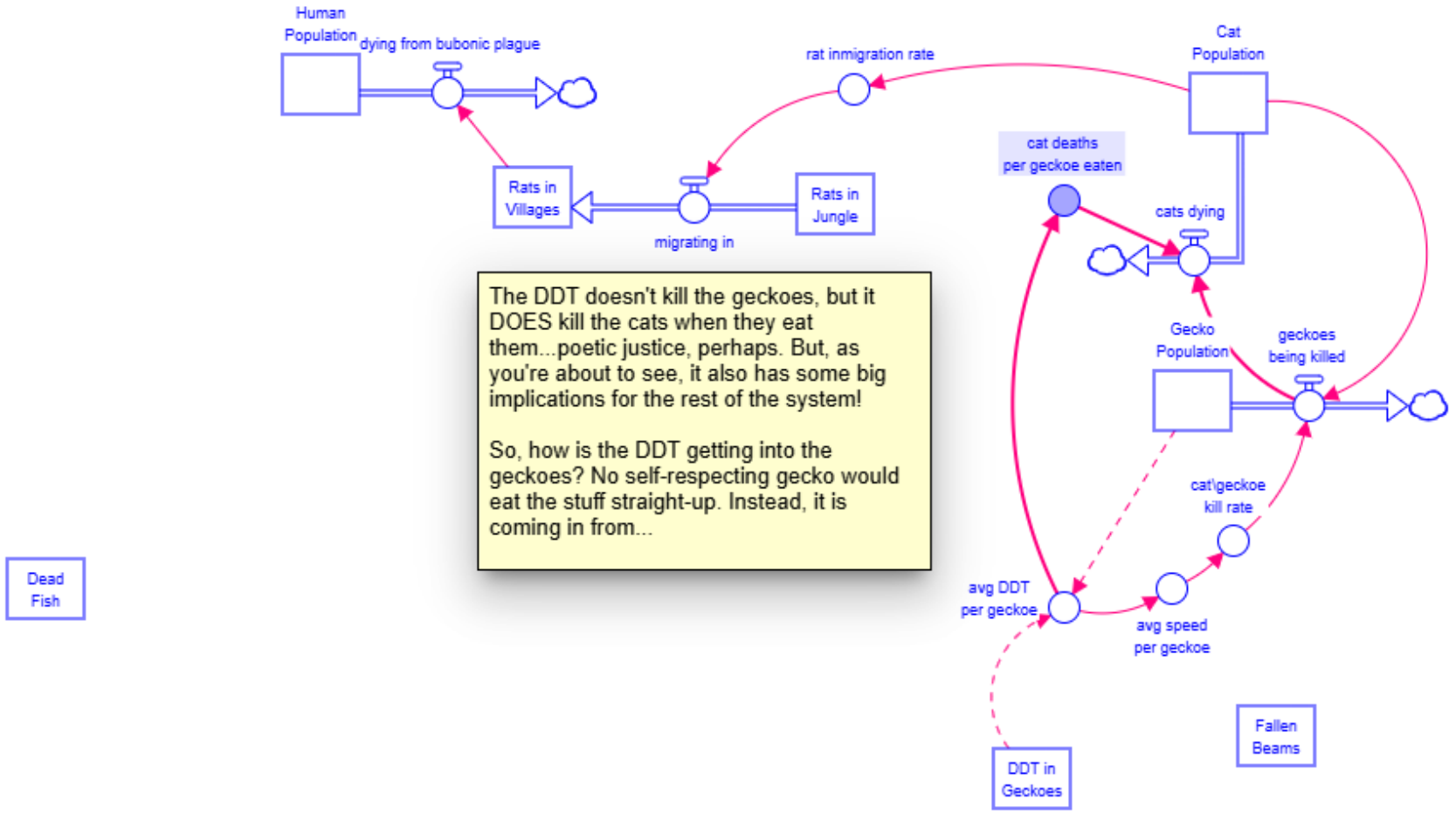

Human Population
dying from bubonic plague
rat inmigration rate
Cat Population
Rats in Villages
migrating in
Rats in Jungle
The answer to this question turns out to be that the cat population has declined dramatically. Villagers keep cats primarily to keep rats out of their huts. As long as the cat population remains substantial, rats stay in the jungle where they can have only very limited contact with the human population. Because the cat population has dramatically declined, rats have begun migrating from the jungle into the villages at a very high rate.
But what has caused the cat population to decline so dramatically?
Dead Fish
Fallen Beams

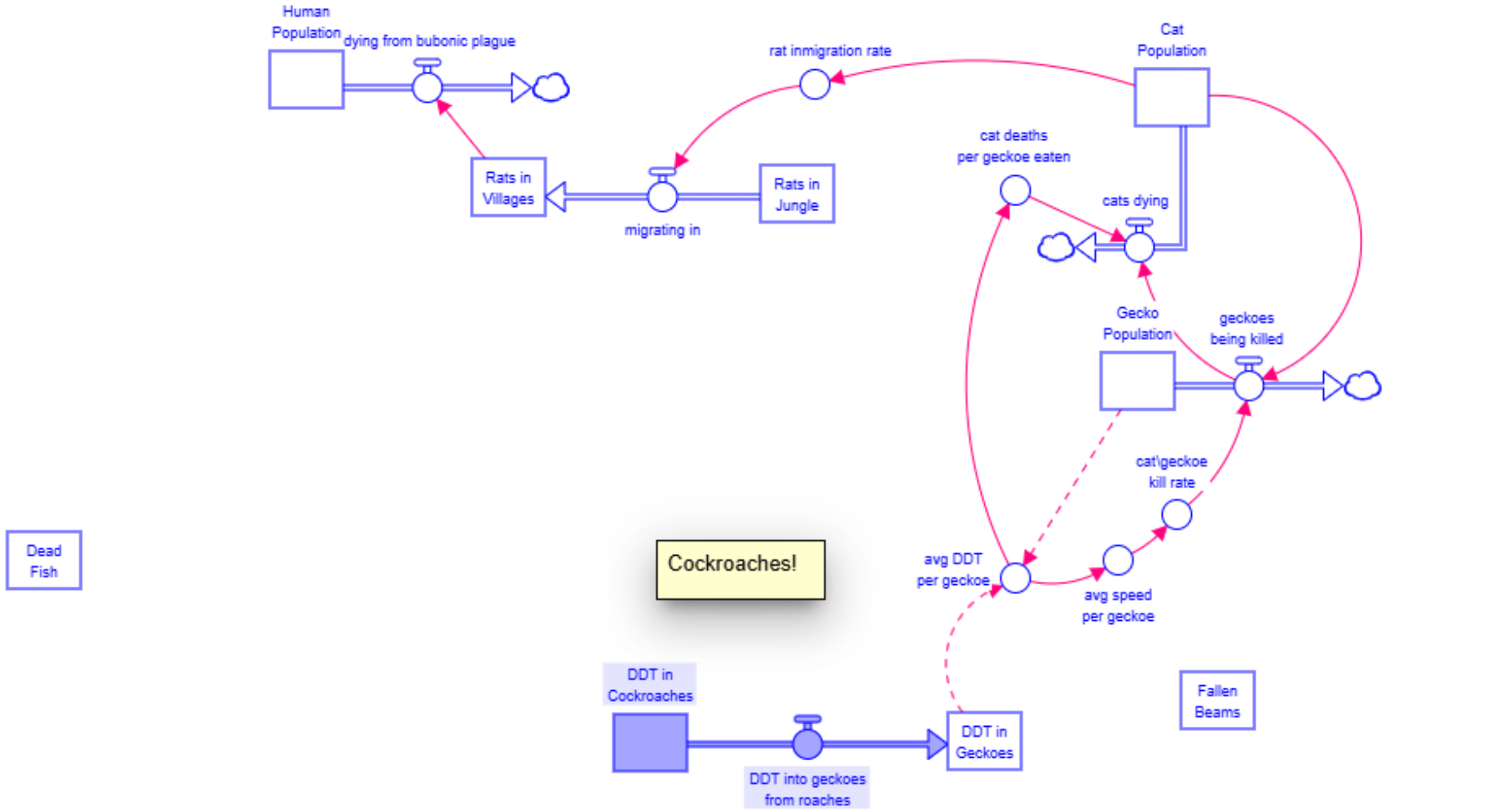

Human Population
dying from bubonic plague
rat inmigration rate
Cat Population
Rats in Villages
migrating in
Rats in Jungle
cats dying
Gecko Population
Well, it turns out that to understand why the cat population has died off, it is essential to understand what happened to the Gecko (i.e., lizard) population.
Dead Fish
Fallen Beams


Human Population
dying from bubonic plague
rat inmigration rate
Cat Population
Rats in Villages
migrating in
Rats in Jungle
cats dying
Under normal circumstances, cats chase geckos when they see them in a villager's hut. But geckos are fast and can climb straight up walls. So, few geckos are actually caught by the cats that pursue them.
But that's under "normal circumstances." And as you are beginning to see, things have been anything but normal in Borneo of late!
Gecko Population
geckoes being killed
cat\geckoe kill rate
Dead Fish
Fallen Beams


Human Population
dying from bubonic plague
rat inmigration rate
Cat Population
Rats in Villages
migrating in
Rats in Jungle
cats dying
Gecko Population
geckoes being killed
cat\geckoe kill rate
avg speed per geckoe
What's happened is that the average speed per gecko has fallen. Gecko's have become listless and lethargic. They have become easy prey for cats! But why?
Dead Fish
Fallen Beams


Human Population
dying from bubonic plague
rat inmigration rate
Cat Population
Rats in Villages
migrating in
Rats in Jungle
cats dying
Gecko Population
geckoes being killed
cat\geckoe kill rate
avg DDT per geckoe
avg speed per geckoe
DDT in Geckoes
Fallen Beams
Dead Fish
The gecko speed mystery is explainable by their diet. No, not junk food. They've been OD'ing on DDT!
DDT doesn't kill the geckoes, it just slows them down. And that's bad news for geckoes, because they now get eaten by cats. But the bad news doesn't stop there!


Human Population
dying from bubonic plague
rat inmigration rate
Cat Population
cat deaths per geckoe eaten
Rats in Villages
migrating in
Rats in Jungle
cats dying
The DDT doesn't kill the geckoes, but it DOES kill the cats when they eat them...poetic justice, perhaps. But, as you're about to see, it also has some big implications for the rest of the system!
So, how is the DDT getting into the geckoes? No self-respecting gecko would eat the stuff straight-up. Instead, it is coming in from...
Gecko Population
geckoes being killed
cat\geckoe kill rate
Dead Fish
avg DDT per geckoe
avg speed per geckoe
Fallen Beams
DDT in Geckoes



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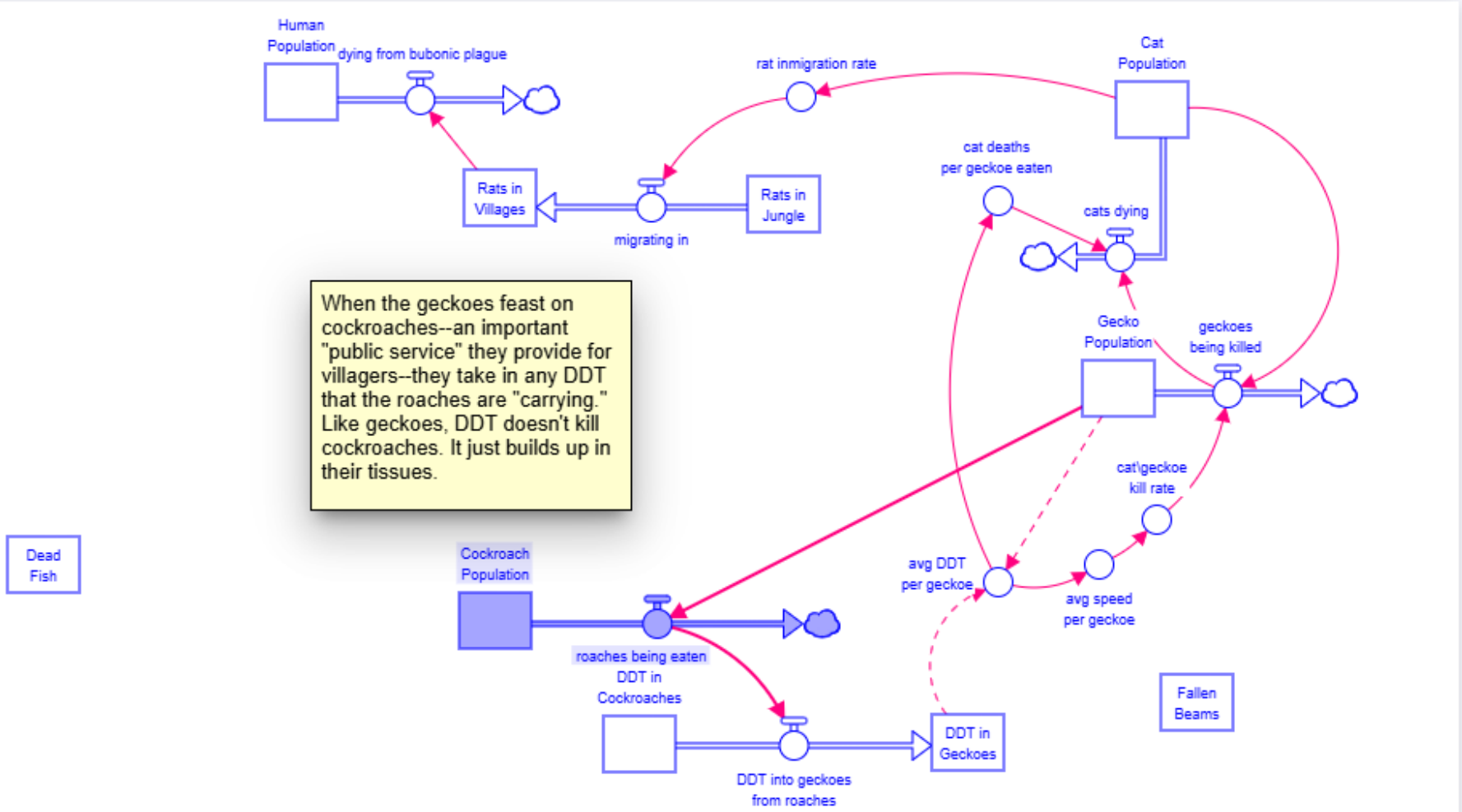

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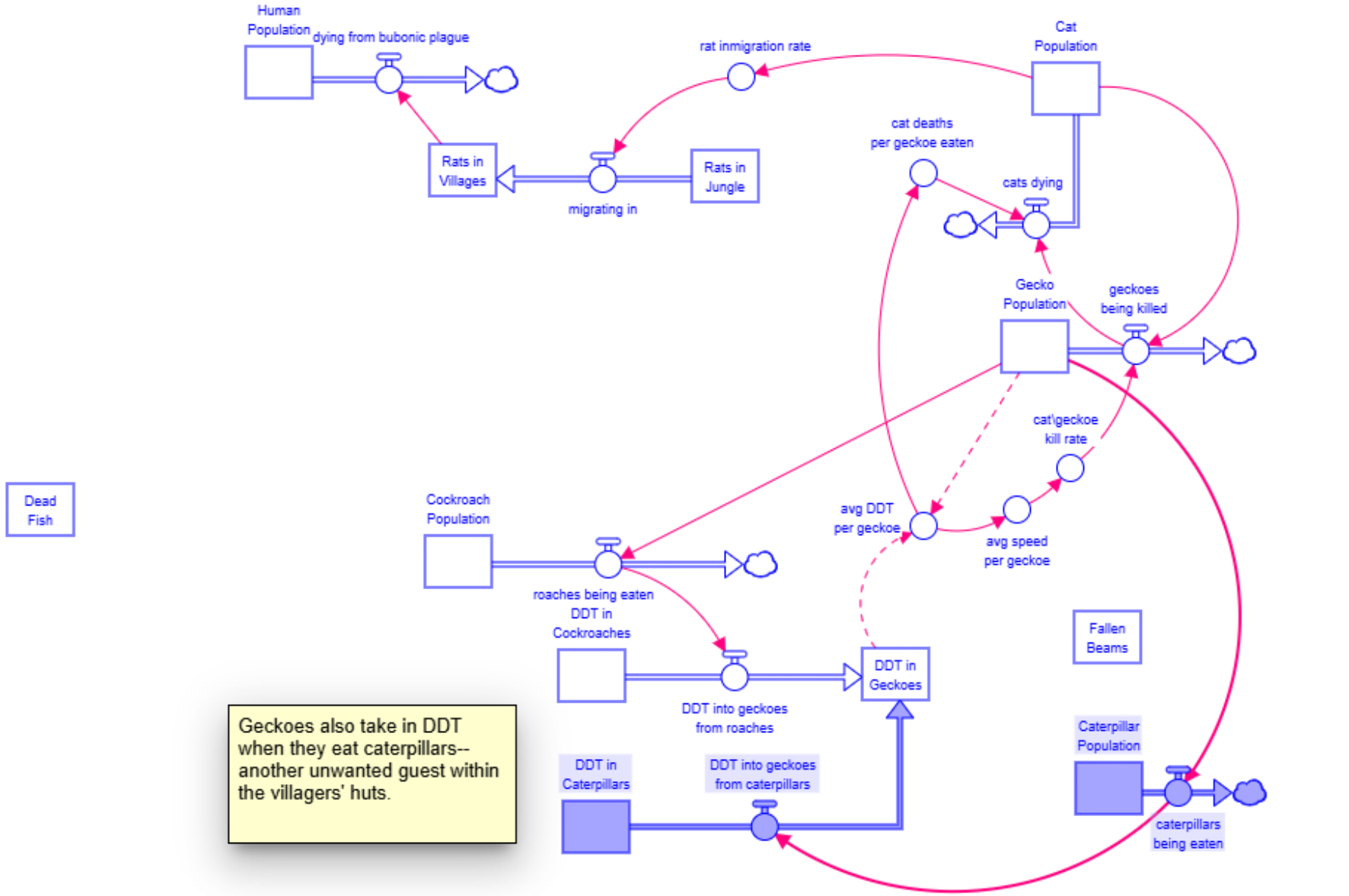

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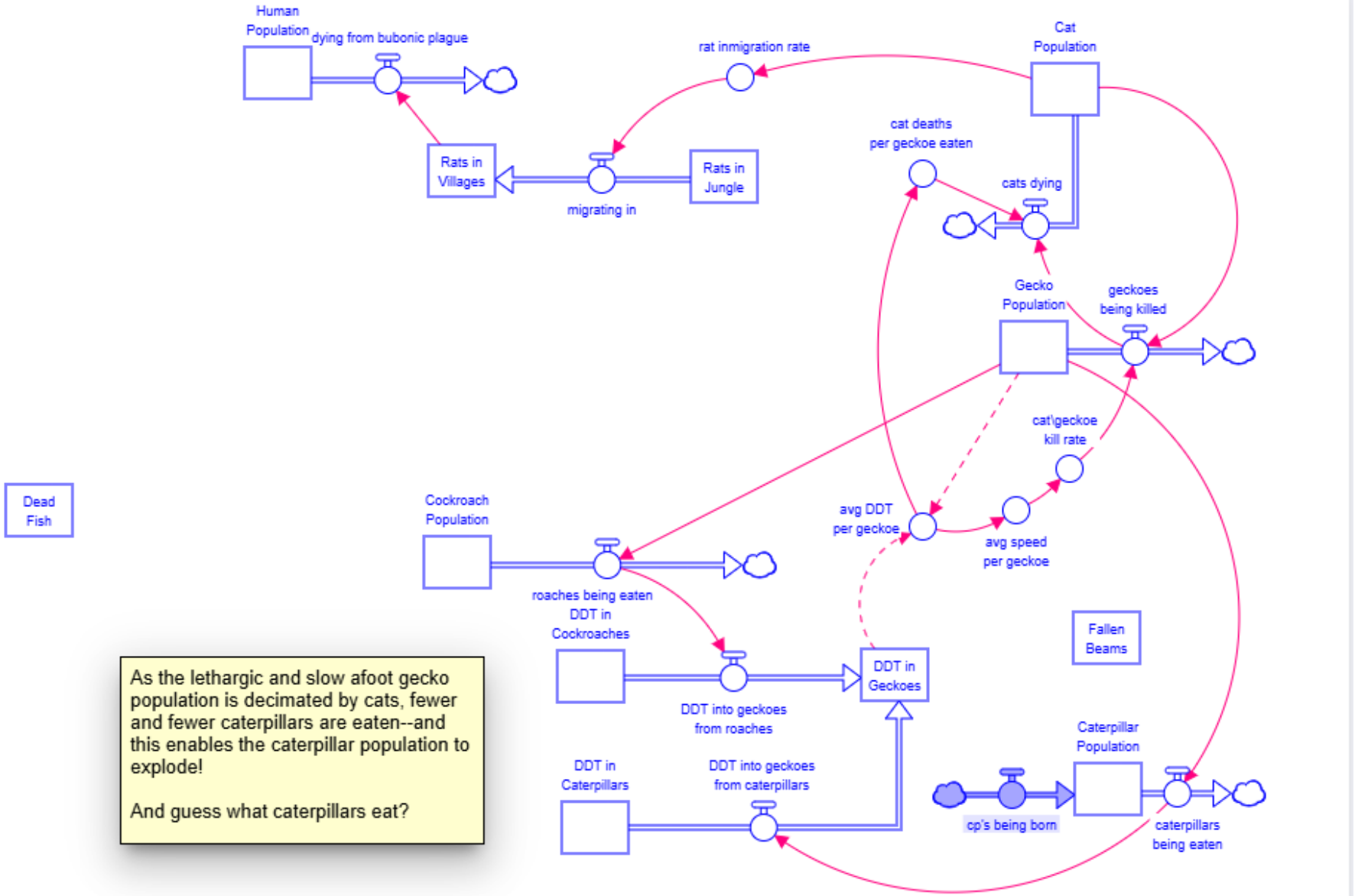
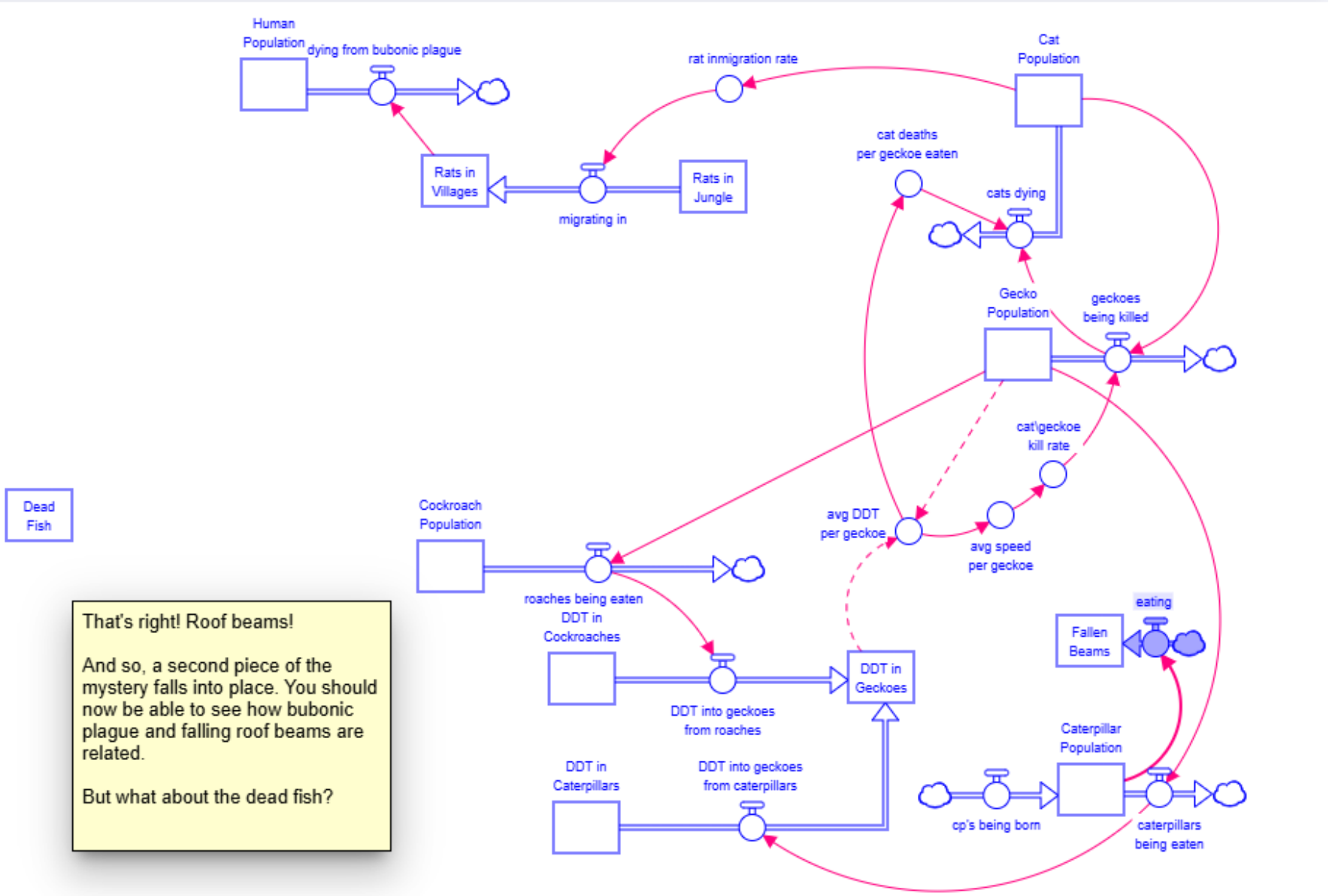
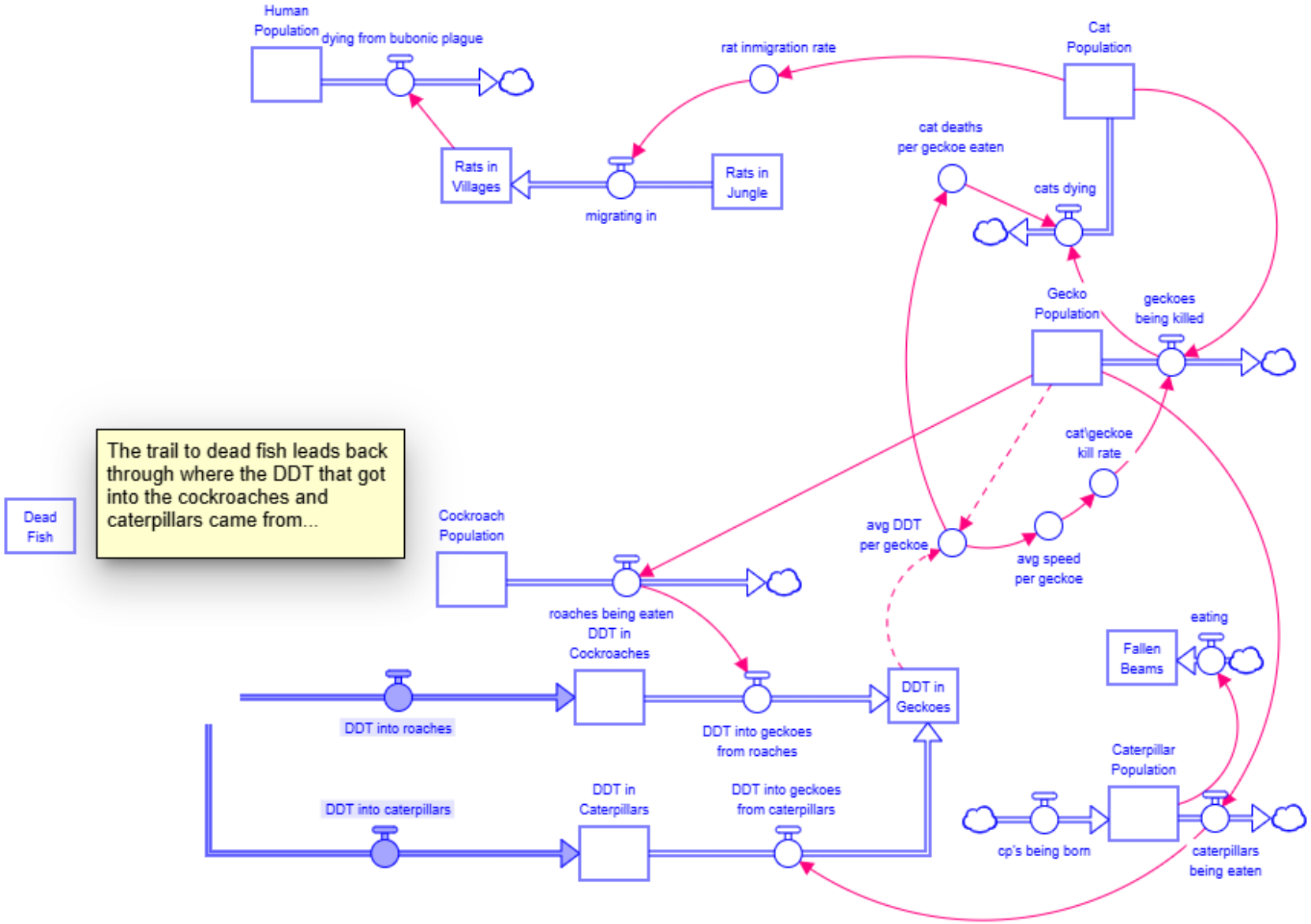

Human Population
dying from bubonic plague
rat inmigration rate
Cat Population
cat deaths per geckoe eaten
cats dying
Rats in Villages
migrating in
Rats in Jungle
Gecko Population
geckoes being killed
cat\geckoe kill rate
Dead Fish
Cockroach Population
avg DDT per geckoe
avg speed per geckoe
roaches being eaten
DDT in Cockroaches
Fallen Beams
DDT in Geckoes
DDT into geckoes from roaches
Caterpillar Population
DDT in Caterpillars
DDT into geckoes from caterpillars
cp's being born
caterpillars being eaten
As the lethargic and slow afoot gecko population is decimated by cats, fewer and fewer caterpillars are eaten--and this enables the caterpillar population to explode!
And guess what caterpillars eat?


Human Population
dying from bubonic plague
rat inmigration rate
Cat Population
cat deaths per geckoe eaten
cats dying
Rats in Villages
migrating in
Rats in Jungle
Gecko Population
geckoes being killed
cat\geckoe kill rate
Dead Fish
Cockroach Population
avg DDT per geckoe
avg speed per geckoe
roaches being eaten DDT in Cockroaches
eating
Fallen Beams
DDT in Geckoes
DDT into geckoes from roaches
Caterpillar Population
DDT in Caterpillars
DDT into geckoes from caterpillars
cp's being born
caterpillars being eaten
That's right! Roof beams!
And so, a second piece of the mystery falls into place. You should now be able to see how bubonic plague and falling roof beams are related.
But what about the dead fish?



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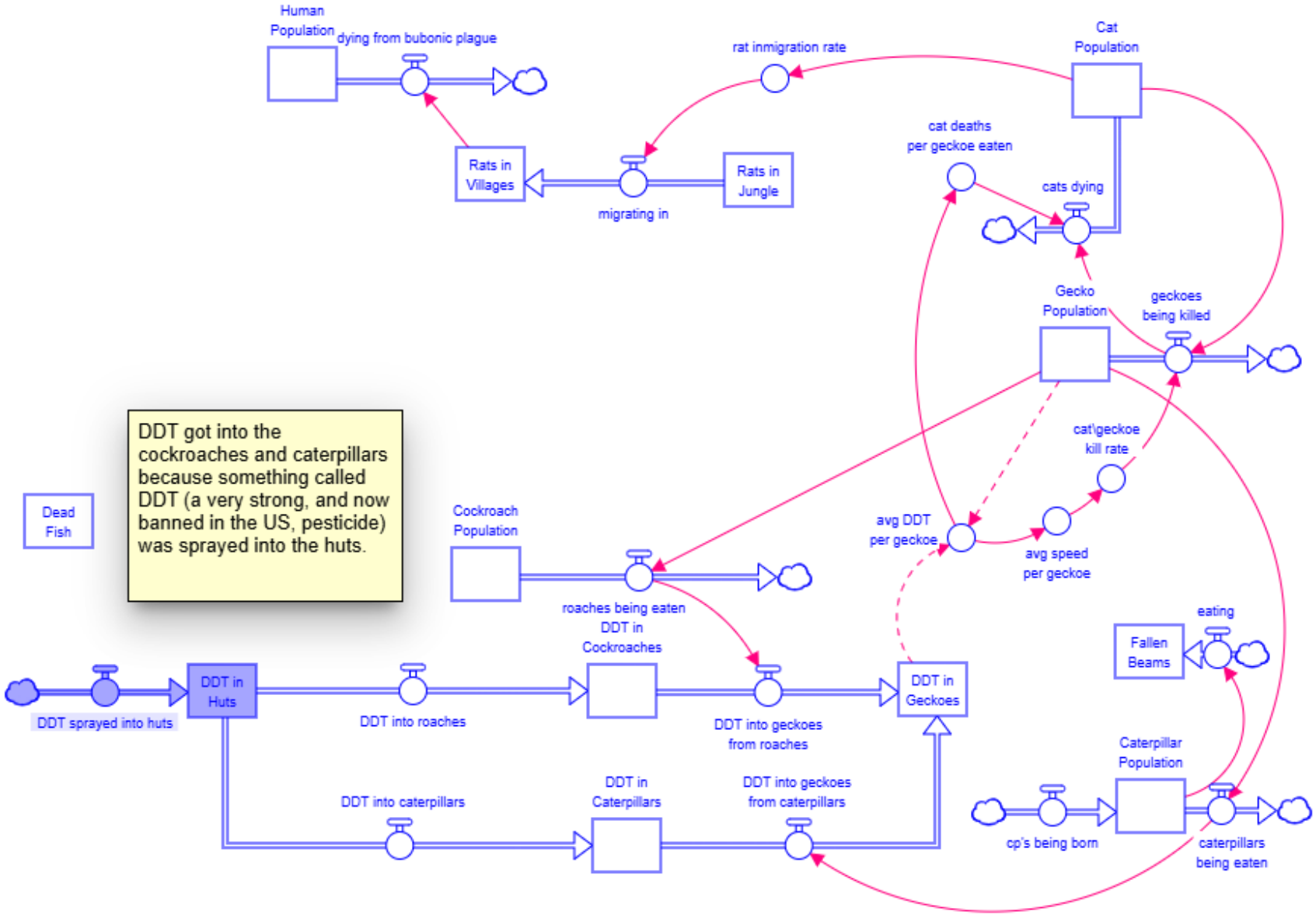

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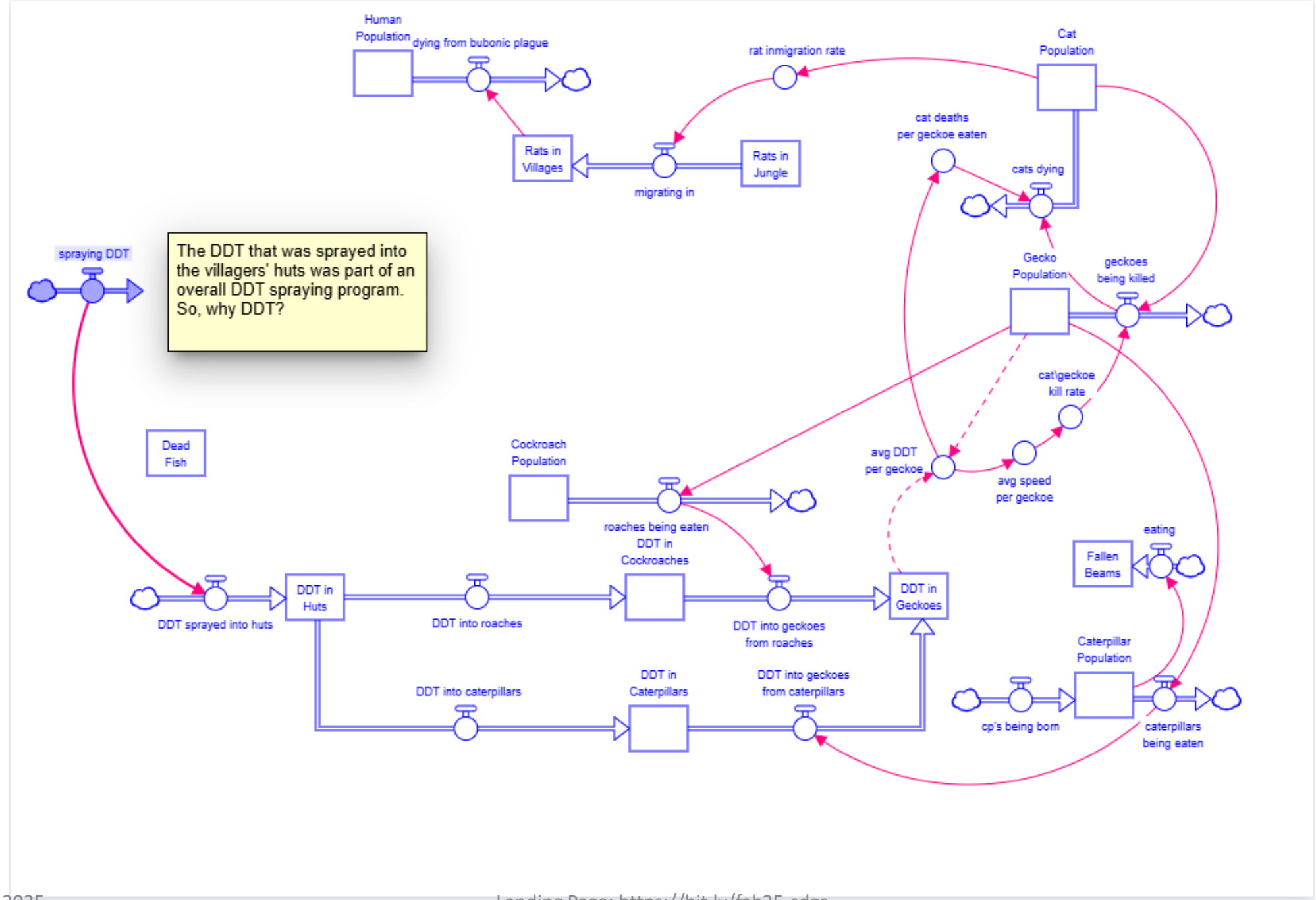
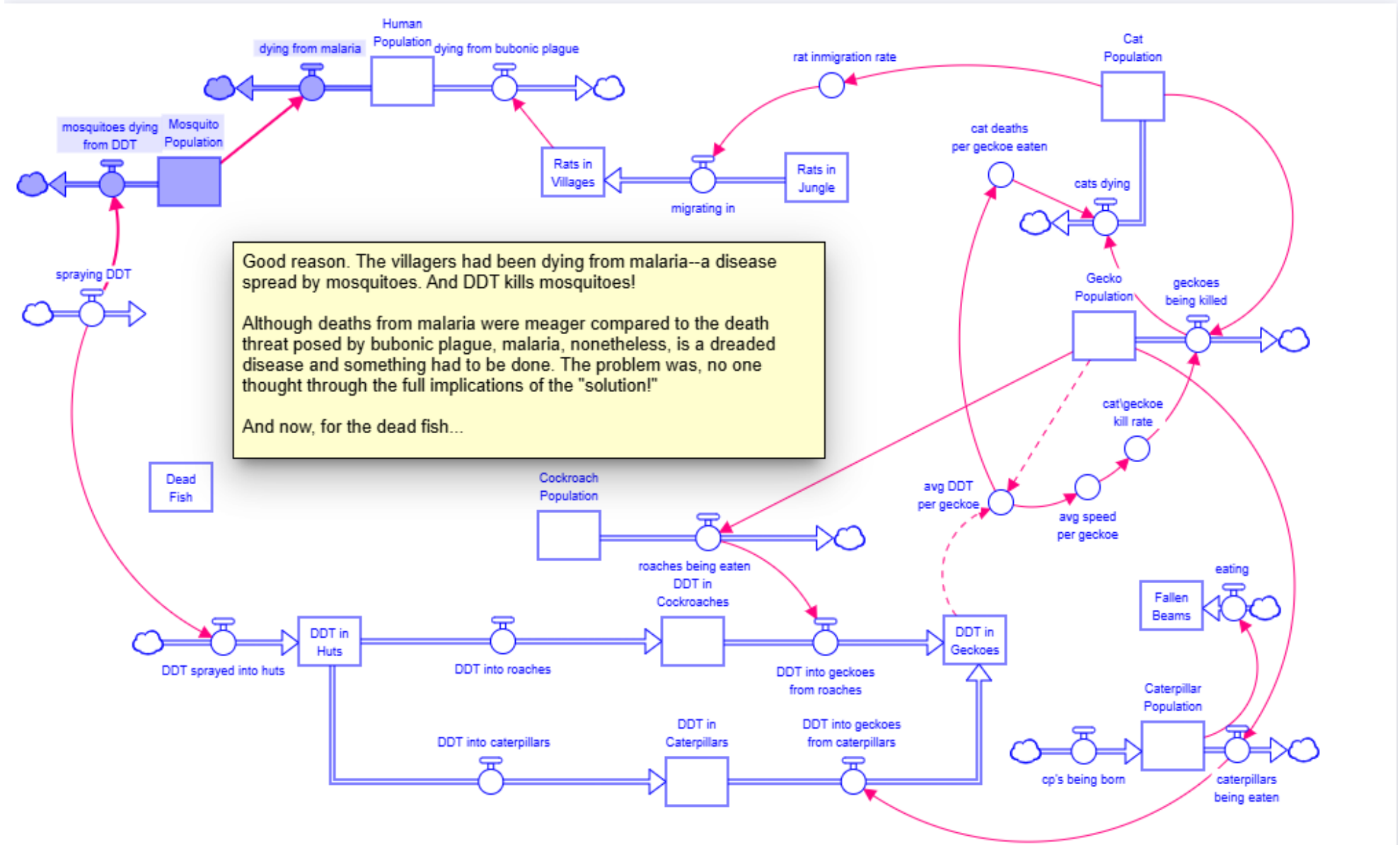
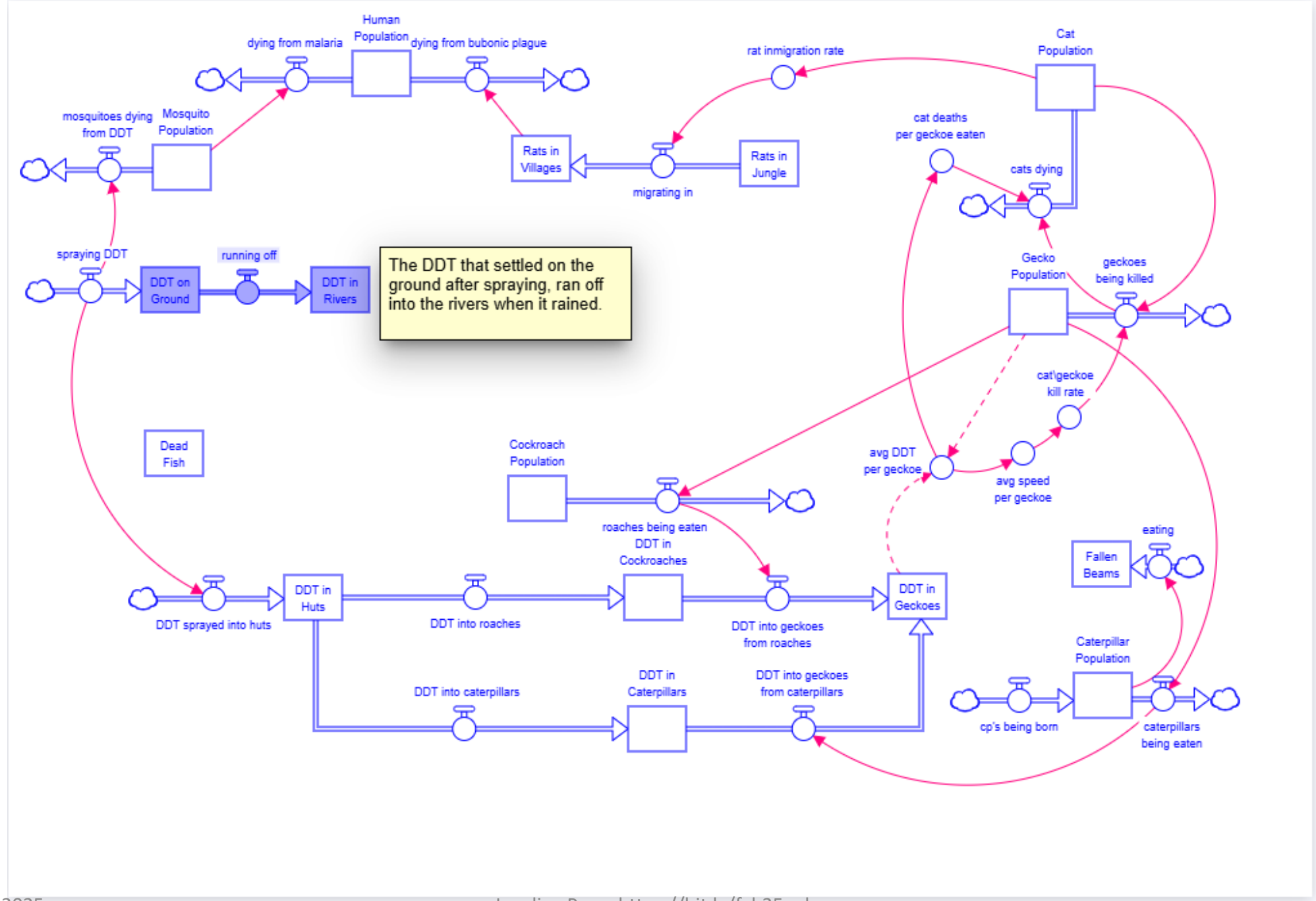

Human Population
dying from bubonic plague
rat inmigration rate
Cat Population
cat deaths per geckoe eaten
Rats in Villages
Rats in Jungle
migrating in
cats dying
spraying DDT
The DDT that was sprayed into the villagers' huts was part of an overall DDT spraying program. So, why DDT?
Gecko Population
geckoes being killed
cat\geckoe kill rate
Dead Fish
Cockroach Population
avg DDT per geckoe
avg speed per geckoe
roaches being eaten DDT in Cockroaches
eating
Fallen Beams
DDT sprayed into huts
DDT in Huts
DDT into roaches
DDT into geckoes from roaches
DDT in Geckoes
Caterpillar Population
DDT into caterpillars
DDT in Caterpillars
DDT into geckoes from caterpillars
cp's being born
caterpillars being eaten


Human Population
dying from malaria
dying from bubonic plague
rat inmigration rate
Cat Population
mosquitoes dying from DDT
Mosquito Population
Rats in Villages
migrating in
Rats in Jungle
cat deaths per geckoe eaten
cats dying
spraying DDT
Gecko Population
geckoes being killed
Good reason. The villagers had been dying from malaria--a disease spread by mosquitoes. And DDT kills mosquitoes!
Although deaths from malaria were meager compared to the death threat posed by bubonic plague, malaria, nonetheless, is a dreaded disease and something had to be done. The problem was, no one thought through the full implications of the "solution!"
And now, for the dead fish...
cat\geckoe kill rate
Dead Fish
Cockroach Population
avg DDT per geckoe
avg speed per geckoe
roaches being eaten
DDT in Cockroaches
eating
Fallen Beams
DDT in Huts
DDT in Geckoes
DDT sprayed into huts
DDT into roaches
DDT into geckoes from roaches
Caterpillar Population
DDT into caterpillars
DDT in Caterpillars
DDT into geckoes from caterpillars
cp's being born
caterpillars being eaten



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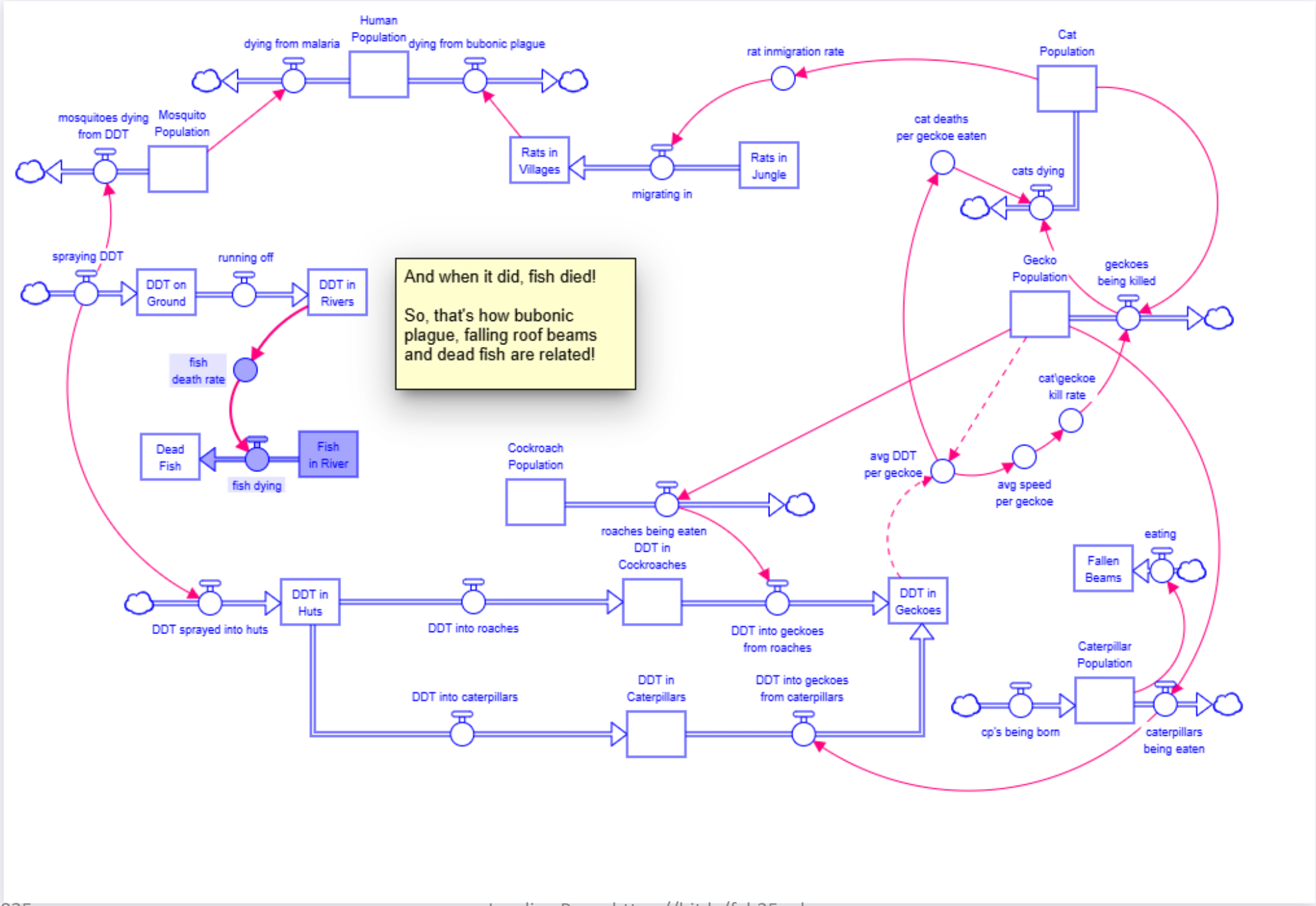
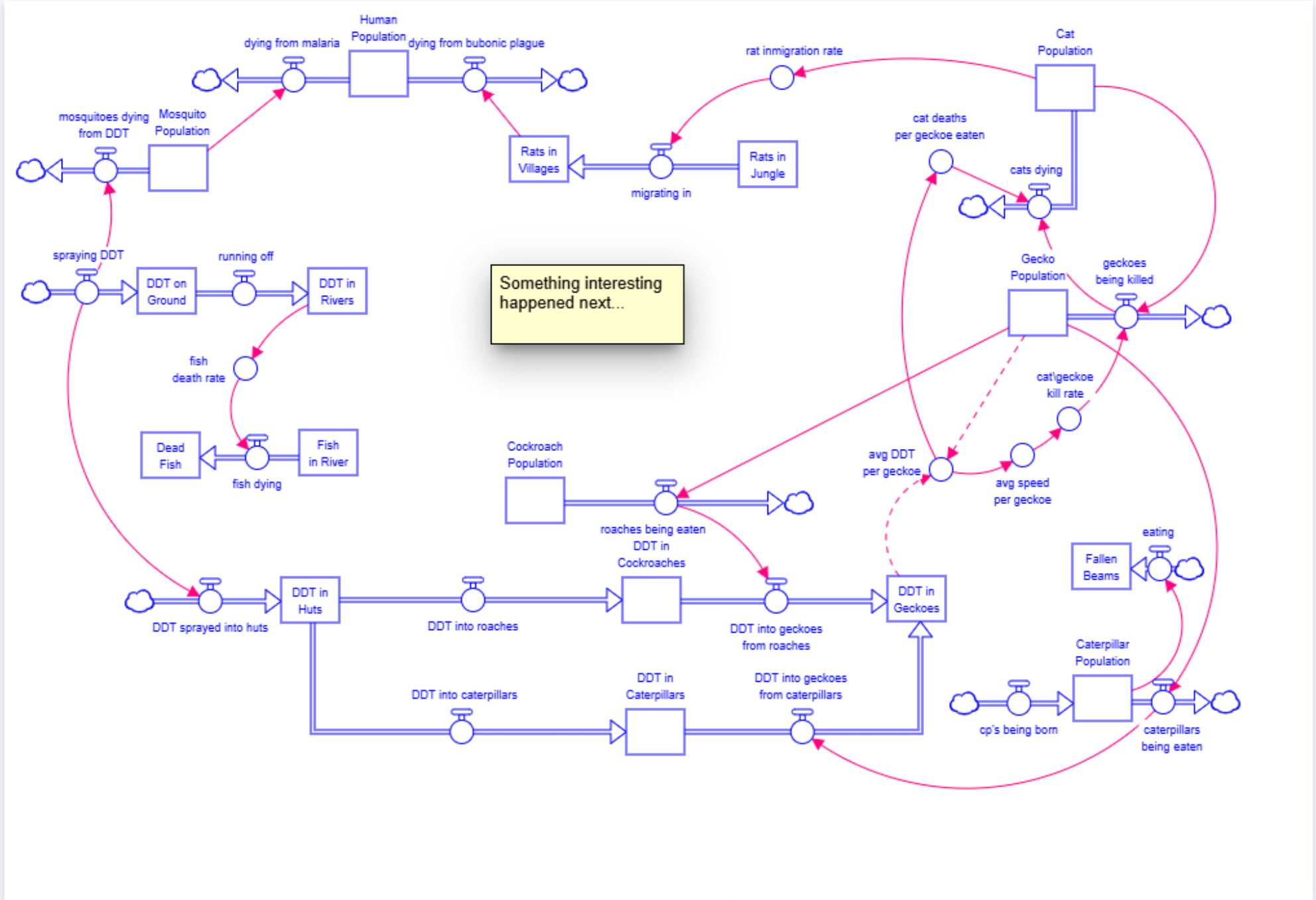

Human Population
dying from malaria
dying from bubonic plague
rat inmigration rate
Cat Population
mosquitoes dying from DDT
Mosquito Population
Rats in Villages
migrating in
Rats in Jungle
cat deaths per geckoe eaten
cats dying
spraying DDT
running off
DDT on Ground
DDT in Rivers
Gecko Population
geckoes being killed
And when it did, fish died!
So, that's how bubonic plague, falling roof beams and dead fish are related!
fish death rate
cat\geckoe kill rate
Dead Fish
Fish in River
fish dying
Cockroach Population
avg DDT per geckoe
avg speed per geckoe
roaches being eaten DDT in Cockroaches
eating
Fallen Beams
DDT in Huts
DDT into roaches
DDT in Geckoes
DDT sprayed into huts
DDT into geckoes from roaches
Caterpillar Population
DDT into caterpillars
DDT in Caterpillars
DDT into geckoes from caterpillars
cp's being born
caterpillars being eaten



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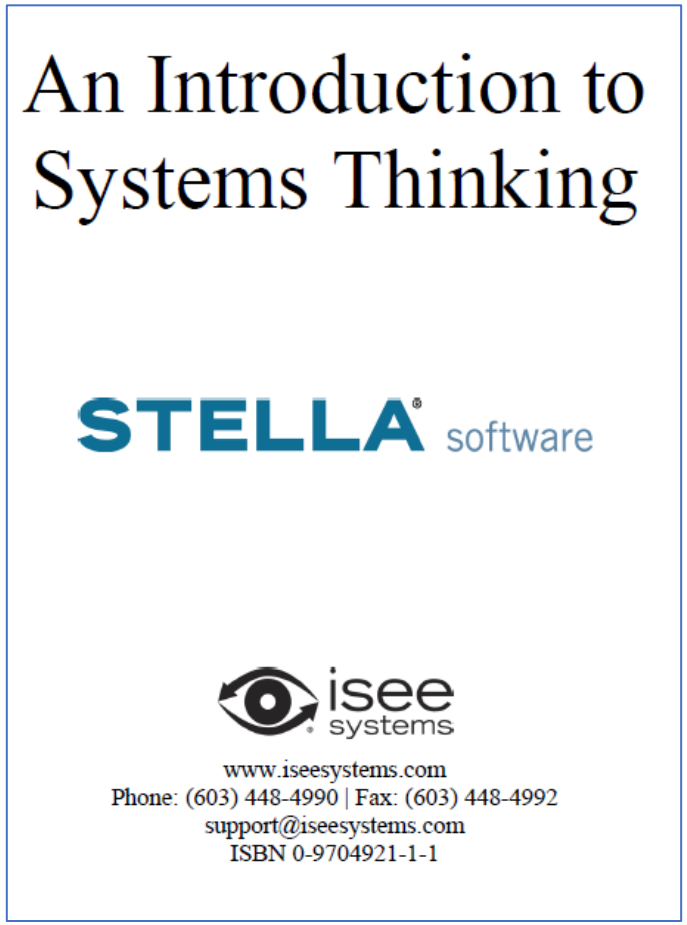
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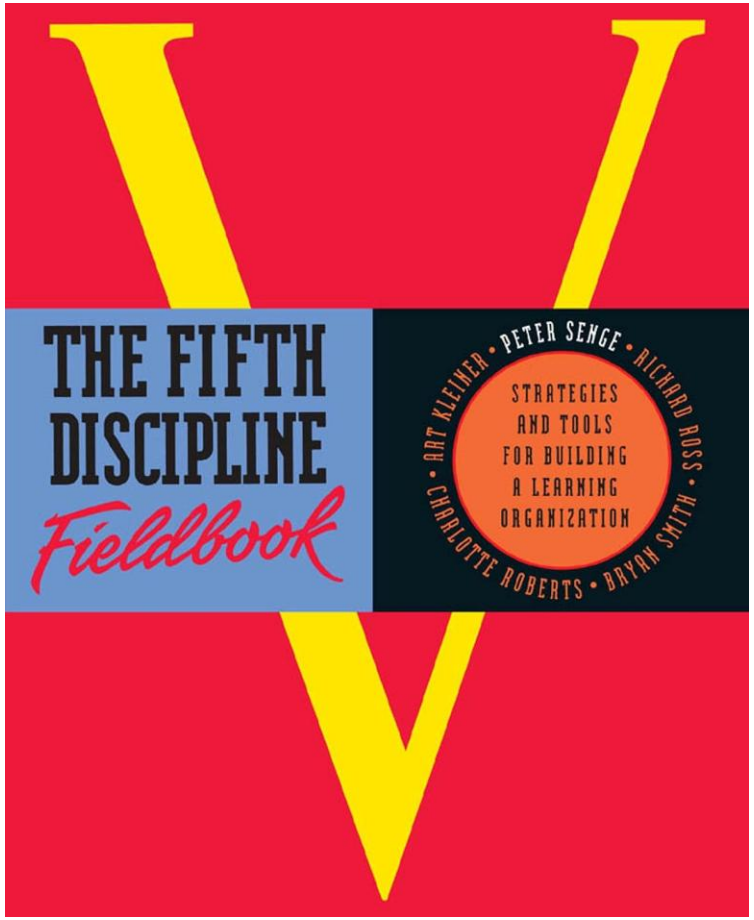
ISBN 0-9704921-1-1

The Learning Organization



1. Personal mastery
2. Mental models
3. Shared vision
4. Team learning
5. Systems thinking

Systems Thinking

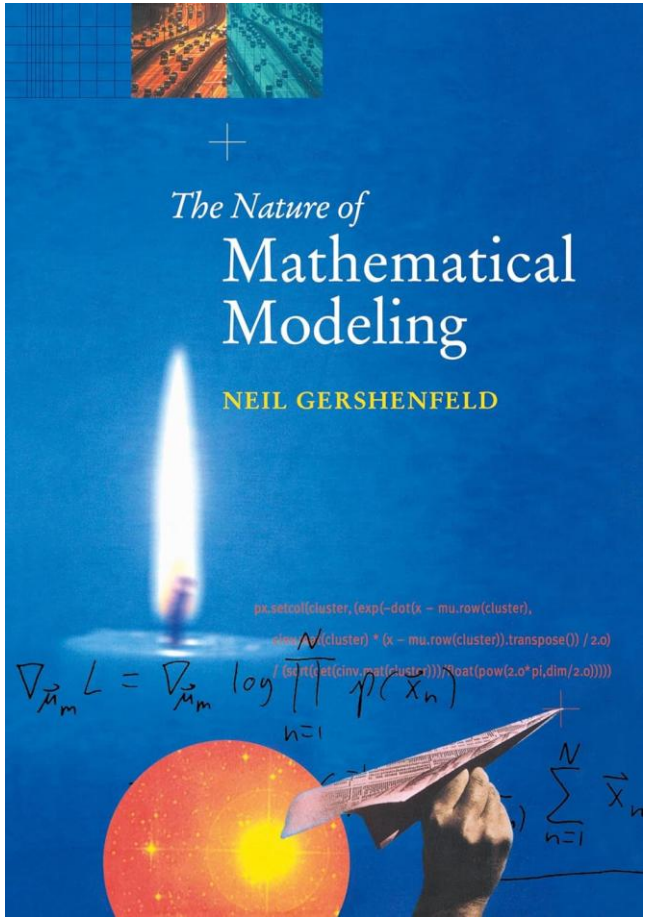
Conclusions:

- Inclusion of local expertise
- Inclusion of a variety of disciplines
- Systems view, stocks and flows
- Structural solutions
- Qualitative model
- AND: “All we need is a pencil”

System Dynamics

Developing a mathematical model
Simulation of the model in time via computer

Mathematical model



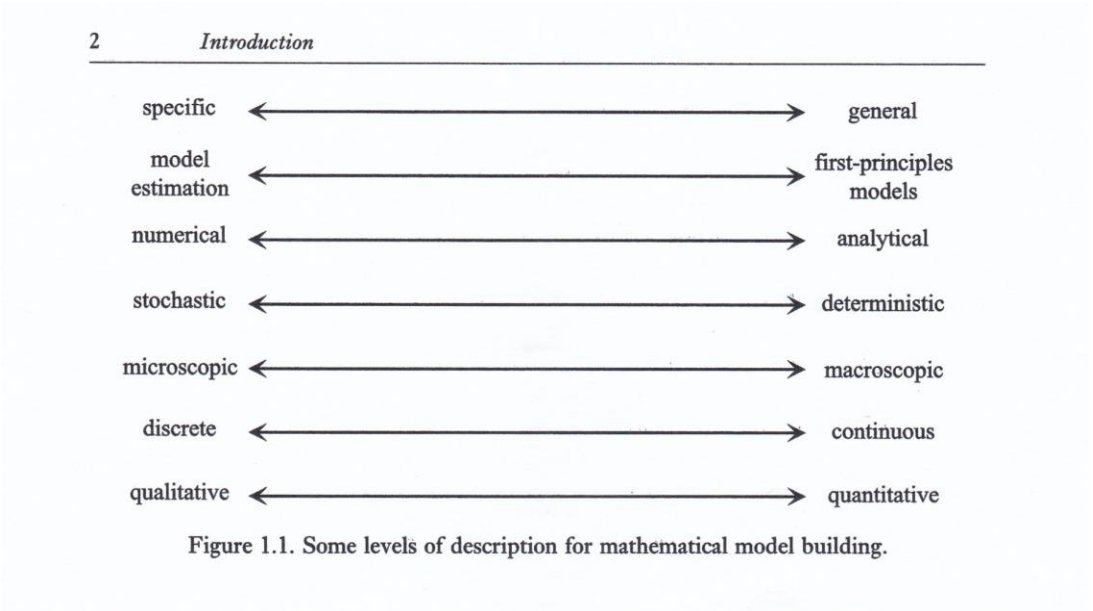


Figure 1.1. Some levels of description for mathematical model building.

Industrial dynamics

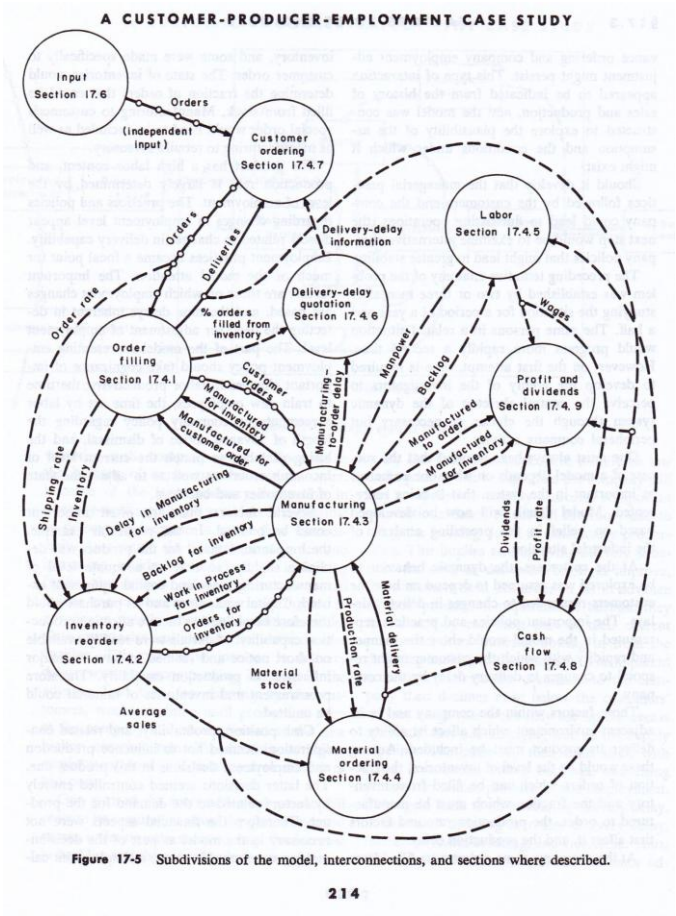


Figure 17-5 Subdivisions of the model, interconnections, and sections where described.

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Urban Dynamics

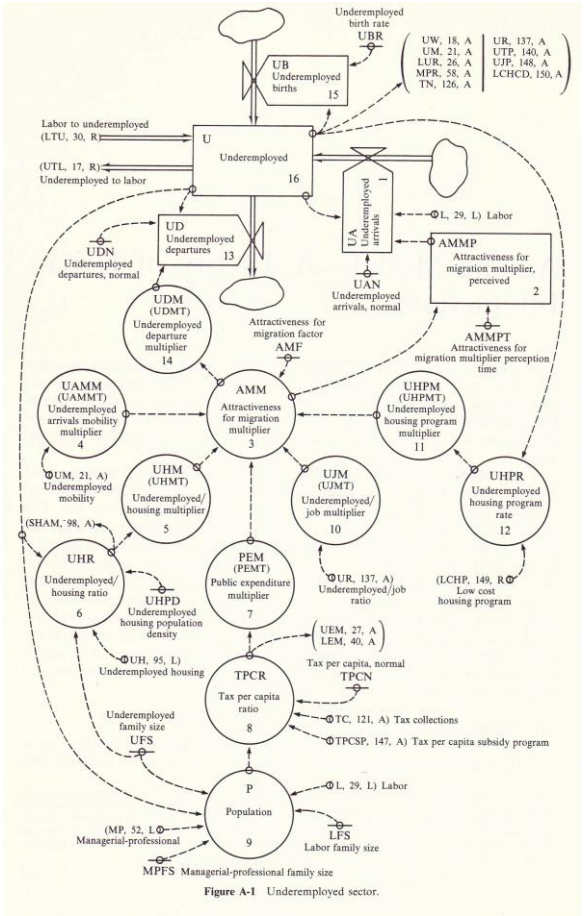


Figure A-1 Underemployed sector.

Cybernetics

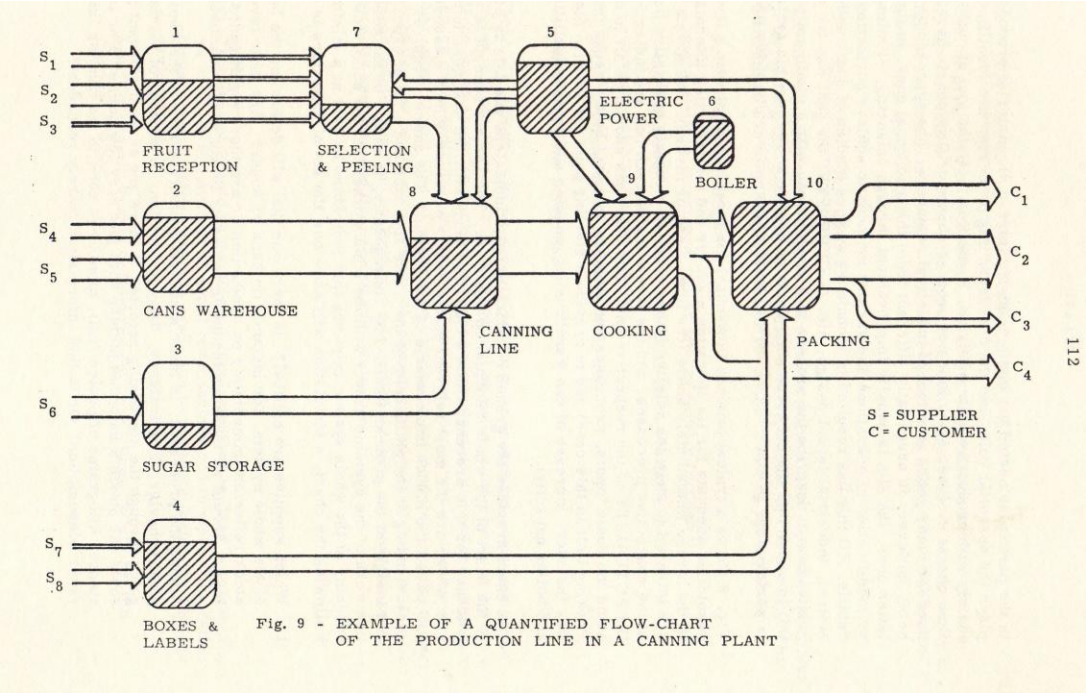


Fig. 9 - EXAMPLE OF A QUANTIFIED FLOW-CHART OF THE PRODUCTION LINE IN A CANNING PLANT

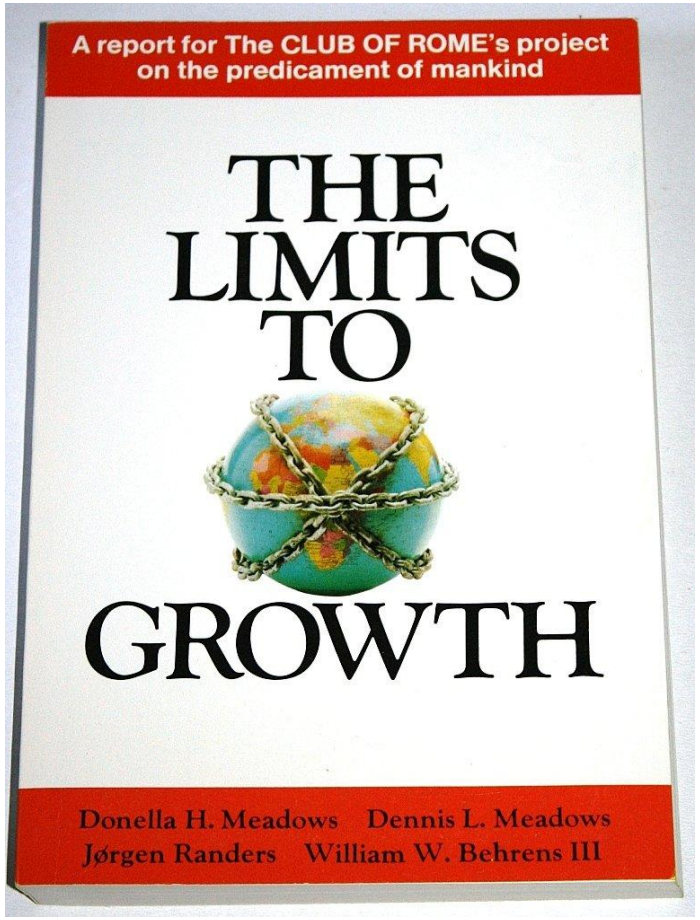
Simulation of the mathematical model

Software

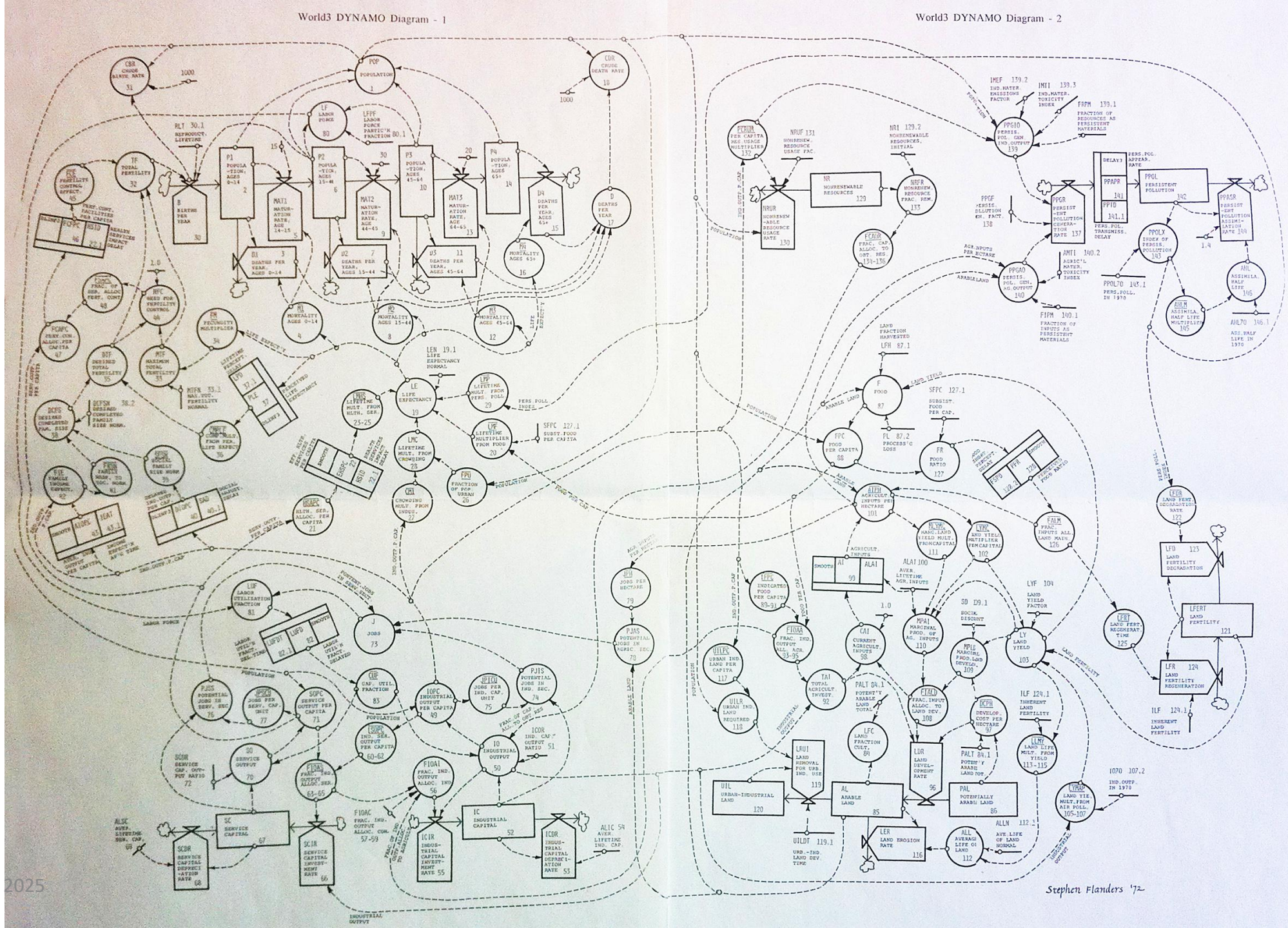
- DYNAMO programming language
- Stella
- iThink
- VenSim
- General purpose languages like Basic, Python, etc.

Method

- Numerical simulation
- DT maybe varied



- Dennis and Donella Meadows et al. 1972
- Scientific report: The Limits to Growth in a Finite World


World3 DYNAMO Diagram - 1
World3 DYNAMO Diagram - 2
Stephen Flanders '72

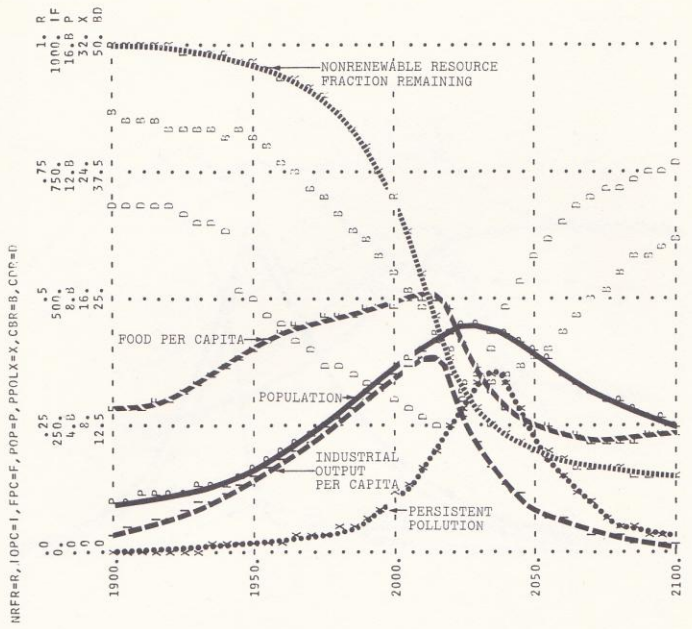


Figure 7-7 Run 7-6A: World3 reference run

This is the World3 reference run, to be compared with the sensitivity and policy tests that follow. Both population POP and industrial output per capita IOPC grow beyond sustainable levels and subsequently decline. The cause of their decline is traceable to the depletion of nonrenewable resources. Runs 7-6B and 7-6C illustrate the mechanisms that force population POP and industrial output per capita IOPC to decline.

- Global Standard Run
- 1900-2100

System Dynamics

Conclusion

- Mathematical model
  - Non-lineair, continuous, numeric
  - Needs to be validated, especially behaviour in extreme conditions
- Once a model has been validated:
  - Study its behaviour over time
  - Study its behaviour under changing assumptions
  - Counterintuitive behaviour
  - Distinction between symptom control and structural solutions

Gaming/Simulation

Combination of a computer simulation with a (non-computer gaming)

Game

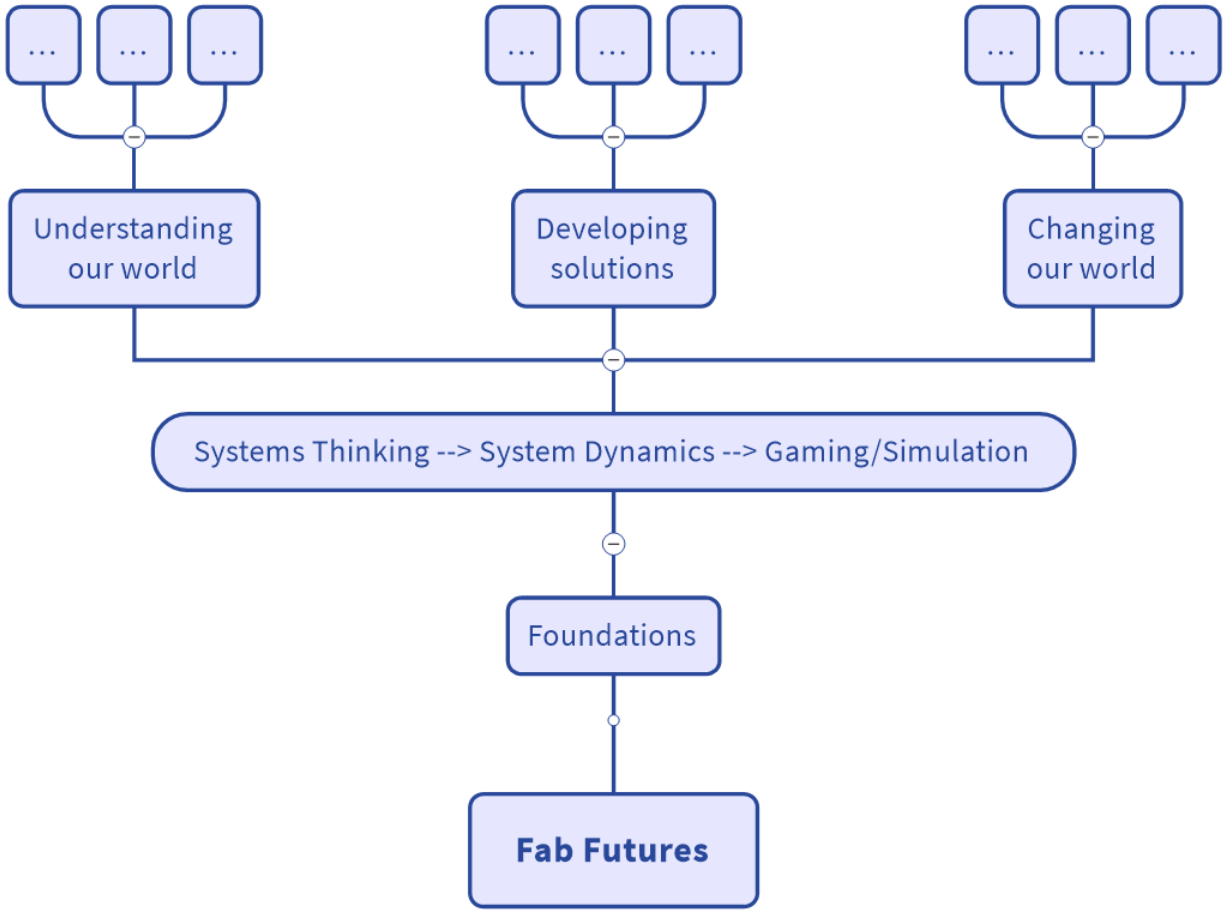
- Stand-alone or integrated with simulation model
- Frame Game
- Chain Game

Gaming/Simulation

Conclusion

- To create a living lab to study the game participants
- To communicate a complex message to particpants
- To train participants in new skills
- To let participants explore new policies

Follow-up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Understanding our world
Developing solutions
Changing our world
Systems Thinking --> System Dynamics --> Gaming/Simulation
Foundations
Fab Futures

Thank You!

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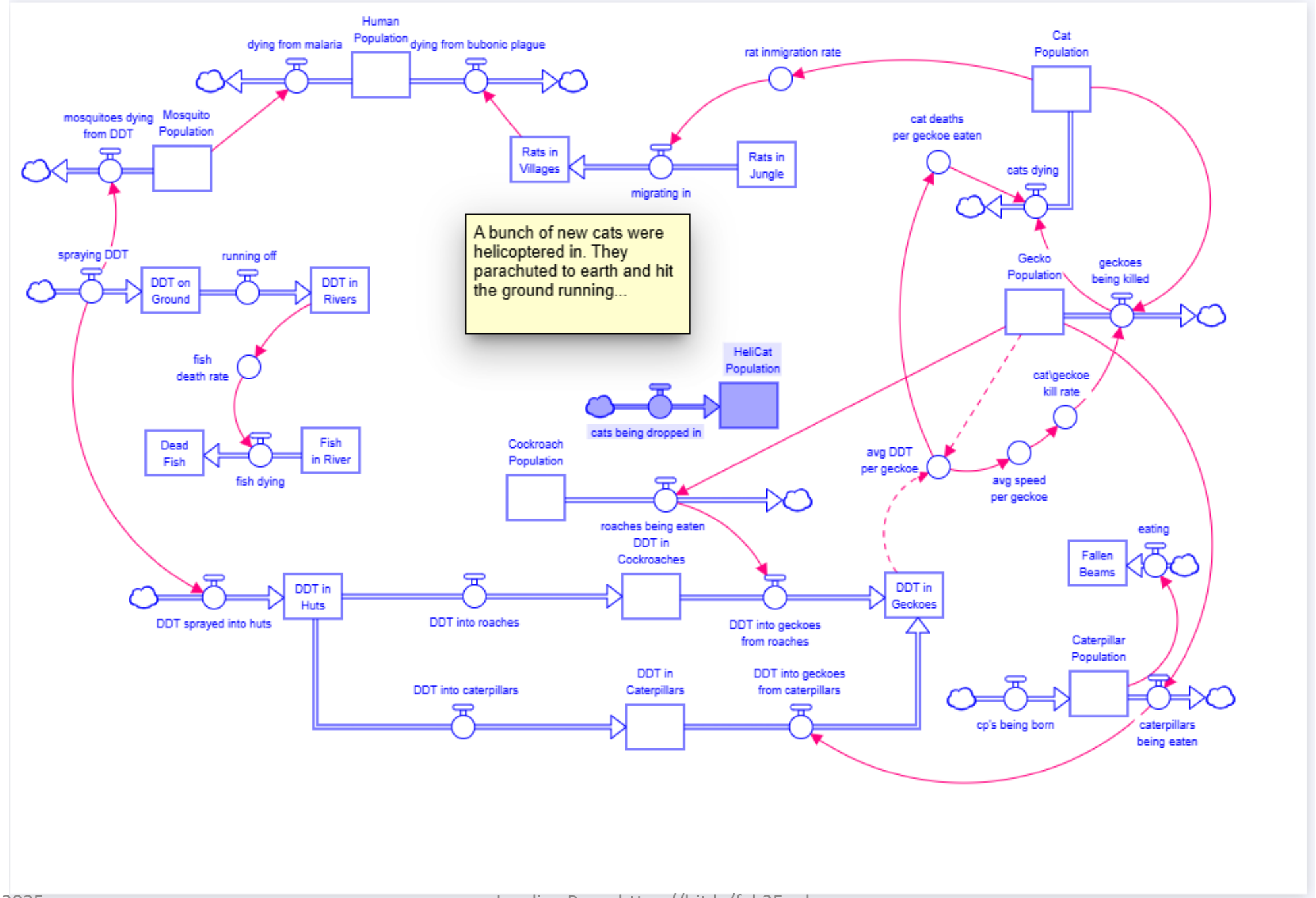
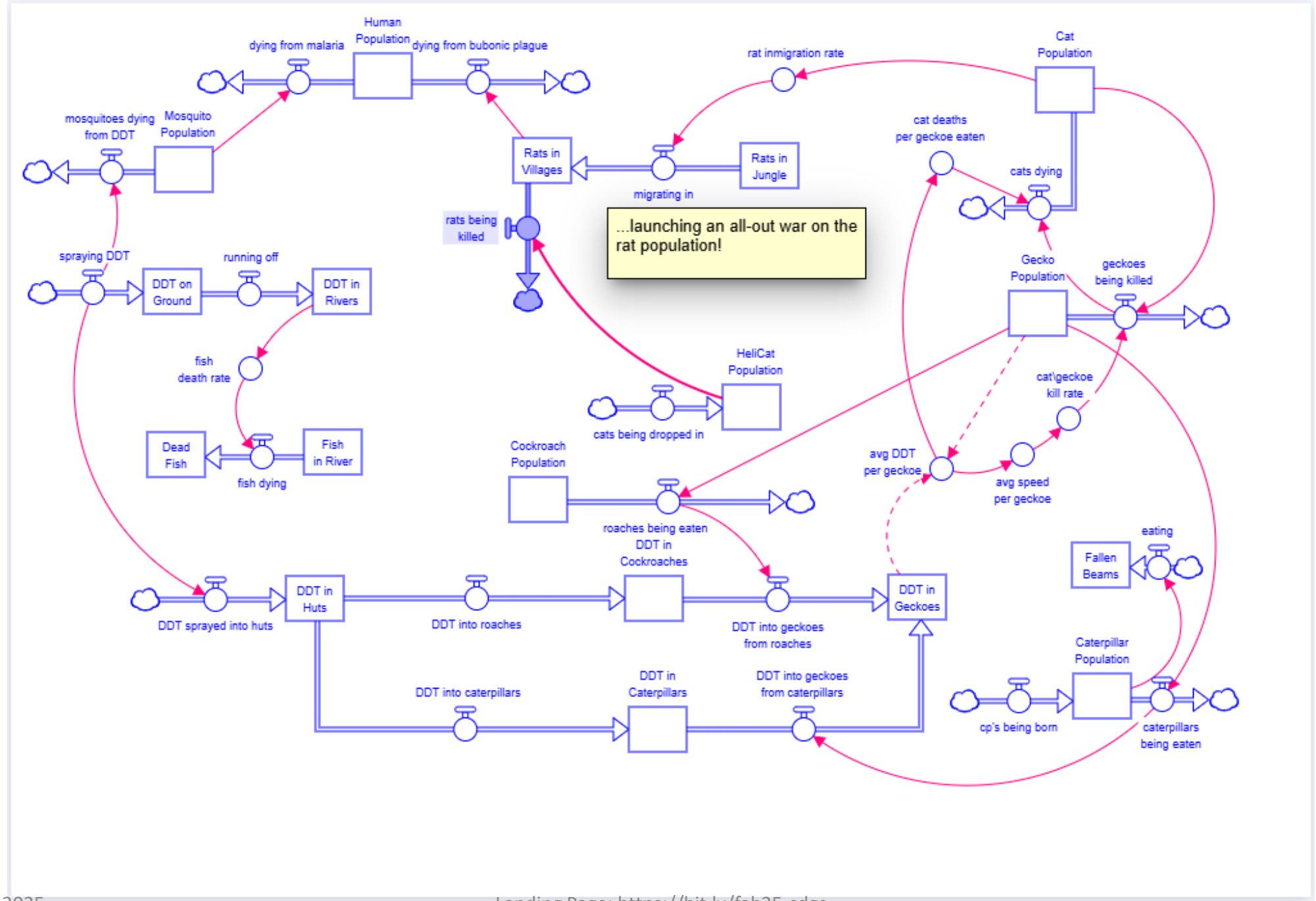

Human Population
dying from malaria
dying from bubonic plague
rat inmigration rate
Cat Population
mosquitoes dying from DDT
Mosquito Population
Rats in Villages
migrating in
Rats in Jungle
cat deaths per geckoe eaten
cats dying
A bunch of new cats were helicoptered in. They parachuted to earth and hit the ground running...
spraying DDT
running off
DDT on Ground
DDT in Rivers
Gecko Population
geckoes being killed
fish death rate
HeliCat Population
cats being dropped in
cat\geckoe kill rate
Dead Fish
Fish in River
fish dying
Cockroach Population
avg DDT per geckoe
avg speed per geckoe
roaches being eaten
DDT in Cockroaches
eating
Fallen Beams
DDT sprayed into huts
DDT in Huts
DDT into roaches
DDT into geckoes from roaches
DDT in Geckoes
Caterpillar Population
DDT into caterpillars
DDT in Caterpillars
DDT into geckoes from caterpillars
cp's being born
caterpillars being eaten



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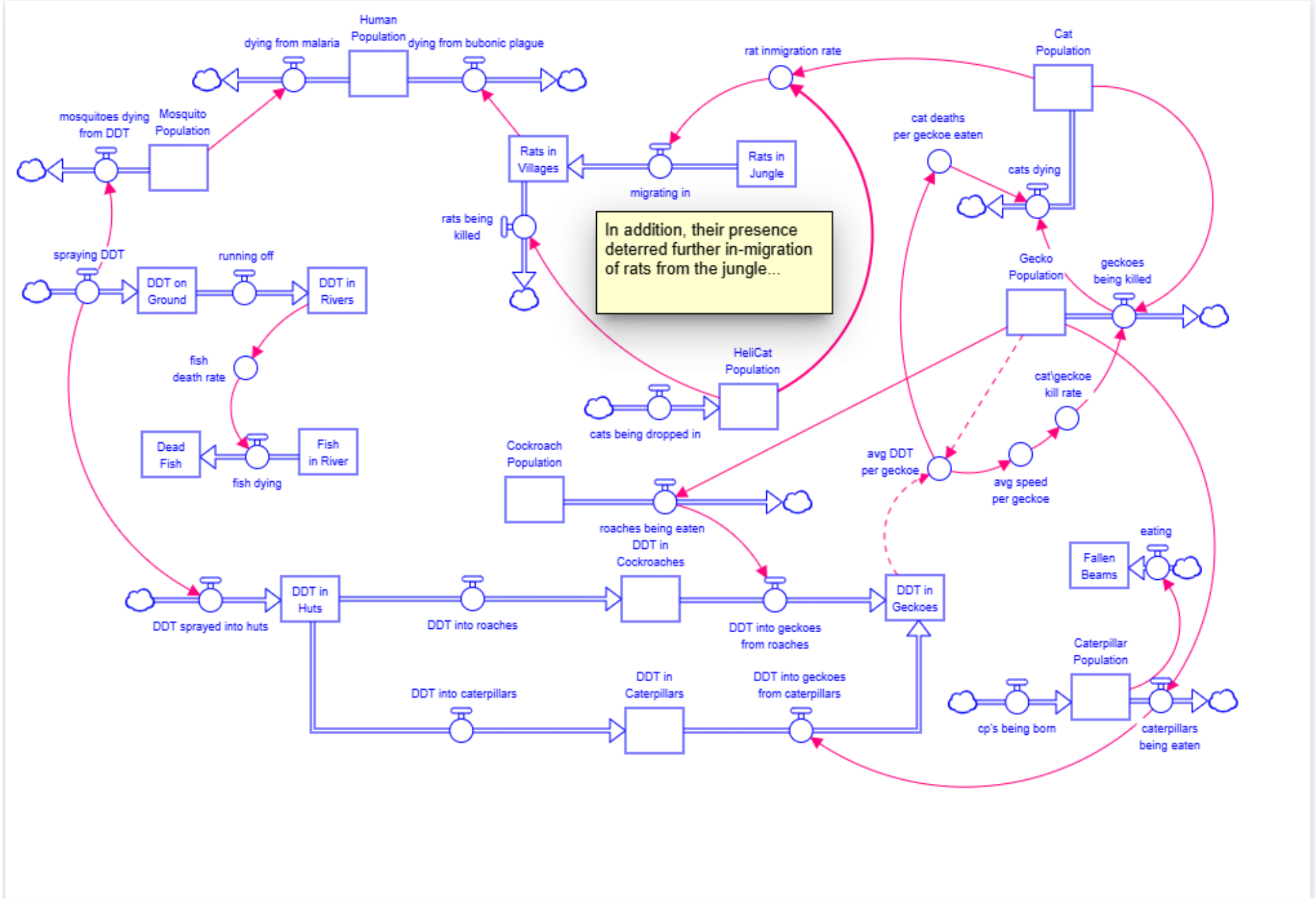

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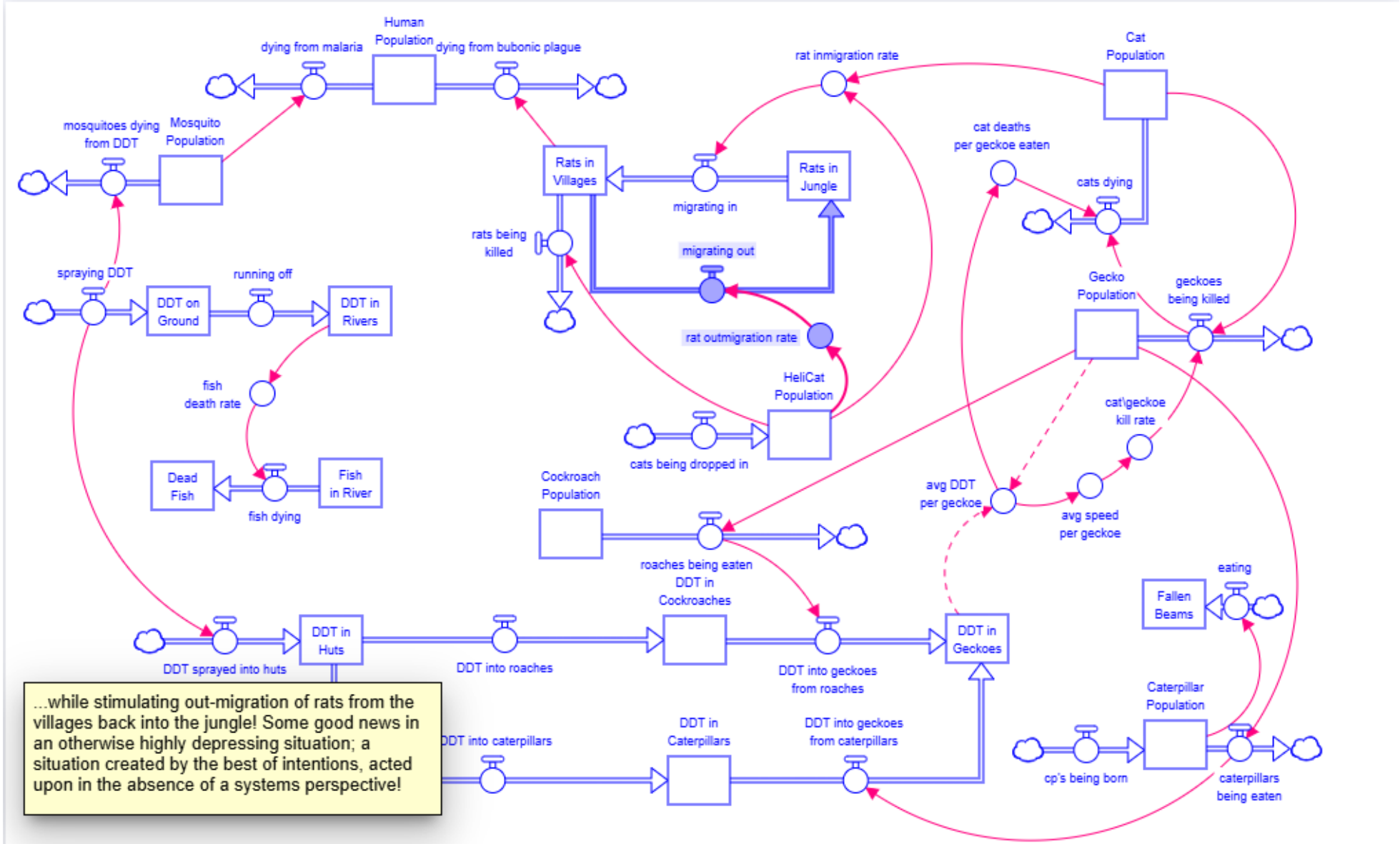
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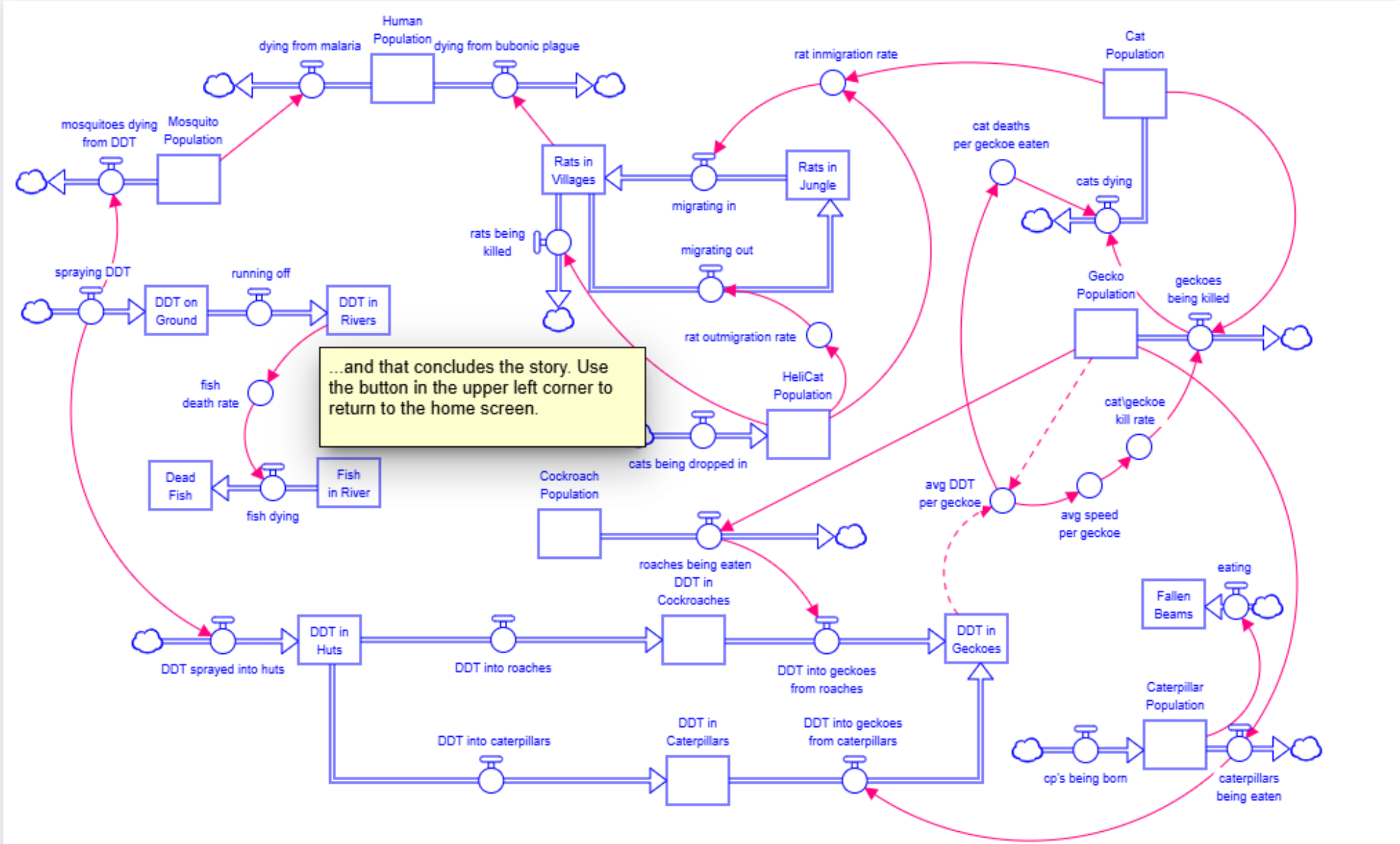
eating
Fallen Beams
DDT in Huts
DDT sprayed into huts
DDT into roaches
DDT in Geckoes
DDT into geckoes from roaches
Caterpillar Population
DDT into caterpillars
DDT in Caterpillars
DDT into geckoes from caterpillars
cp's being born
caterpillars being eaten
...while stimulating out-migration of rats from the villages back into the jungle! Some good news in an otherwise highly depressing situation; a situation created by the best of intentions, acted upon in the absence of a systems perspective!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Mosquito Population
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Rats in Jungle
cat deaths per geckoe eaten
cats dying
rats being killed
migrating out
spraying DDT
running off
DDT on Ground
DDT in Rivers
Gecko Population
geckoes being killed
rat outmigration rate
...and that concludes the story. Use the button in the upper left corner to return to the home screen.
fish death rate
HeliCat Population
cat\geckoe kill rate
Dead Fish
Fish in River
fish dying
cats being dropped in
Cockroach Population
avg DDT per geckoe
avg speed per geckoe
roaches being eaten DDT in Cockroaches
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Fallen Beams
DDT in Huts
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