

# A Brief Journey Through Complexity

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## What is causation?

Aristotle said there are four kinds of causes...

**Material:** *What's for breakfast?*



**Efficient:** *How is it made?*



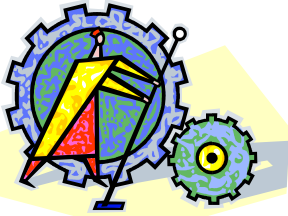
**Formal:** *What's the recipe?*



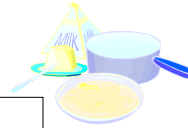
**Final:** *I'm hungry*



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# What is a Mechanism?

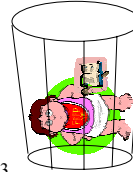


**Material:** What's for breakfast?  
**Efficient:** How is it made?

~~**Formal?** Forget the recipe, the cook is blind.  
**Final?** What cause? Eating has no purpose.~~

*Mechanistic science tries to reduce formal and final cause to material and efficient cause, or ...*

*Formal cause = Platonic laws, Pattern is an "emergent property" of a system*

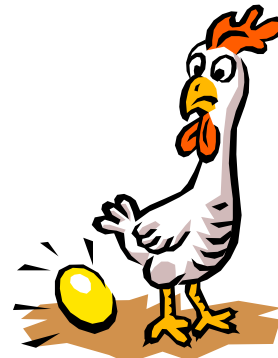


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# What is an Organism?

**Material:** Matter  
**Efficient:** Process  
**Formal:** Design  
**Final:** Purpose



*Its a whole...*

*... that embodies all of its causes, and therefore causes itself.*



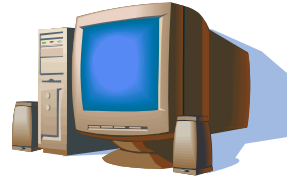
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# Can Mechanisms Describe Organisms?

**Material description:** What is it made of?

**Efficient description:** How does it work?

What is the mechanistic view of nature?



*Material cause:* things + energy

*Efficient cause:* behaviors



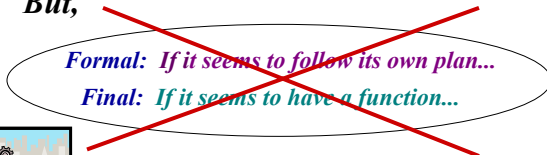
“Good mechanistic science”



**But,**

*Formal: If it seems to follow its own plan...*

*Final: If it seems to have a function...*



You get

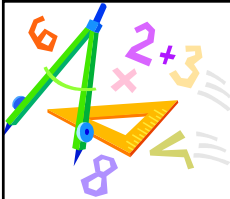
Impredicativity  
Indeterminism  
Metaphysics



**Then mechanistic theories fail!**

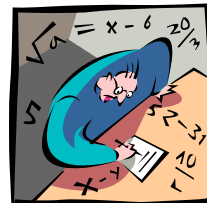


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Mechanisms are calculable, but is everything real calculable?

Mathematics itself is incomplete  
Goedel



Therefore mechanisms cannot fully describe organisms - Rosen



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# How we Look



Determines What we See

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## Can The Organic View Describe Machines?

*Hint: Organic vs. inorganic vs. mechanical vs. scientific vs. mathematical vs. engineering*



**Material:** What is it made of?

**Efficient:** How does it work?

**Formal:** How is it designed?

**Final:** What is its purpose?

Intrinsic system

So, what is the organic view of a machine?

Extrinsic system

**Material:** matter and energy  
**Efficient:** processes  
**Formal:** laws of nature  
**Final:** quantum or origins

**Material:** parts  
**Efficient:** manufacturing  
**Formal:** schematics  
**Final:** marketing

Both are **inherently complex**

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## Occam's Razor For Mechanists

*Keep it Simple?*

**"Organisms ain't nothin' but machines"**



### What did Occam really say?

*"One should not do with more, what  
can be done with less."*

***An infinite number of mechanisms are needed  
to explain an organism...***

***...the organic view does it with less.***

# IT Takes An Organism To See An Organism

*Natural System*

**Material:** What's it made of?  
**Efficient:** How does it work?  
**Formal:** How is it designed?  
**Final:** What is its purpose?



sees



*Formal System*

**Material:** Energy and material flows  
**Efficient:** Transformation processes  
**Formal:** Evolved patterns / encodings  
**Final:** Life strategies and goals



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## Complexity Puts Mechanism Back Into Relationship with Function



**Material:** What components?  
**Efficient:** How does it work?

Structure/dynamics

Encoding



**Formal:** What design?  
**Final:** What purpose?

Function/meaning

Decoding

*A Rosen Modeling Relation...*

*... and a complex complementarity between form and function.*

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