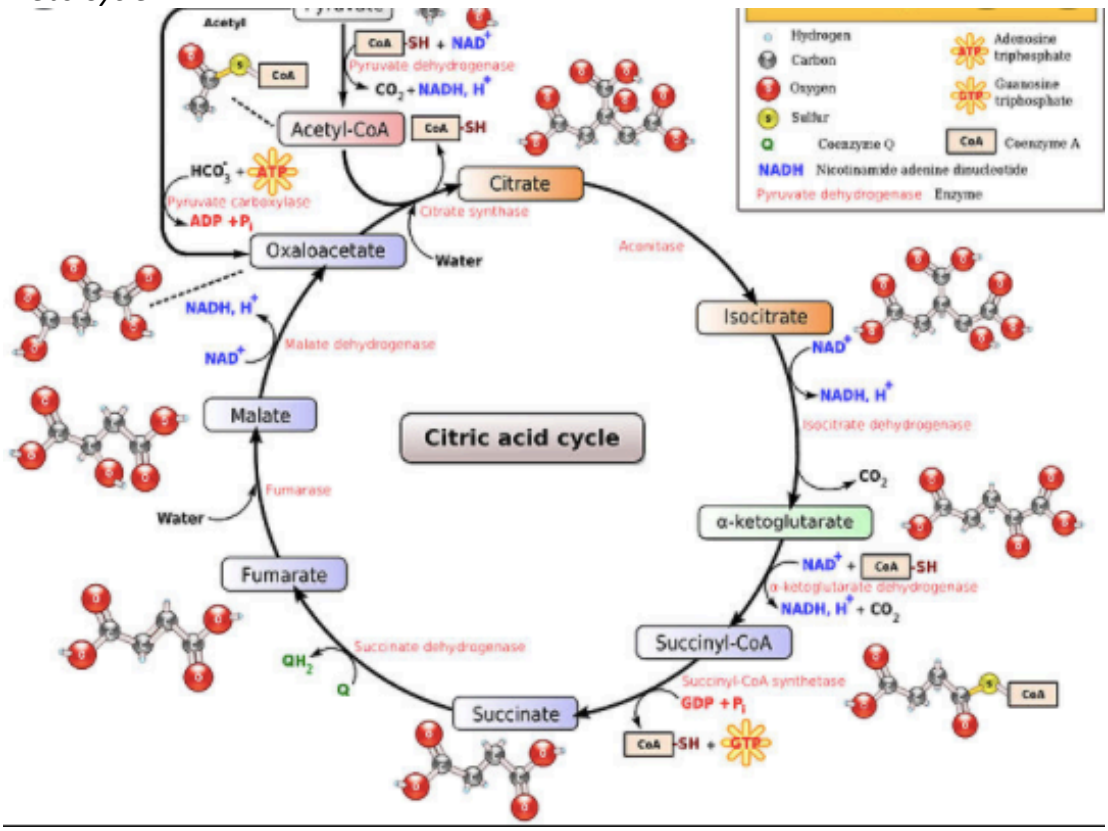
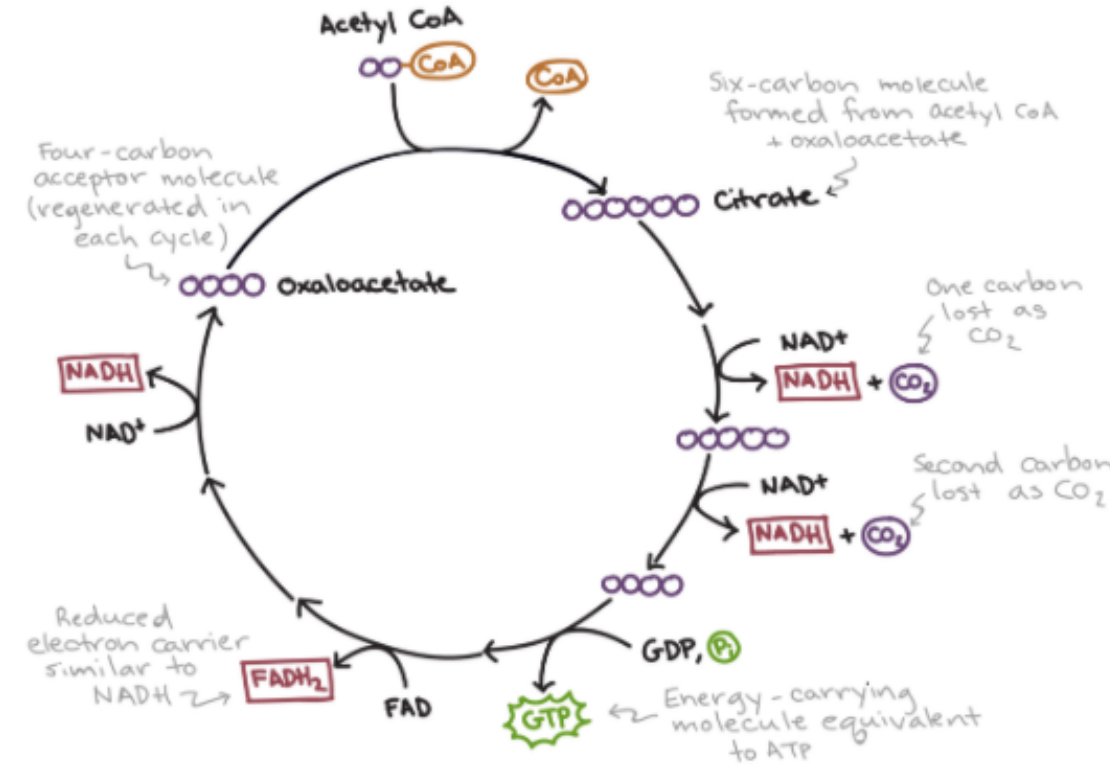
Suarez: Inferential Concept of Scientific Representation

Las Meninas

Krebs Cycle


Acetyl
CoA
SH + NAD+
Pyruvate dehydrogenase
CO2 + NADH, H+
Acetyl-CoA
CoA
SH
HCO3- + ATP
Pyruvate carboxylase
ADP + Pi
Citrate
Citrate synthase
Water
Oxaloacetate
Aconitase
Isocitrate
NADH, H+
NAD+
Malate dehydrogenase
NAD+
NADH, H+
Isocitrate dehydrogenase
Malate
Citric acid cycle
CO2
Fumarase
Water
α-ketoglutarate
NAD+ + CoA SH
α-ketoglutarate dehydrogenase
NADH, H+ + CO2
Fumarate
Succinyl-CoA
QH2
Q
Succinate dehydrogenase
Succinyl-CoA synthetase
GDP + Pi
Succinate
CoA SH + GTP
Hydrogen
Carbon
Oxygen
Sulfur
Coenzyme Q
Adenosine triphosphate
Guanosine triphosphate
Coenzyme A
NADH Nicotinamide adenine dinucleotide
Pyruvate dehydrogenase Enzyme


Acetyl CoA
CoA
CoA
Six-carbon molecule formed from acetyl CoA + oxaloacetate
Four-carbon acceptor molecule (regenerated in each cycle)
Citrate
Oxaloacetate
One carbon lost as CO2
NAD+
NADH
+ CO2
NAD+
NADH
Second carbon lost as CO2
+ CO2
GDP, Pi
Reduced electron carrier similar to NADH
FADH2
FAD
GTP
Energy-carrying molecule equivalent to ATP

Fundamental question: What is representation? How, exactly, do models "represent" things in science?

Representation: A "source system" *A* "represents" a "target system" *B*

What we discuss here is the pursuit of a "substantive theory of representation": what conditions must a model meet to serve as a representation (i.e. "carry out a *representational function*")? As Suarez puts it, "In virtue of what is the graph a *representation* (however incomplete or inaccurate) of the bridge?" (767-768)

Review of existing theories

	Variety of pragmatic uses	Logical properties of representing	Misrepresentation due to inaccuracy or mistargeting	Nonnecessity of conditions	Nonsufficiency of conditions
Similarity: structural aspects of the source correspond to structural aspects of the target.	Not exhaustive: exemplification, instantiation, convention, etc. *Guernica*	Similarity entails symmetry, reflexivity, etc.	Velasquez counterexample. Strict accuracy properties required (Newtonian mechanics)	*Guernica*/abstract art counterexample	Lack of directionality
Isomorphism: the source is structurally identical to the target.	Not exhaustive. Toy bridge example	Isomorphism entails reflexivity, symmetry, etc.	Brownian motion counterexample. Too-strict accuracy properties	*Guernica*/abstract art counterexample	Lack of directionality
Homology: there exists a "similarity" relationship between the target and source, but it need not be structural.	OK—too vague, perhaps, to effectively evaluate	Homology holds whenever examining *A* allows inferences about *B* (entails reflexivity)	Velasquez canvass counterexample still works	OK—perhaps necessary but not explanatory	Misrepresentation shows lack of sufficiency
DDI (denotation-demonstration-interpretation): denotation of elements of a model, demonstration of consequences, interpretation of results	Ok	Ok	Ok	No (not even taken separately); in fact, denotation rules out representations of things that don't actually exist	No
Inferential	Ok—this is an explanation of how we use representations; it is not structural and therefore does not run afoul of the variety argument.	Ok—force goes only in one direction and is not transitive; no requirement of reflexivity, symmetry, transitivity	Ok—we avoid mistargeting by stipulating force, and avoid inaccuracy because of the claim that we have to be able to draw inferences.	Ok—force is clearly necessary; we avoid nonnecessity problems with condition 2 because it is a condition on the model's use rather than its structure.	Our theory is deflationary; these are at the very least *minimal* conditions, but proving their sufficiency is not required.

Deflationary theory of truth: to assert that a statement is true is just to assert that statement.
Deflationary theory of representation: sufficient conditions are not always appropriate. The search for a *defining* condition, rather than a merely necessary one, will ultimately fail.

Only a few concepts, then, are necessary for our deflationary theory.
"Force": the capacity of a "source" to make its viewer see it as approximating the target.
"Objectivity": a representation must be cognitively valuable to an arbitrary observer for its ability to impart information useful to all.

Suarez's Explanation

1. Representational force of *A* has to point to *B.*
   Why isn't this enough by itself? Scientific representation adds "objectivity," which functions as "informativeness."
2. *A* allows competent and informed agents to draw specific inferences about *B*.

Virtues of Inferentialism

- Inferentialism explains truth, adequacy, and completeness
  - Truth means false conclusions aren't licensed by observing the representation.
  - Completeness occurs when a representation is "fully informative."
  - Adequacy means truth and completeness hold for all ways in which the representation will be empirically used.
- Relationship between the two requirements is a "dynamical system":
  - 1 constrains any leeway in 2, by stipulating a preexistent relationship between target and source.
  - 2 allows us to rule out unbefitting instances of target/source pairs, or find better targets or sources when necessary.
  - Conceptually representative force is logically independent of inferential applicability; they are distinct conditions.
- Inferentialism seems to genuinely explain *why* representation happens, even when we ourselves aren't informed enough to *use* the representation, or it is outside the sciences.
- By the same token, it is not defeated by incompetent, cognitively dissonant, or poorly informed users.
  - Incorrect inferences, mistargeting, or inaccuracy on the part of the agent do not therefore count against the theory.

Gems:

1. Deflation simplifies the problem, and provides an explanation of why the previous attempts have not worked.
2. Use of analogies and examples (ships-on-the-sea, toy bridge, graphical bridge) gives us a sense from early in the paper of what we are shooting for.
3. Logically separating the two conditions for representation is a genius move—it divides the problem into a "representative character/representative use" distinction that seems intuitively right. (If a differential equation for Brownian motion exists in the woods, and no one uses it, is it still a representation?)