*Research Symposium on Nutrient Requirements for Humans and Animals in the Era of Precision Nutrition: UF/IFAS Center for Nutritional Sciences: March 21, 2024*

# Developing Nutrient Requirements for Large Animals: Precision Nutrition and Practical Applications

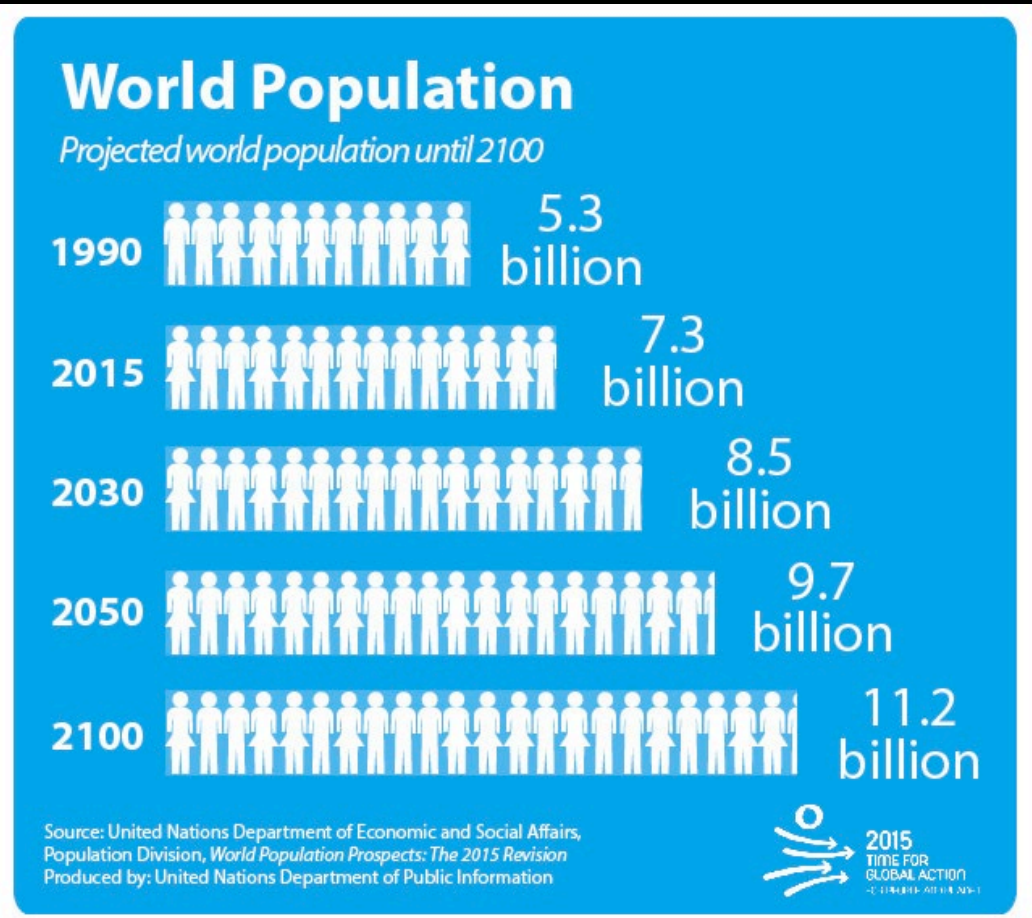
*J. S. Caton*
*Dept of Animal Science and Center for Nutrition and Pregnancy*
North Dakota State University, Fargo, ND, USA

Center for Nutrition and Pregnancy

NDSU
Animal Sciences Dept.

# Importance to Society: Broader Impacts

- Obesity, Metabolic Disease, Cancer
- Feeding the world population
- Sustainability
  - Biosphere,
  - Hydrosphere,
  - Atmosphere



# Defining and Delivering the Nutrient Requirements: The Essence of Precision Nutrition

- Long history of discovery and application
- More in front of us than behind us
- Requirements for nutrients range from percentage of the diet to mg or mcg/kg DMI
  - Most expressed as proportion of diet
  - What about per unit of BW or Metabolic BW
- Requirements are fickle and depend upon many things
- Where the best of science and the art of management merge


# Selenium History

- 1817: Discovered by Berzelius
- 1930's: Se highly toxic to grazing livestock
- 1940's: Implicated as causing cancer in laboratory animals
- 1957 to 1980's:
  - Essential nutrient for laboratory animals, food animals, and humans; relationships with Vit. E; narrow range between requirement and toxicity
- 1996- Anticarcinogenic
- 2008- Involved in diabetes
- 2015- Se and 1-C metabolism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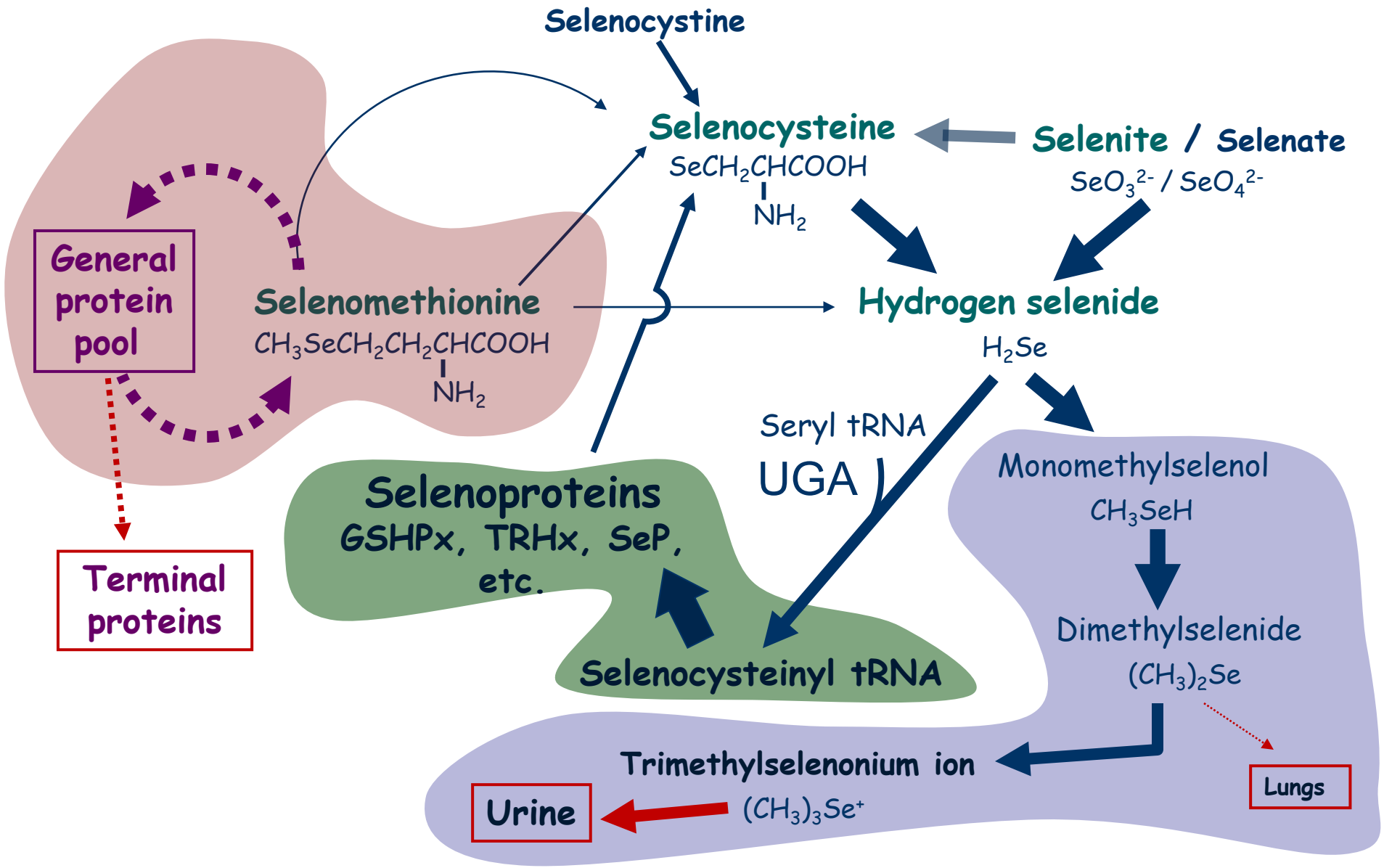
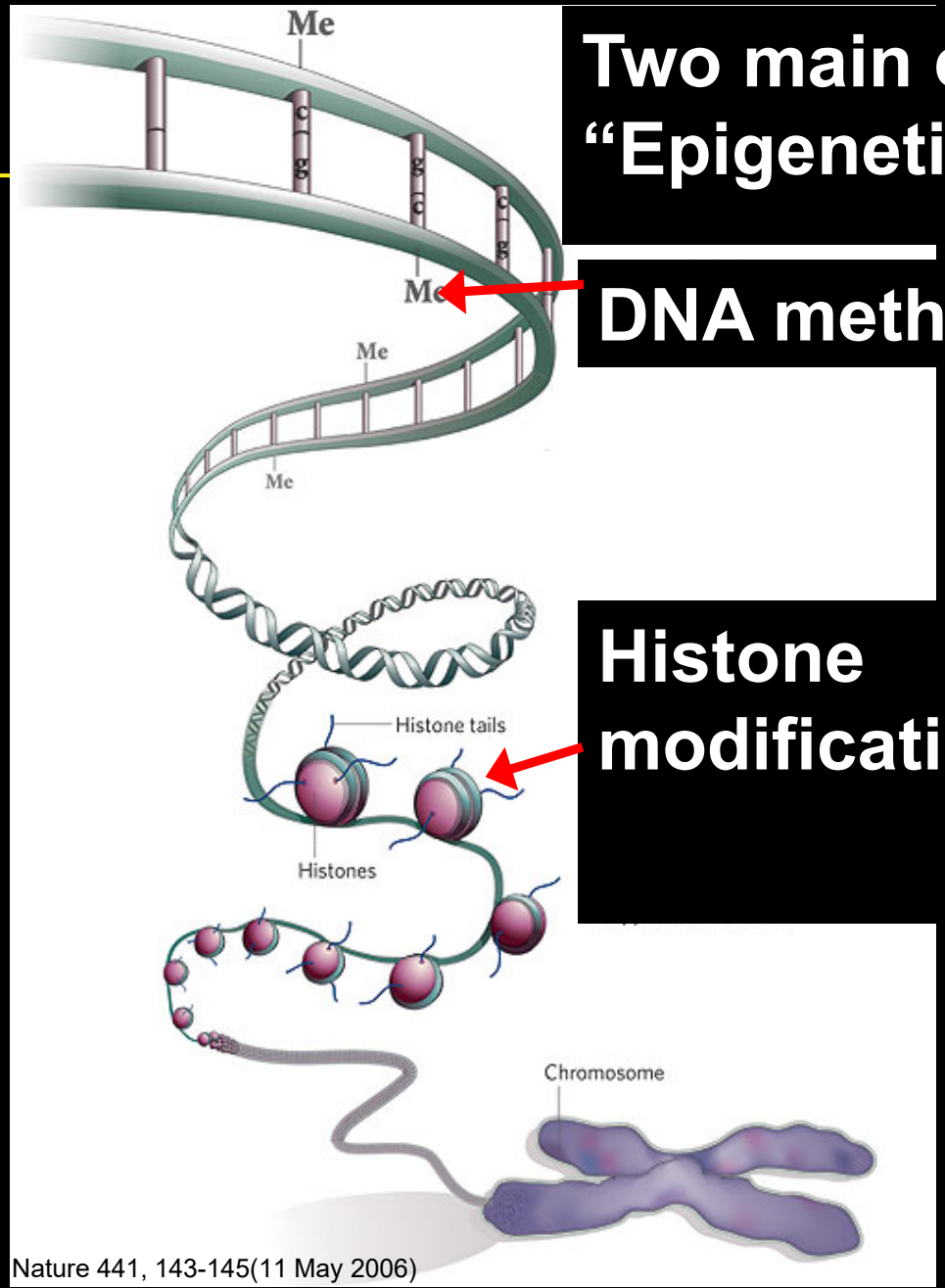
# Selenium Metabolism (*abbreviated*)



# Developmental Programming and Epigenetics




Nature 441, 143-145(11 May 2006)

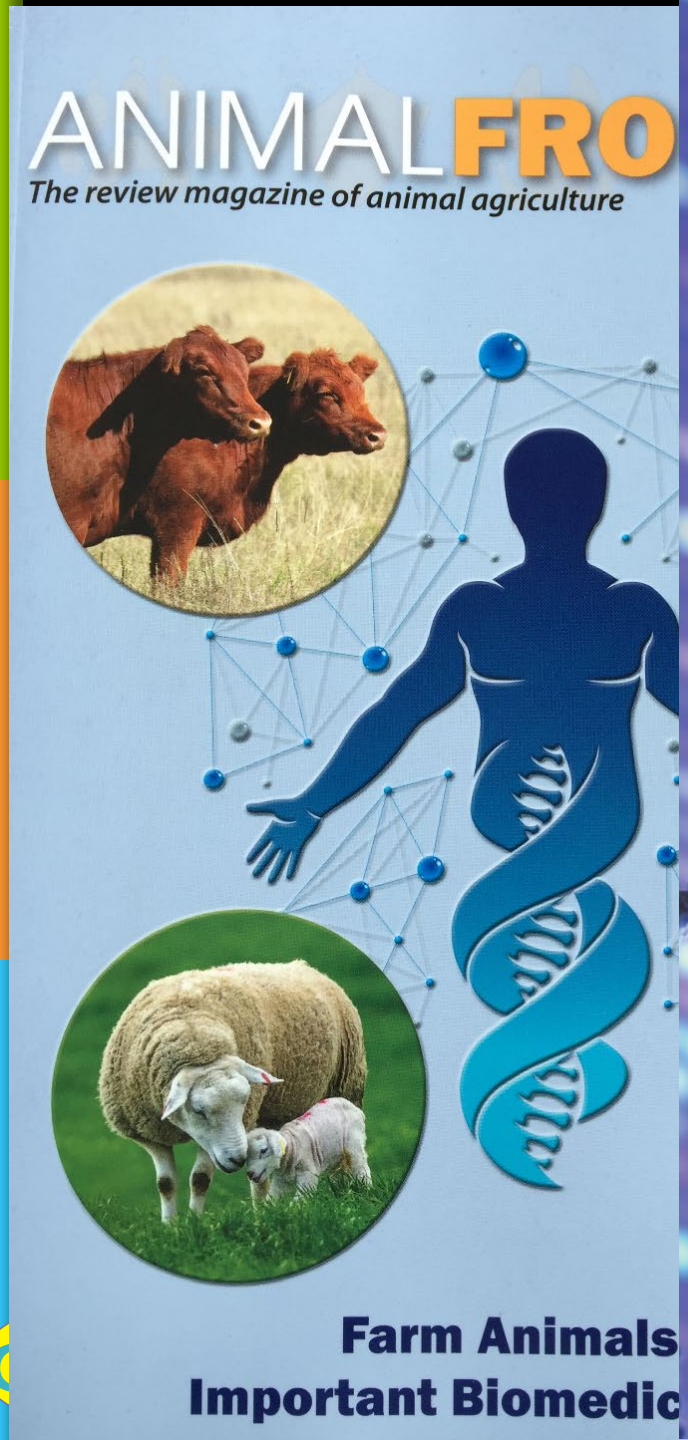
Two main components of the "Epigenetic Code"

DNA methylation

Selenium status alters 1-C metabolism

Histone modifications

Influenced by Epigenetic Modifiers or One Carbon Metabolites (OCM)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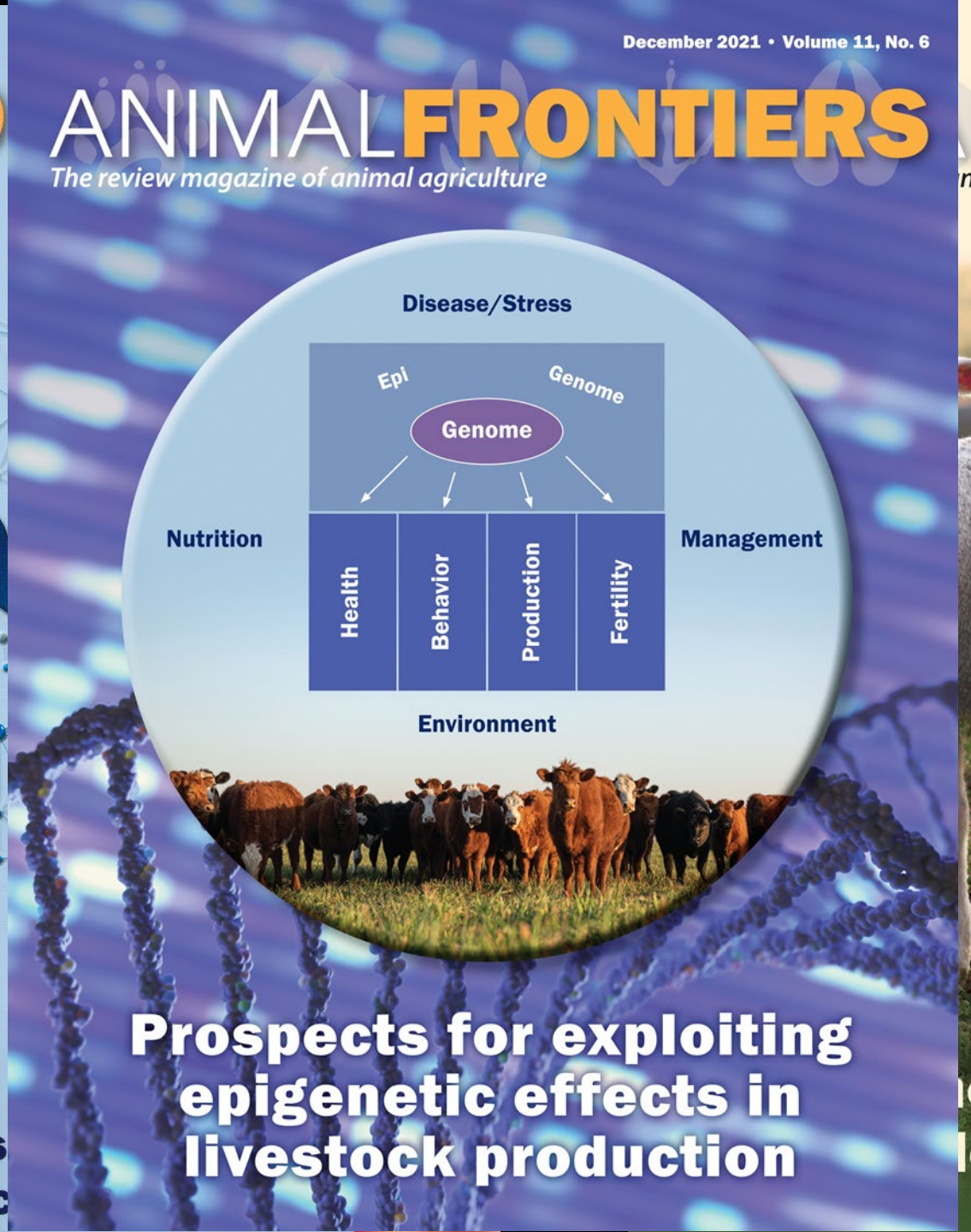
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July 2017 • Volume 7, No. 3
FRONTIERS
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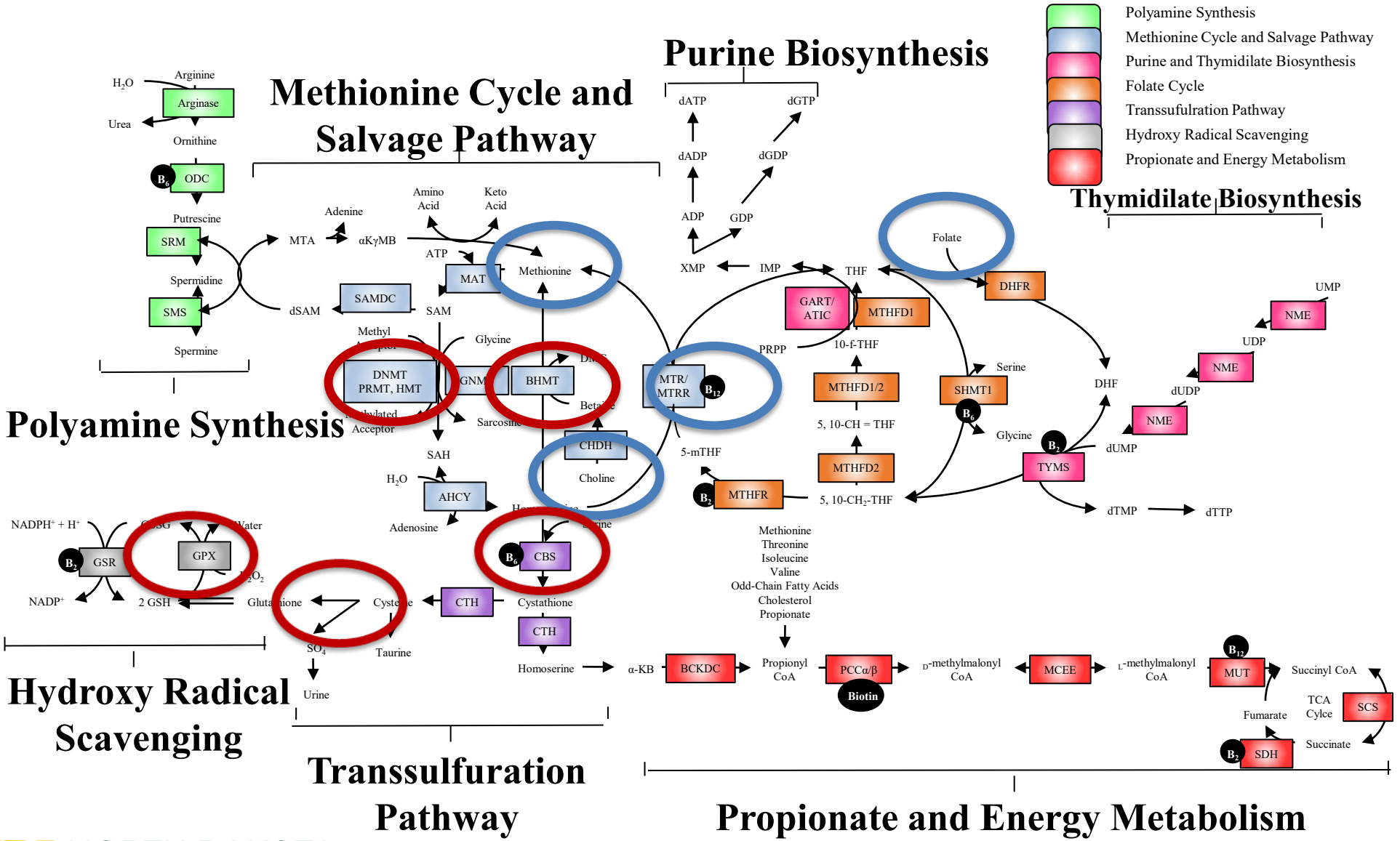
# Epigenetic events

- Can be caused by perturbed maternal or neonatal nutrition and/or other “events”
- Specific nutrients are required for and “drive” epigenetic events.
- Remember the Human Folic Acid Example!
- Physiological events, like blood flow, can alter nutrient supply to developing offspring and are in fact themselves responsive to maternal nutrient supply.

# Interconnection of One-Carbon Metabolism, Energy, Metabolism, Nucleotide Synthesis, and Hydroxy Radical Scavenging.

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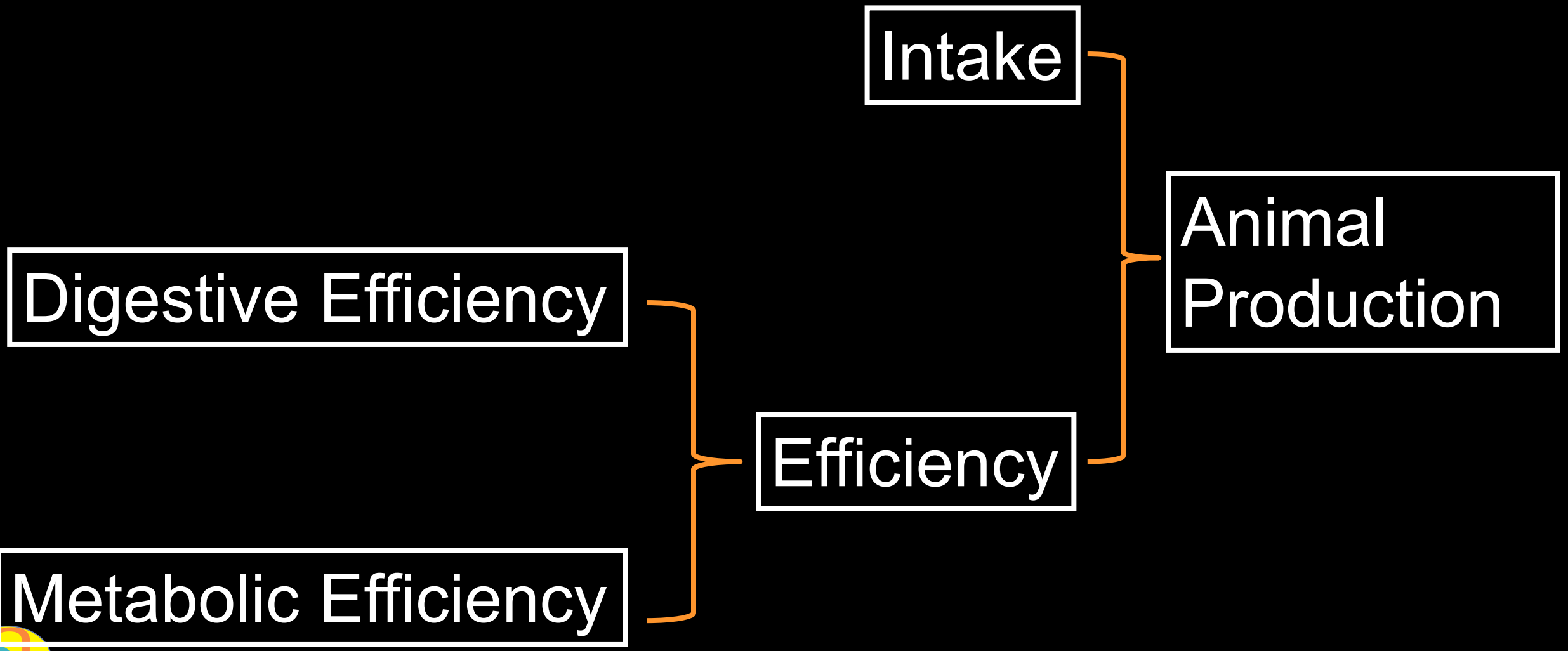
Crouse et al., 2019 Unpublished

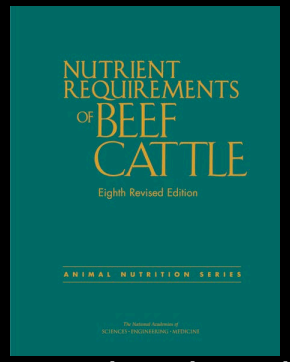
# Defining and Delivering the Nutrient Requirements: Nutrient Supply vs. Demand

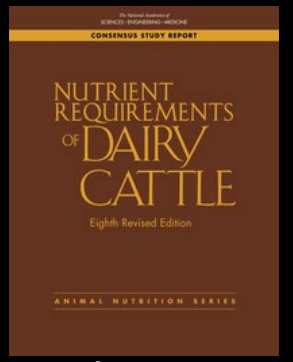


# Establishing Nutrient Requirements; The NASEM Process

- National Academies of Sciences, Engineering, and Medicine; Division on Earth and Life Studies; Board on Agriculture and Natural Resources; Committee on Nutrient Requirements:
  - Dairy Cattle 2021
  - Beef Cattle 2016
  - Swine Pending
  - Poultry Pending

https://www.nationalacademies.org/about




NANP-NRSP9
https://animalnutrition.org/

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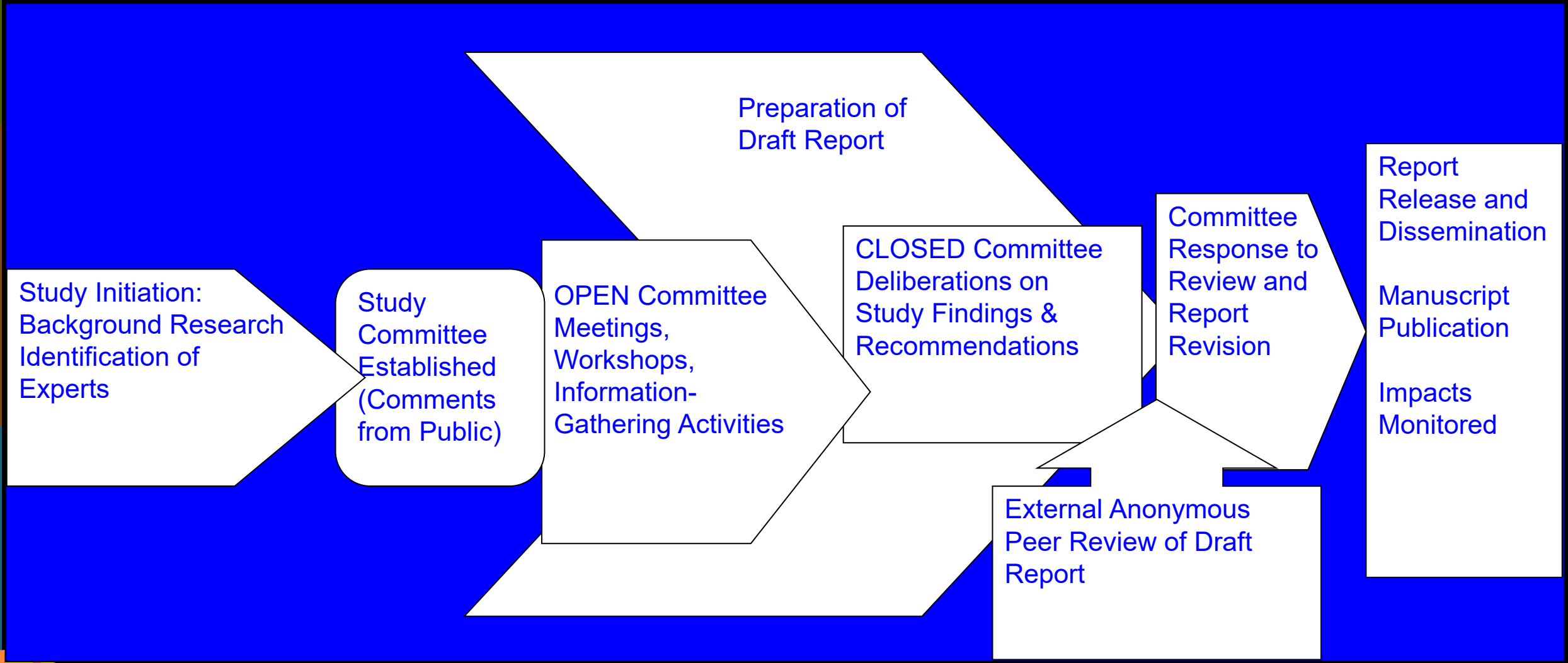
# The NASEM Report Process



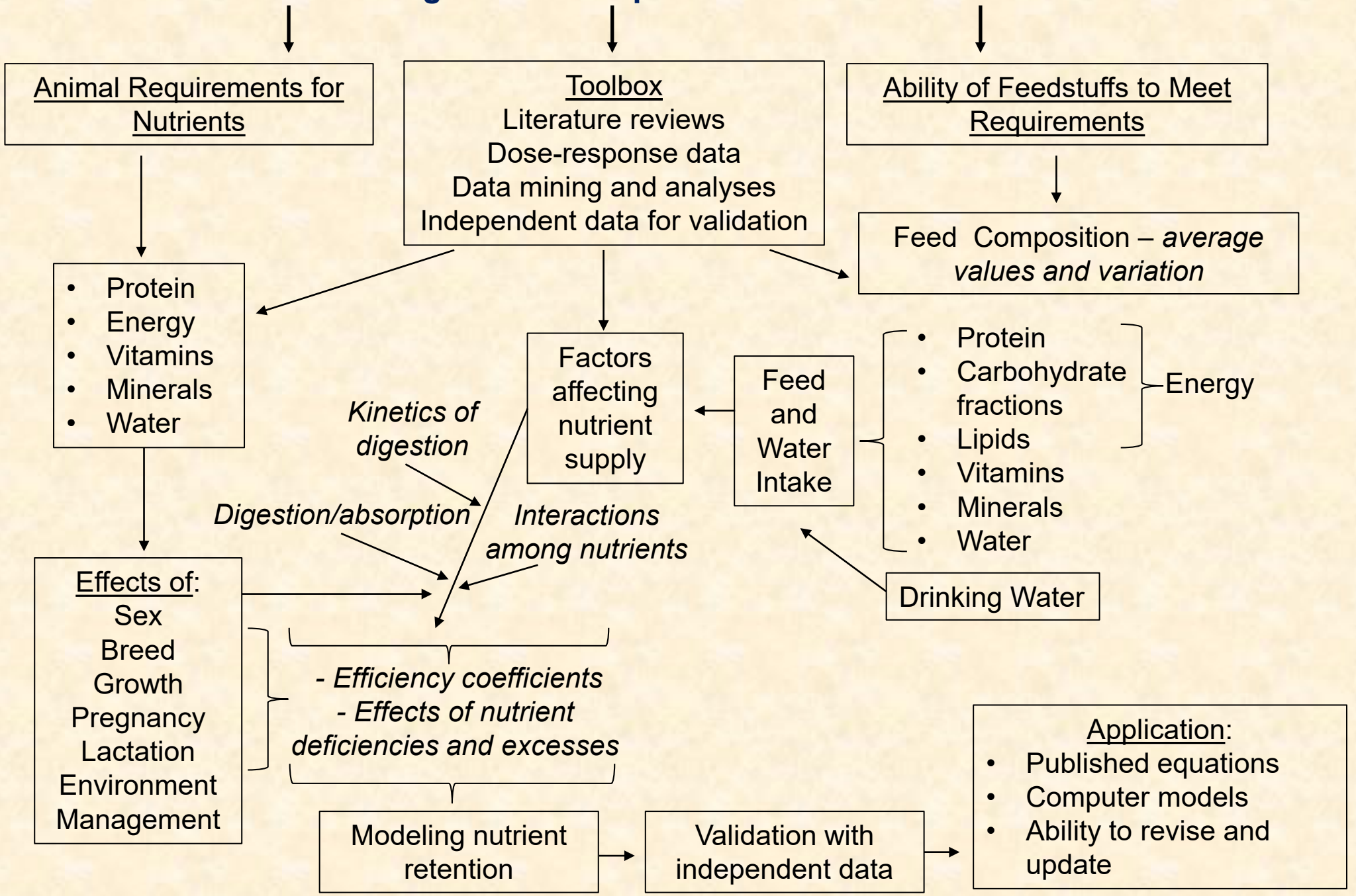
# Objectives:

- Conduct a review of the published scientific literature on nutrient requirements.
  - Create or update the databases
- Incorporate new information into the revised Nutrient Requirements publication.
  - Modeling the data
  - Balance with animal, producer, economic, environmental and societal needs
- Incorporate information from previously published NRC's (Dairy, Small Ruminants, Mineral tolerances of livestock, etc.) where appropriate.

# Approach = Questions?

- Can we more accurately estimate the nutrient requirements for a given species based on literature published since the most recent Nutrient Requirements publication?
- Ground rule – Is there any information that supports
  - Changing existing?
  - Creating new?

# Determining Nutrient Requirements of Ruminants




Galyean, 2016

# Defining the Demand (Requirement)

- Minimum dietary requirements are amounts needed in the diet to prevent the appearance of a deficiency disease or a metabolic syndrome associated with specific nutrient deficiencies and to provide for normal life and production processes.
- It is with this classical view of nutrient requirements in mind that dietary requirements for nutrients have been traditionally established in livestock.

# Determining Requirements

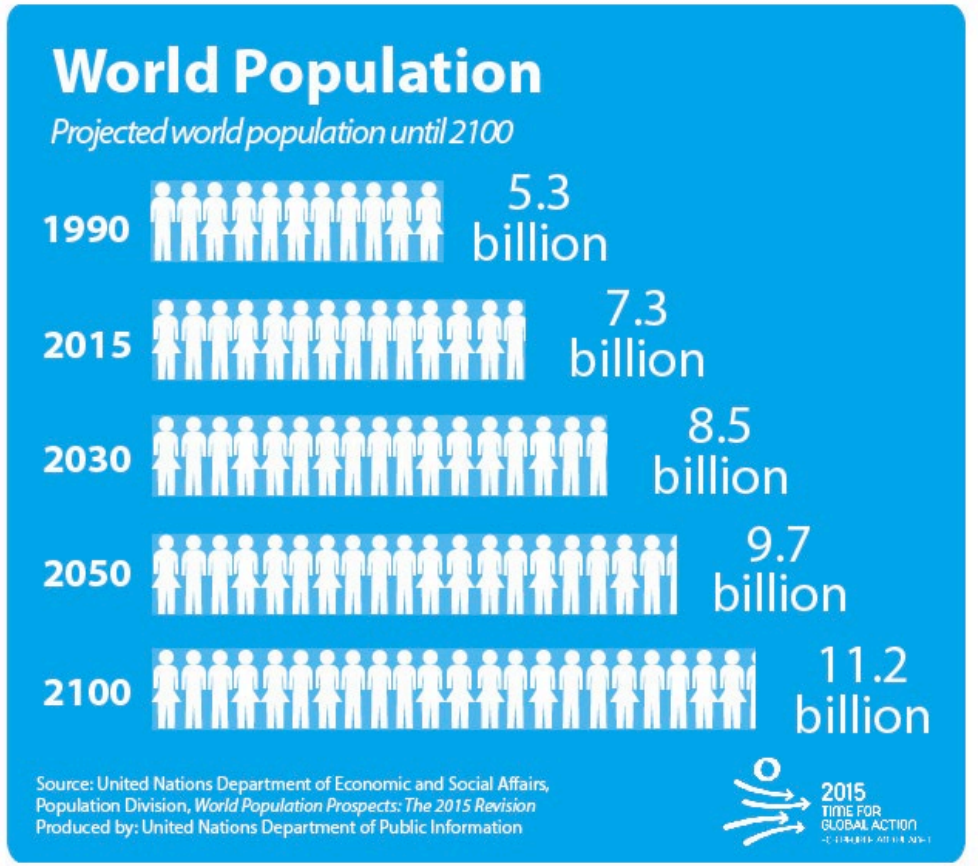
- Factorial estimates/modeling
  - Sum of the components of net requirements for maintenance and production and divide the total by the coefficient of absorption.
- Dietary experimentation estimates
  - Supplement a diet deficient or suspected of being deficient in a nutrient with one or more concentrations of the nutrient of interest.
- Balance and retention
- Modeling the data
- Animal production objectives
  - Sustainably meeting human demands

# Dietary supply to meet requirements

- Production objectives
- Environmental constraints
- Feed/nutrient sources and availabilities
- Intake
- Efficiencies of nutrient use
- Animal considerations
  - Species, breed, production status, health, etc.

# Precision Nutrition: Practical application

- Optimal animal growth and production
- Long-term environmental sustainability
- Sustained economic viability
- Increased food security
- Broad societal impacts



# Challenges: Barriers: Needs

- Robust and comprehensive scientific studies
  - Integrated across disciplines
  - Better define requirements
  - Both discovery and application based outcomes
- Stronger industry partnerships
- Expanded and targeted federal grants programs
  - Nutrient requirements
  - Precision nutrition
  - Broader societal outcomes

# Precision Nutrition: Practical Applications

**Optimal animal growth and production**

**Long-term environmental sustainability**

**Sustained economic viability**

**Increased food security**

**Broad societal impacts**

# Thank you

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