Why do we model what we model?

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NANP NSRP 0808

National Animal Research Program-National Research Support Program

Lord Kelvin - 1886

“I often say that when you can measure something and express it in numbers, you know something about it. But when you cannot measure it, when you can not express it in numbers, your knowledge is of a meager and unsatisfactory kind, it may be the beginning of knowledge, but you have scarcely, in your thoughts, progressed to the level of science, regardless of what the matter may be”- Stine, 1992

Why?

"There is general agreement among most informed authors that products of animal agriculture will continue to contribute to the world food supply. However, the key challenge of ascertaining how much animals should contribute has not been resolved." Baldwin, 1995

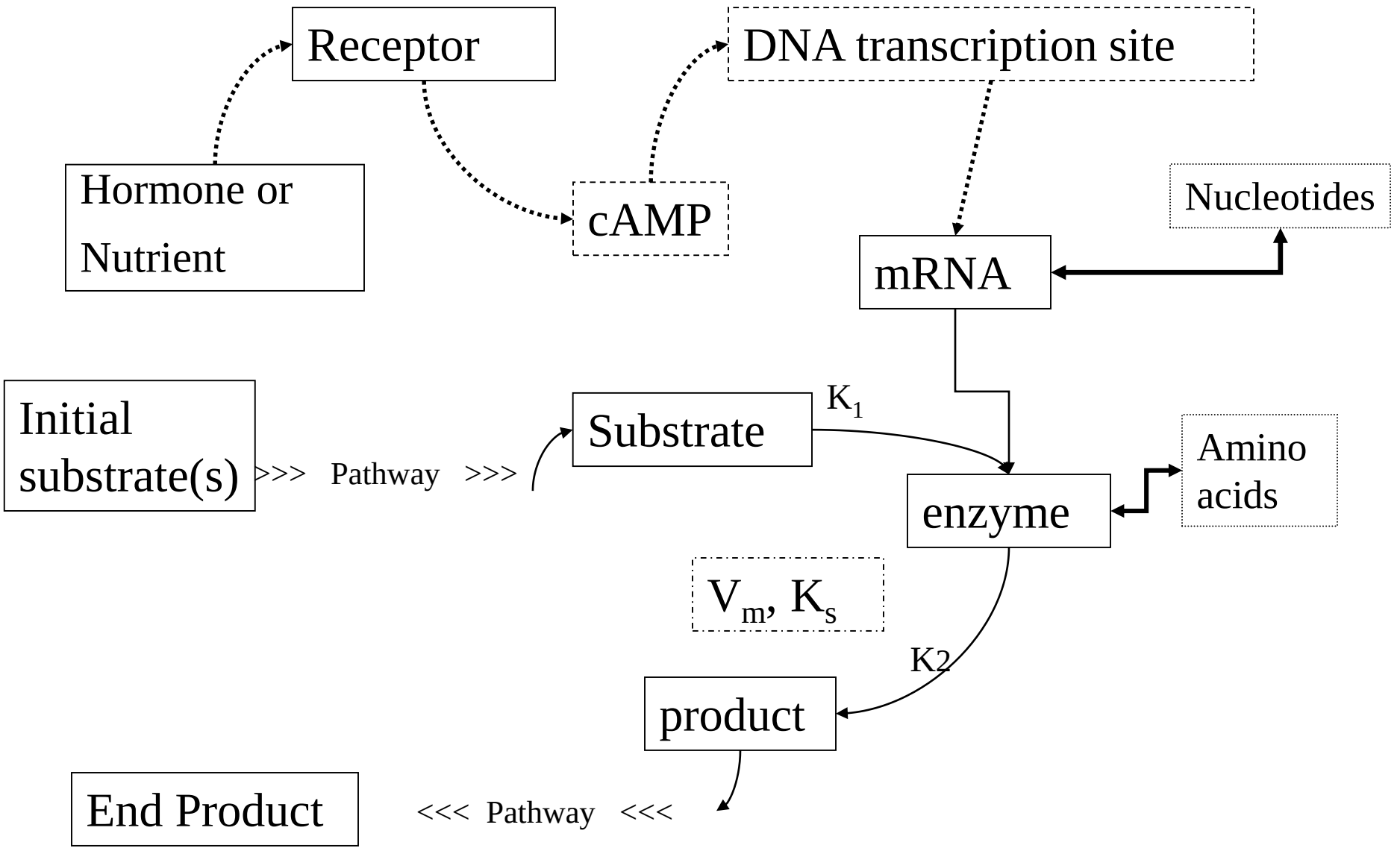
"This is a long-term goal that will require the availability of advanced dynamic, mechanistic models of ruminant digestion and metabolism…"

(and genetics, and reproduction, and…)

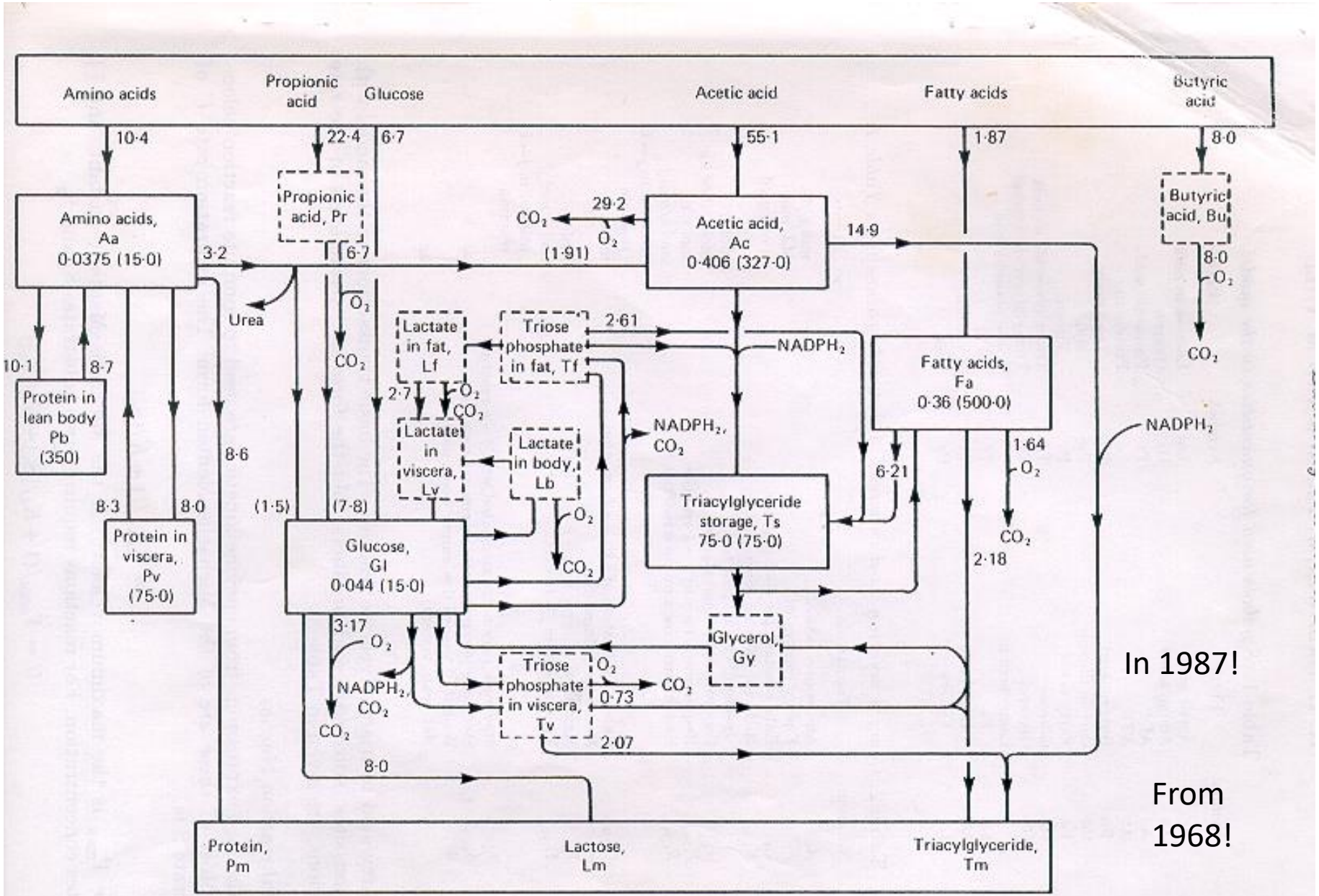
The First Step in Modeling is THE OBJECTIVE

- Our objective is to improve the precision of predicting amino acid requirements of dairy cows.
- Our objective is to improve the prediction of the effect of ambient temperature and humidity on growth of broilers.
- Our objective is to describe the metabolism of adipocytes of a lactating dairy cow during a lactation cycle as affected by genotypic variation, rate of milk and component production and nutritional intake.
- Ad infinitum….

Figure 1. Conceptual flow of genetic mechanisms of control of flux, involvement of gene transcription and environmental effects.



Metabolic Network--Molly



In 1987!

From 1968!

Fig. 1. Diagrammatic representation of the model. Boxes enclosed by solid lines indicate state variables. Boxes enclosed by broken lines indicate metabolites with

Cow in the cow herd

Cow Farm in the World

Why do we model?

Cross Cutting Concepts

- Scale, Proportion and Quantity
- Systems and Systems Models
- Energy and Matter
- Structure and Function
- Stability and Change.

Science and Engineering Practices

- Asking Questions and Defining Solutions
- Developing and Using Models
- Planning and Carrying out Investigations
- Analyzing and Interpreting Data
- Using Mathematical and Computational Thinking
- Construct explanations and designing solutions
- Engaging in Argument from Evidence
- Obtaining, evaluating and communicating information

Next Generation Science Standards
Adopted by most states for K-12 education.

Energy Flow in Organisms

- **Performance Expectation**
- **MS-LS1-7**: The student is expected to develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.
- **Related Modules**
- This is one of two modules in the **Organization for Matter and Energy Flow in Organisms** Component Idea.
- Introduction to Photosynthesis
- Energy Flow in Organisms

Ongoing Federal Programs

- “Big Data” Data Sciences Integration
- In many science areas covered by this RFA, large and diverse datasets are produced at a rapid pace. The availability of big data provides unprecedented opportunities for synthesizing new knowledge, for making predictive decisions, and fostering data-supported innovation in agriculture. NIFA has embarked on Food and Agriculture Cyberinformatics and Tools (FACT) initiative to catalyze activities in these areas. In FY 2017, all program area priorities that accept conference applications also welcome submission of FACT workshop applications.

Ongoing Federal Programs

- “Big Data” Data Sciences Integration
- The workshops supported will focus on identifying priorities and bottlenecks in generating, managing and integrating data in a specific domain of the food and agricultural system. Expected outcomes include strategic plans and specific community-supported solutions to handling standards, repositories, data sharing and engagement across sector and disciplines. In addition, these workshops should begin to address how data management plans can assist in prioritizing collection and storage of primary and meta-data relevant for each community.

Ongoing Federal Programs

- Tactical Sciences
- What are economic, political, social, technological, and scientific trends/forces that will impact security of the American food system enterprise in the next 10 years?
- If we had an approach to Tactical Sciences that was extremely successful, how would you describe the characteristics of this approach?
- “These are scientific assets that protect the integrity, reliability, and sustainability of the U.S. food and agriculture system against known and potential threats from plant, animal, and human health pests and diseases. There is an urgent and growing need to strengthen our tactical science capabilities on a scale commensurate with threats to the safety, stability, diversification and profitability of our nation’s food and agricultural systems.

Tactical Sciences

“NIFA’s current tactical science investments are focused in three areas: detection and diagnostics (National Plant Diagnostic Network/NPDN and National Animal Health Laboratory Network/NAHLN), regulatory systems support (Minor Crop Pest Management/IR-4, Food Animal Residue Avoidance Database/FARAD, Minor Use Animal Drugs Program/MUADP), and deployment of new crop and animal production and protection technologies and management systems (Crop Protection and Pest Management/CPPM, IR-4, MUADP, Extension Disaster Education Network/EDEN).”

The NANP 0808 / NSRP

https://nanp-nrsp-9.org/tment of Agriculture.

The National Animal Nutrition Program (NANP) serves as a forum to identify high-priority animal nutrition issues and provides an integrated and systemic approach to sharing, collecting, assembling, synthesizing, and disseminating science-based information, educational tools, and enabling technologies on animal nutrition that facilitate high-priority research among agricultural species. The NANP is a research-support activity funded as a **National Research Support Project (NRSP)** with Hatch funds appropriated by the **NIFA**, **USDA**

Modeling Committee

The function of this group is to serve the animal nutrition research community by improving the use of predictive technologies and tools, to best utilize available platforms, and to work with researchers to effectively share, combine, manage, manipulate, and analyze models and modeling information.

Our objective is to ultimately know everything that is happening [in an animal]

Carl Davis, Univ. of Illinois