EDUCATION/TRAINIG

SHORT TERM ACTIONS

- BIO STUDENTS TAUGHT LOGISTICS – HELPS REDUCE FEAR OF MATH
- EXPLOIT PASSION FOR THEIR SUBJECT
- SHARE SUCCESS STORIES - AWARENESS
- CLEARINGHOUSE TO GET BIO/ENG INFORMATION
- INCORPORATE BIO SUBJ. IN ENG.
- FORM NEW "DEPARTMENTS" THAT COMBINE BIO/ENG/TECH
- SPECIALIST VS. HYBRID: DEPTH VS BREADTH
- MODULES – BABY STEPS – RESOURCES
- RELATION TO OTHER DISCPLINES.
- PROMOTE OPPORTUNITIES FOR INTERACTION – LOCAL → GLOBAL

10, 11, 12 10 year

- DISCIPLINARY SOCIETIES — BRING AWARENESS

* - BRING DIFF. DISCIPLINES TOGETHER AROUND COMMON PROBLEM
  - HOW DO PEOPLE IN DIFF. DISC. TOGETHER — THE PROBLEM DRAWS THEM IN

① AWARENESS

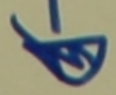
② Bring us together

③ Cross-educational or New Mix ~~information~~ learning

0-10 yr

Today's Goals

top-down



- In-situ field measurements
- Establish methods of sharing field space
- Response surface
- Controlled Nutrient fields
- Increase knowledge of
  - Plant/microbe relationships (microbio)
  - Signal Processing
  - Statistics

- Reduce N inputs while maintaining yield (increase sustainability)
- More fast + cheap new plant variants
- Component (modular) ideotype breeding (understand
- Assessing available phenotypic variation
- Engineer in-situ root morphology, techniques
  Imaging

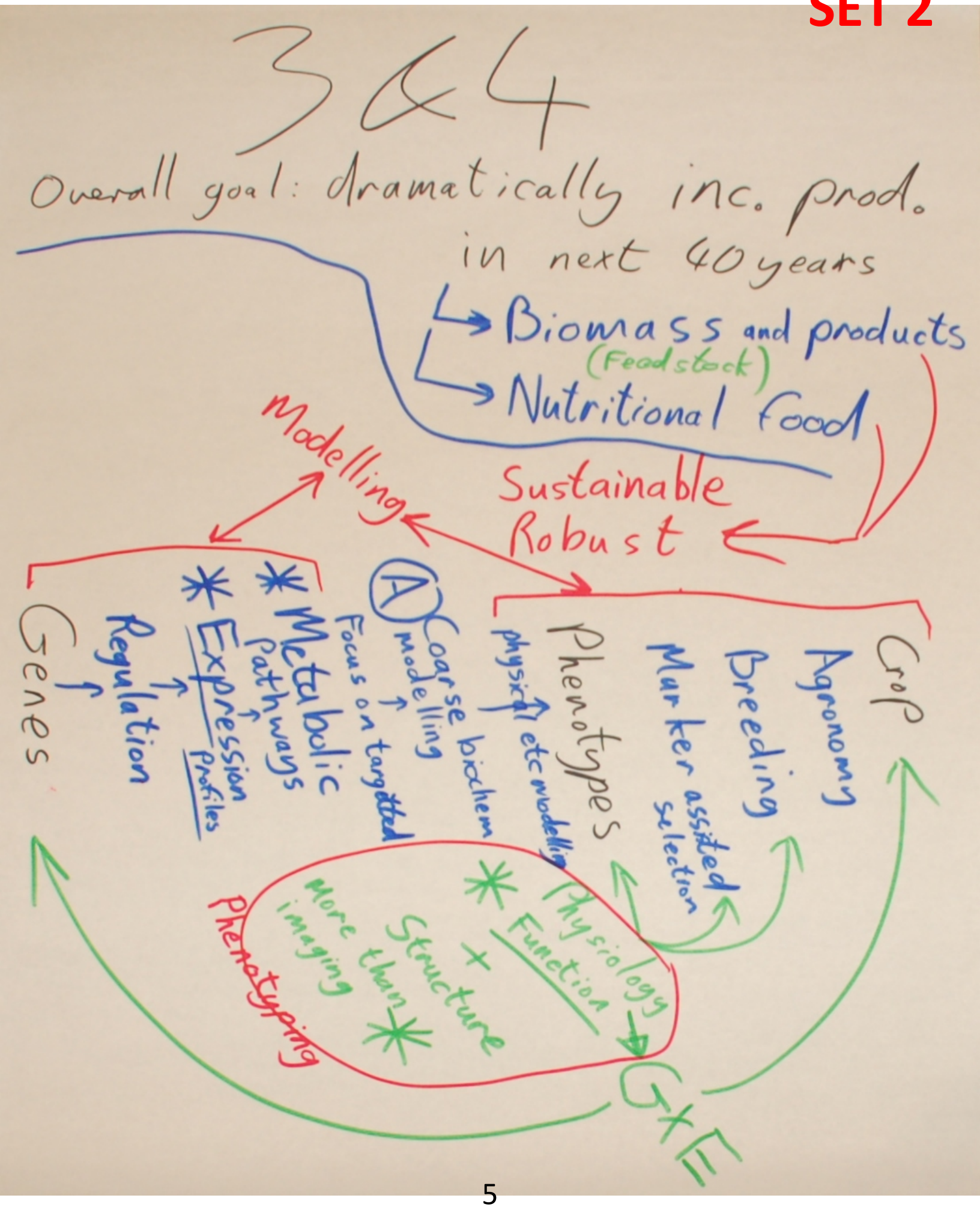
10 ~ beyond

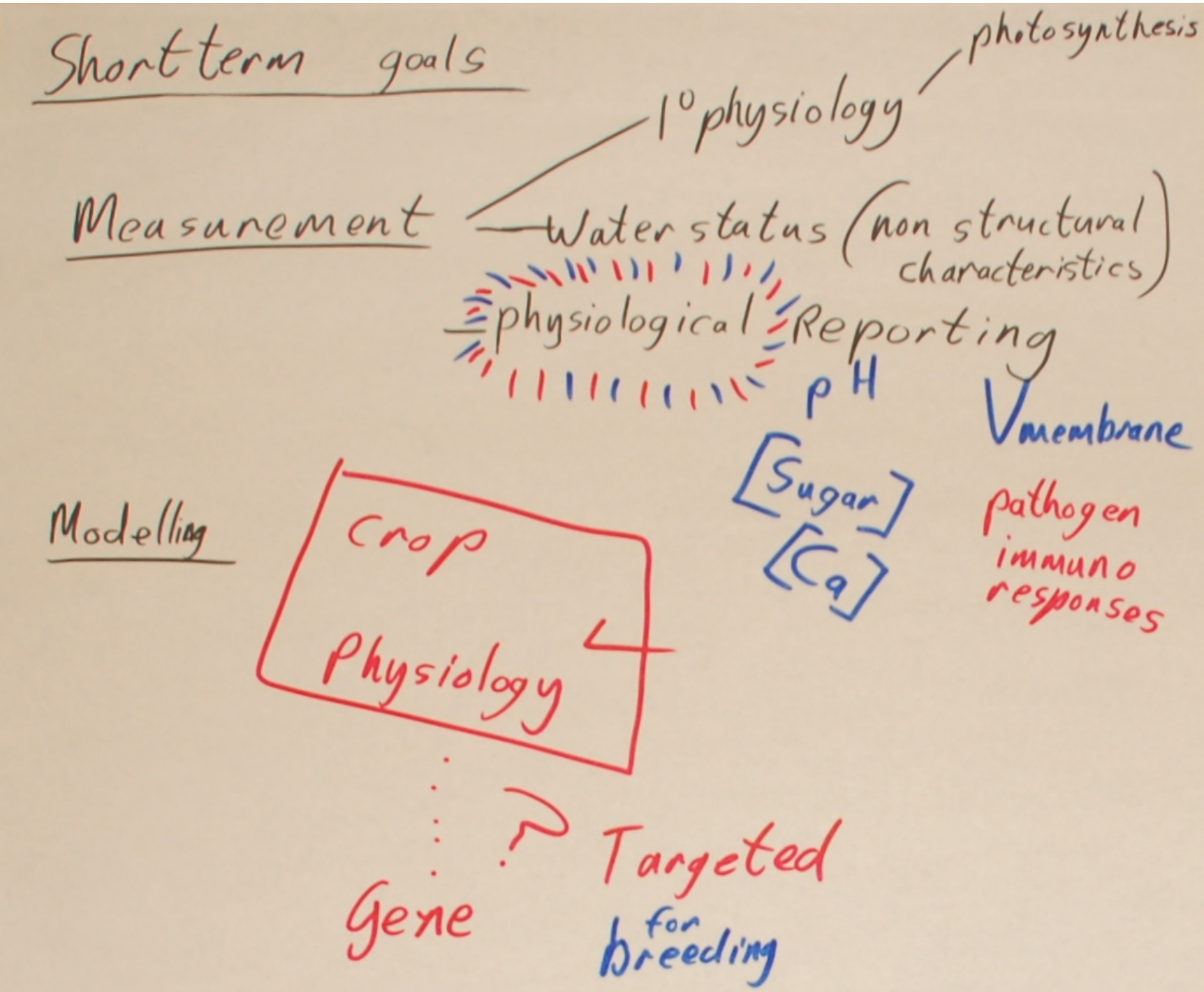
Tomorrow's Goals

- Perennial Crops
- Climate Prediction
- Engineered microbe communities in soils
- Parameterize environmental factors that influence yield + Growth

- Modular ideotype breeding at the ready

suites of genes
germplasm reserves
microbial effectors

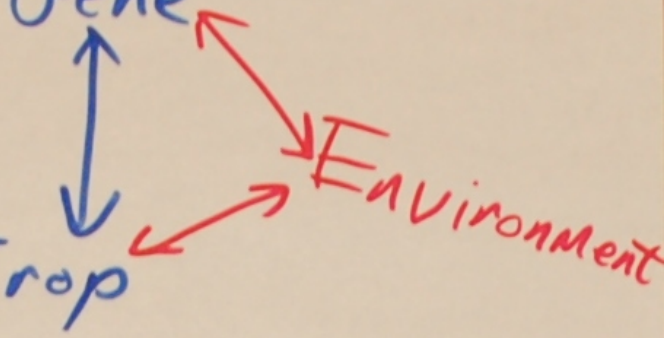

3 & 4
Overall goal: dramatically inc. prod.
in next 40 years
Biomass and products
(Feedstock)
Nutritional food
Modelling
Sustainable
Robust
Genes
Regulation
Expression
Profiles
Metabolic
Pathways
A
Coarse
modelling
Focus on targetted
biochem
physiol etc modelling
Phenotypes
Marker assisted
selection
Breeding
Agronomy
Crop
Physiology
Function
x
Structure
More
imaging
than
Phenotyping
GxE

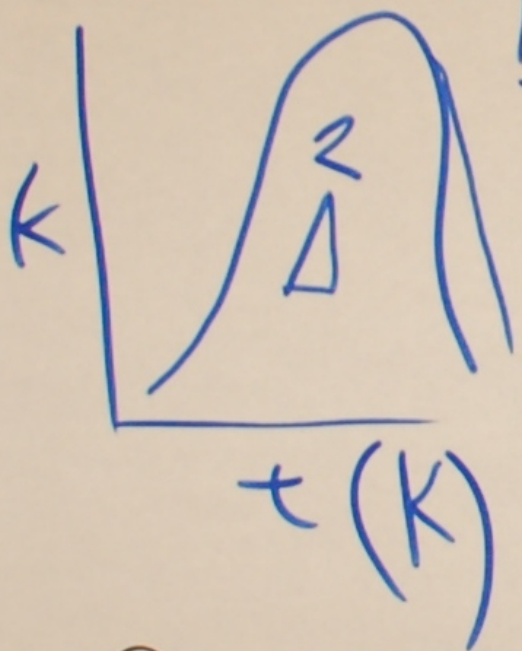

Short term goals
1° physiology
photosynthesis
Measurement
Water status (non structural characteristics)
physiological
Reporting
pH
V membrane
[Sugar]
[Ca]
pathogen immuno responses
Modelling
Crop
Physiology
?
Gene
Targeted for breeding

Blue sky

Systems modelling

Are plants: *chaotic
*too complex (temperature) ?





Need to try large models
eg. E.coli

Goal: directed crop breeding

Computer

gene x gene x Environment

Diversity VS scissors and glue

Direct Lighting from Plants

* Food Security (local)

Academics will have access to expensives technologies

Citizen Plant Engineers

Engineered ENVIRONment

Synthetic PLANT with greater Genetic Potential

TRANSform P.B. to P. Engineer

Wild species

Adaptive ENG SYSTEMS

Developing World

Are solutions the same as U.S.?

Funding

NSF

New program: breeding ↔ Synthetic biol. + modelling

computational pico molecular breeding + farming

predictive

What do we need?

- Funding sources & strong proposed ideas
- Real partnerships
  (Faculty - Student - industry exchange)
- Build multidisciplinary program
  in crop engr.
- Administration buy-in
  - more emphasis in interdisiplinary ventures

SET 3

7, 8, 9

1-10 years

What will you go home to do today?

1. Find new collaborator from discipline other than our own.
2. Organize next meeting/workshop.
3. Communicate interests/priorities.
4. Strategize approach to ~~conte~~ connect w/ industry
   - Natl Assn of Plant Breeders Annual Mtg.
   - Societies
   - Energy-Water Nexus ASME

~~Action~~ Agenda for Industry

- Collaborative efforts
- IP
- Talking Pts.
- Goals of Academia vs. Industry

- Reflect on Mtg / Lit review of less familiar field.
- Invite funding prospects + journal editors
- Engage policymakers / politicians
- Develop crystal-clear message.
- undergrad research involvement

& Why engr. crops programs ought to be favored.

- Self initiative via communication

1-10 yrs.

Blue Sky 50-100 yrs.

- Engineer healthier foods
- ~~Self fertilizing~~ Nitrogen efficient crops
- Soil sustainable ag
- Regenerate soil
- Nutrient efficiency
- Completely engineered organism
- More efficient in selecting phenotypes.
- Terraforming plants
- 80%+ of yield potential globally

Blue Sky 2

- Optimized land management
- Engr. outdoor environments for phenotyping
- Plants to substitute steel bldg. materials.
- Change of diet in society
- Improve shelf life + taste of vegetables
- Logistics / storage of foods
- Freely available climate / soil data

Blue Sky 3

- Plug-and-play systems models at multiple scales
- Systems of info. (1-10 yrs)

SET 4

#5 & 6

UG vs Grad

Education: Eng 4 Bio, Bio 4 Eng } flexibility

→ Hypothesis definition?
Problem definition
→ Articulate needs clearly.
→ Start from faculty/PI

Learn from
→ Counterpoint → learn from common problems!
→ Starting point → plant physiology.
→ inculcate openness, understand terminology.
→ enumerate a set of minimal concepts at different administrative scales.
→ Problem solving enablers.

Education

→ applied learning modules & broader dissemination
integrated framework

link to real world

involve education researchers, best practices,
continuous assessment.

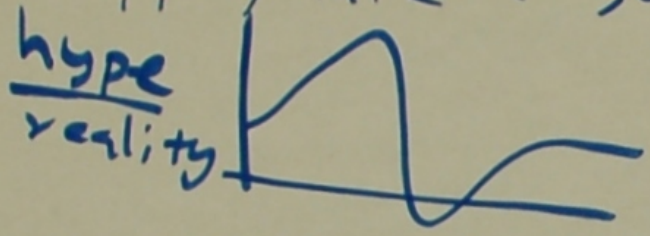
→ Engineering Gut physiology

→ Complex traits to tractable ones (Yield?)

→ understanding / accounting for trait correlations

→ classification of traits → direct cause
↘ indirect / resultant cause.

→ limits / application of technology
appropriate use, best practices



→ extraction of data @ cell resolution

→ automated fashion

→ Genetic controls ↔
sensitivity of subsets on complex traits.

→ data formats, best practices
environmental data,
Meta-data
library of stressors

→ Benchmark for network construction.
Certification of networks.

Long term

→ Yield differential ...
enabling improvements in developing countries
via education / access

→ improved management principles
in cropping systems
→ agronomists & engineers.

→ data sharing open source!
pipelines to utilize data deluge

→ Simulate crop performance under
different environmental conditions

→ Cropping systems
top-down vs bottom-up
→ start at the middle!

→ model xylem-phloem

Performance / conductivity across
environmental conditions.

→ confidence bounds on
Gene → phenotype
molecular mechanism.

→ Visualization of water, starch

→ epi-genetics

→ funding