

Can AGRICULTURE *save the planet...*



before it **DESTROYS** it?

Hot, Hyper, and Interconnected



40%



Land

25%

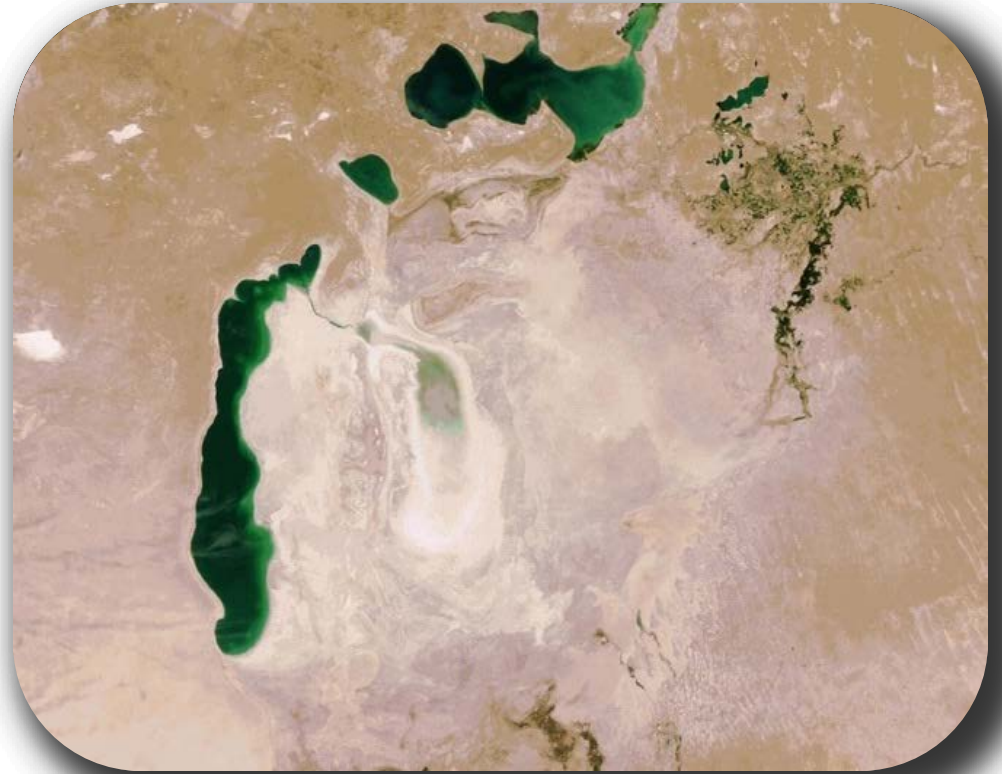
Greenhouse gas emissions from
agriculture and deforestation



Climate

70%

Aral Sea
1973 today



Water

9 billion



2050

8 billion



2030

7 billion

2014



5 1990

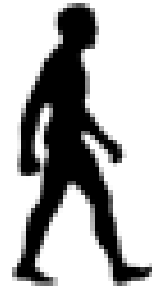
Global Population Growth

That's **75** million
more people each year

About the number of people in Germany



How **big** is the challenge ?



According to the **UN Food and Agriculture Organization**
the world needs to produce more food between 2000 and 2050
than was produced during the previous

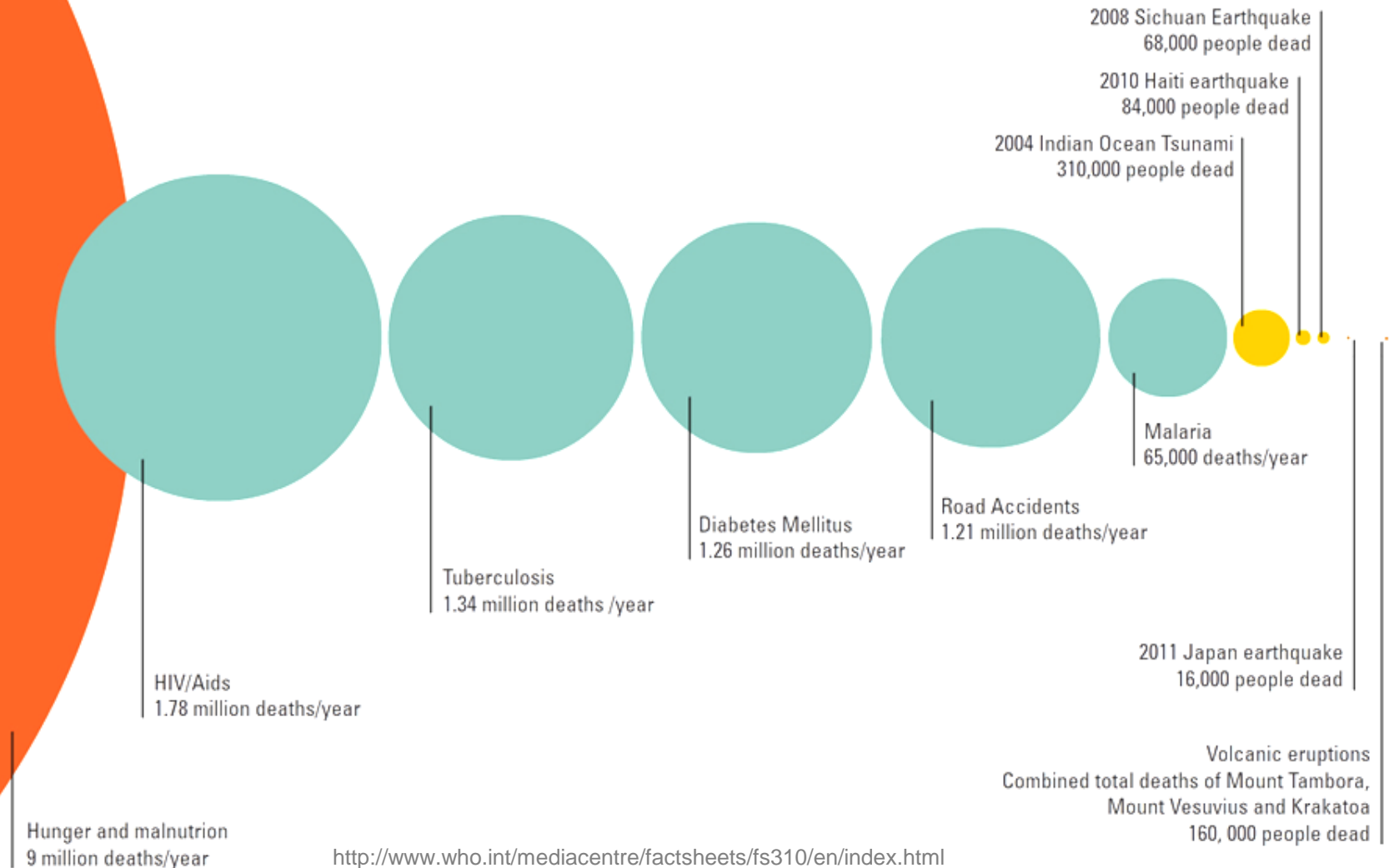
10,000 years

We all need to eat



And yet over **800 million**
don't have enough food today

People dying due to hunger vs other causes



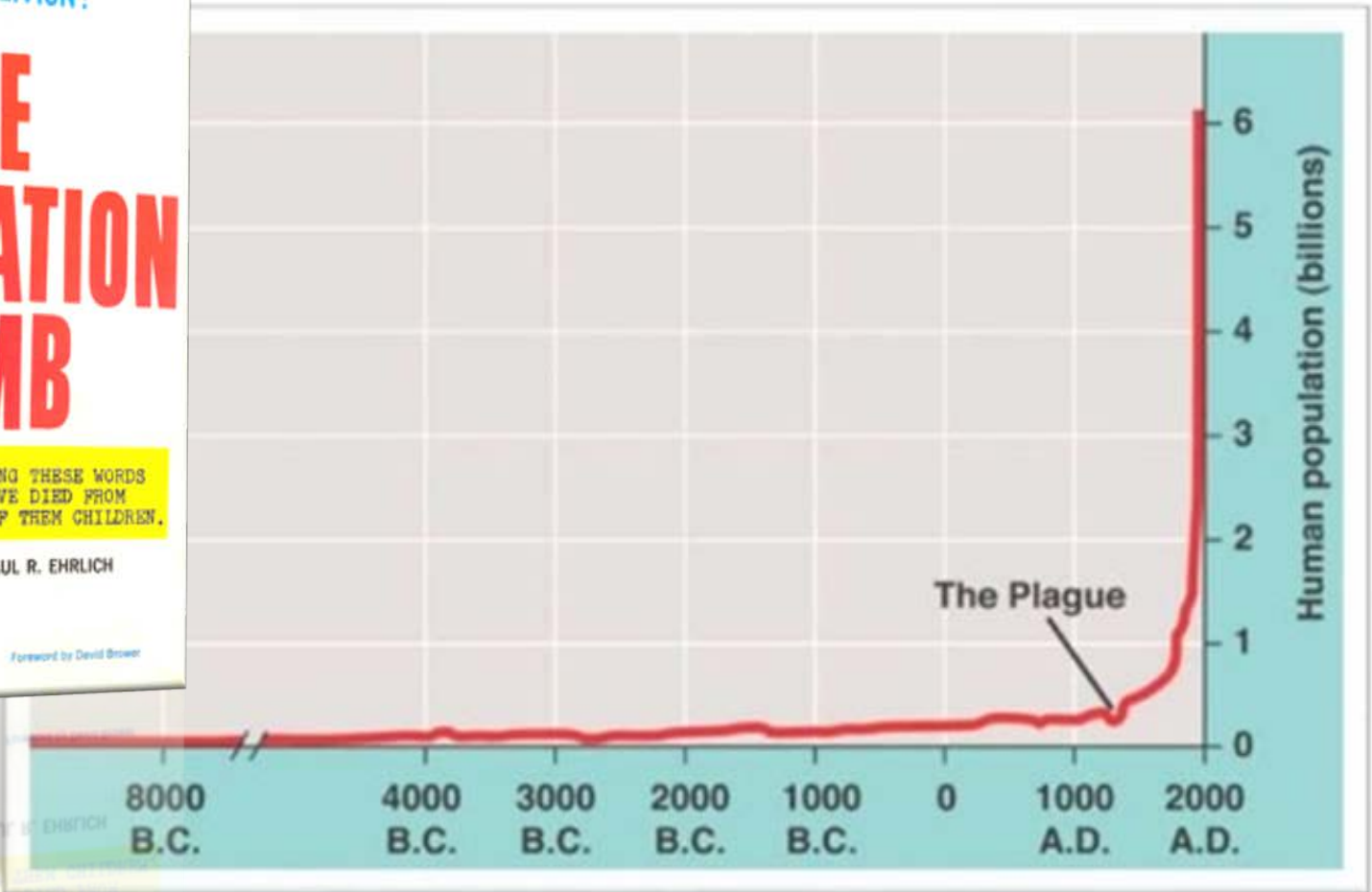
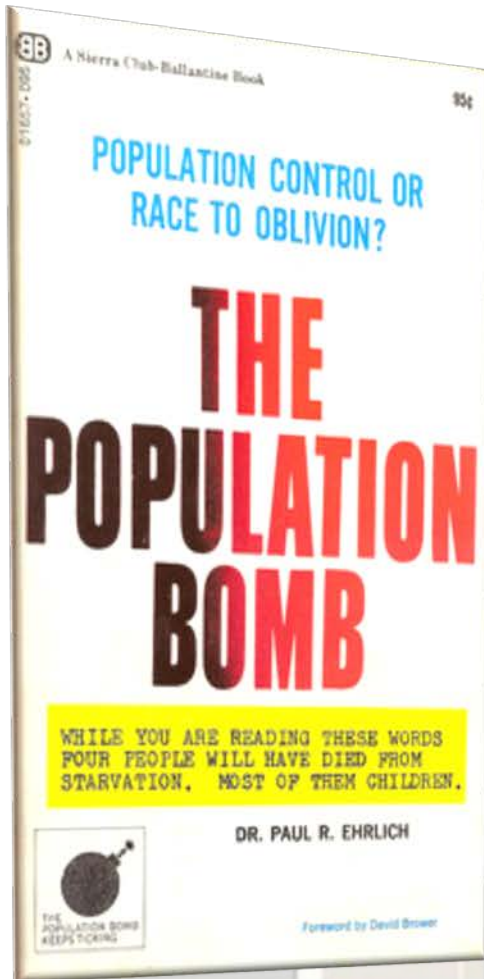
60% more food by 2050, using...



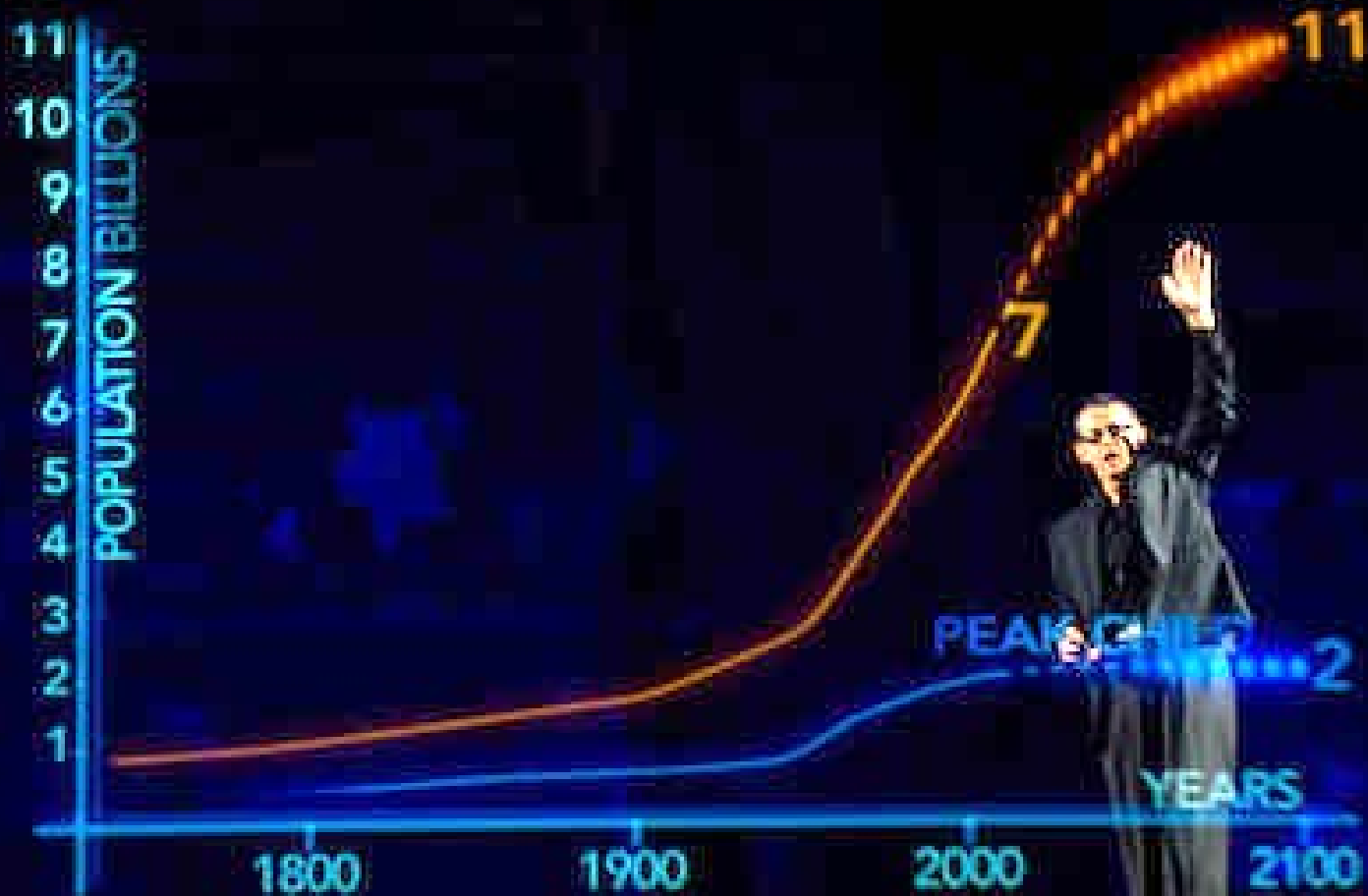
A close-up photograph of numerous small, shallow metal bowls filled with a wide variety of ground spices and herbs. The colors range from deep reds and oranges to bright yellows, greens, and browns. The bowls are arranged in a cluster, with some in sharp focus and others blurred in the background, creating a sense of depth. The lighting is warm, highlighting the textures of the spices.

Why Now Matters

Baby Boom?

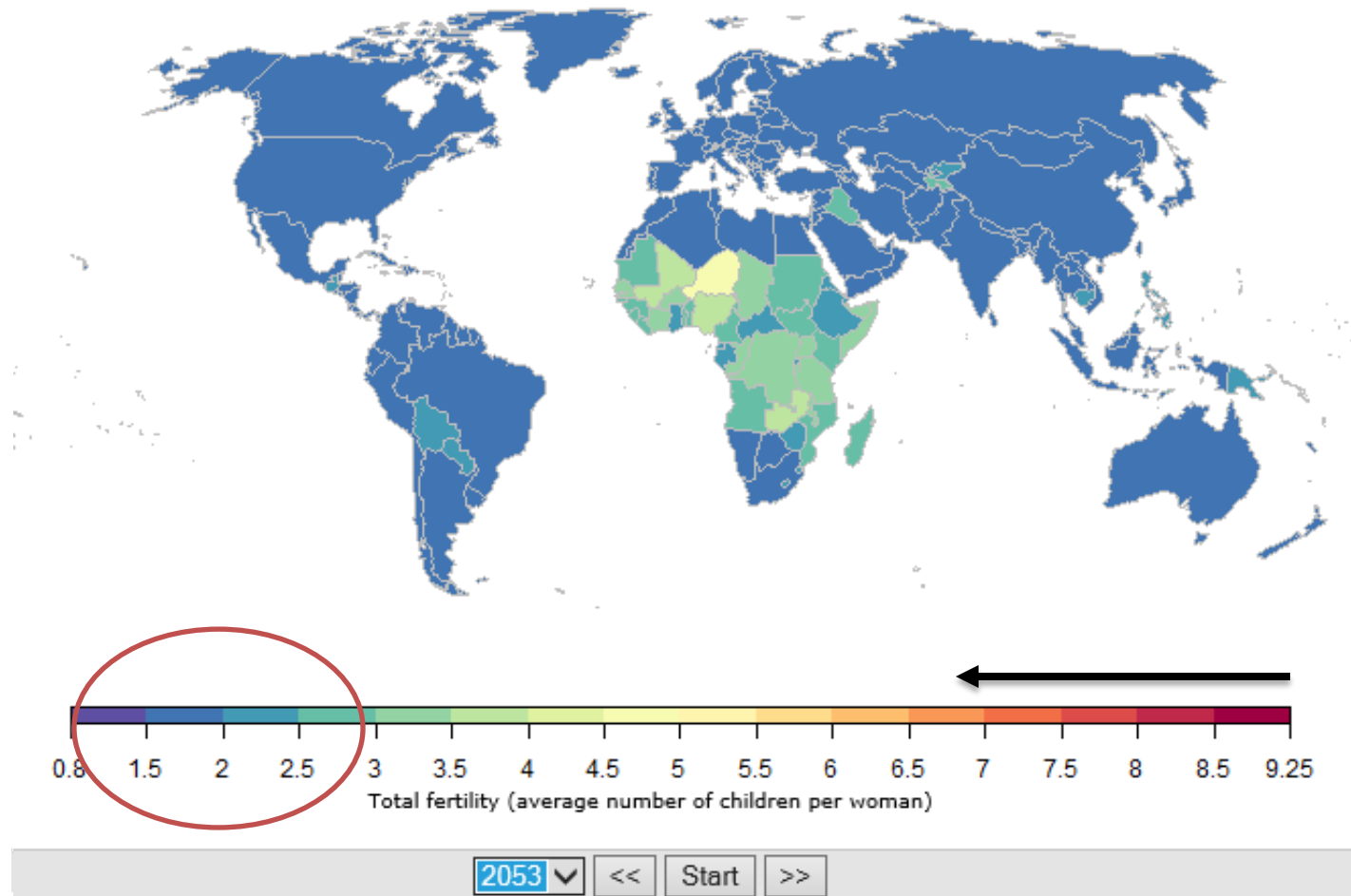


Peak Child



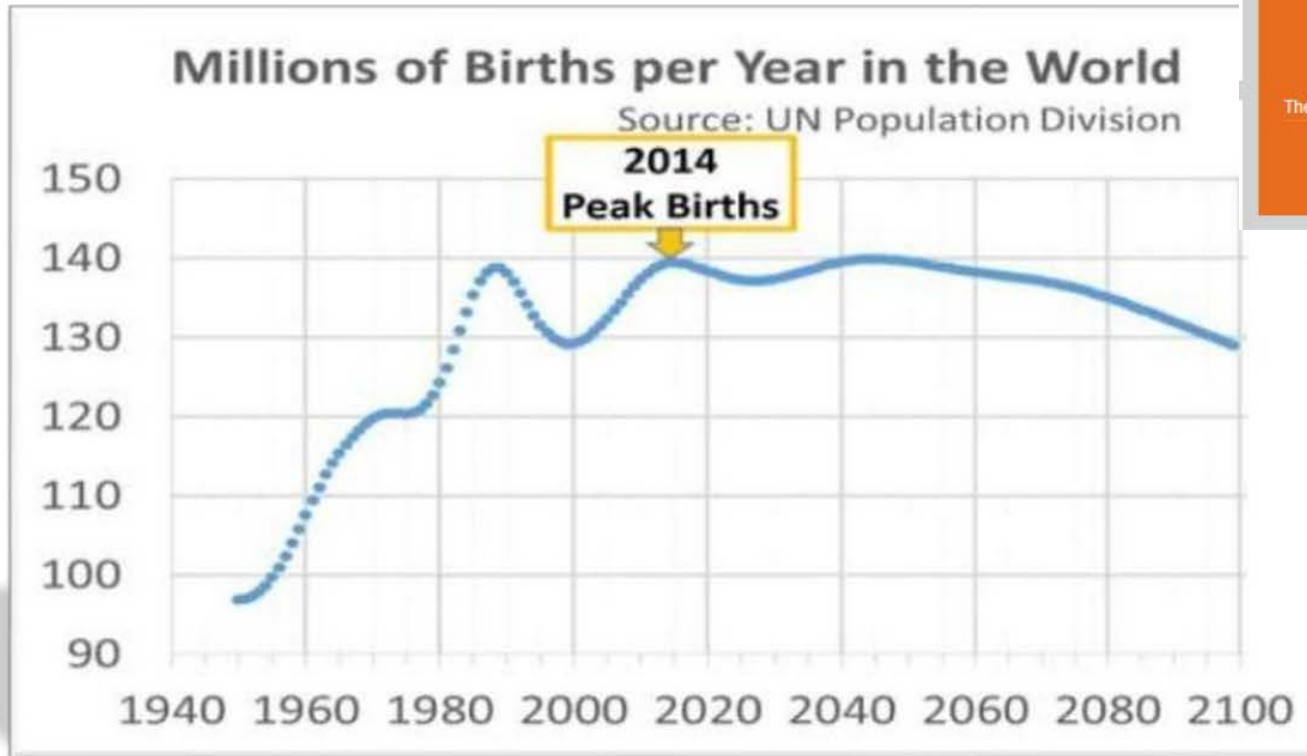
The Good News

2050-2055 median total fertility projection



UN, Department of Economic and Social Affairs

Peak Child



2.5

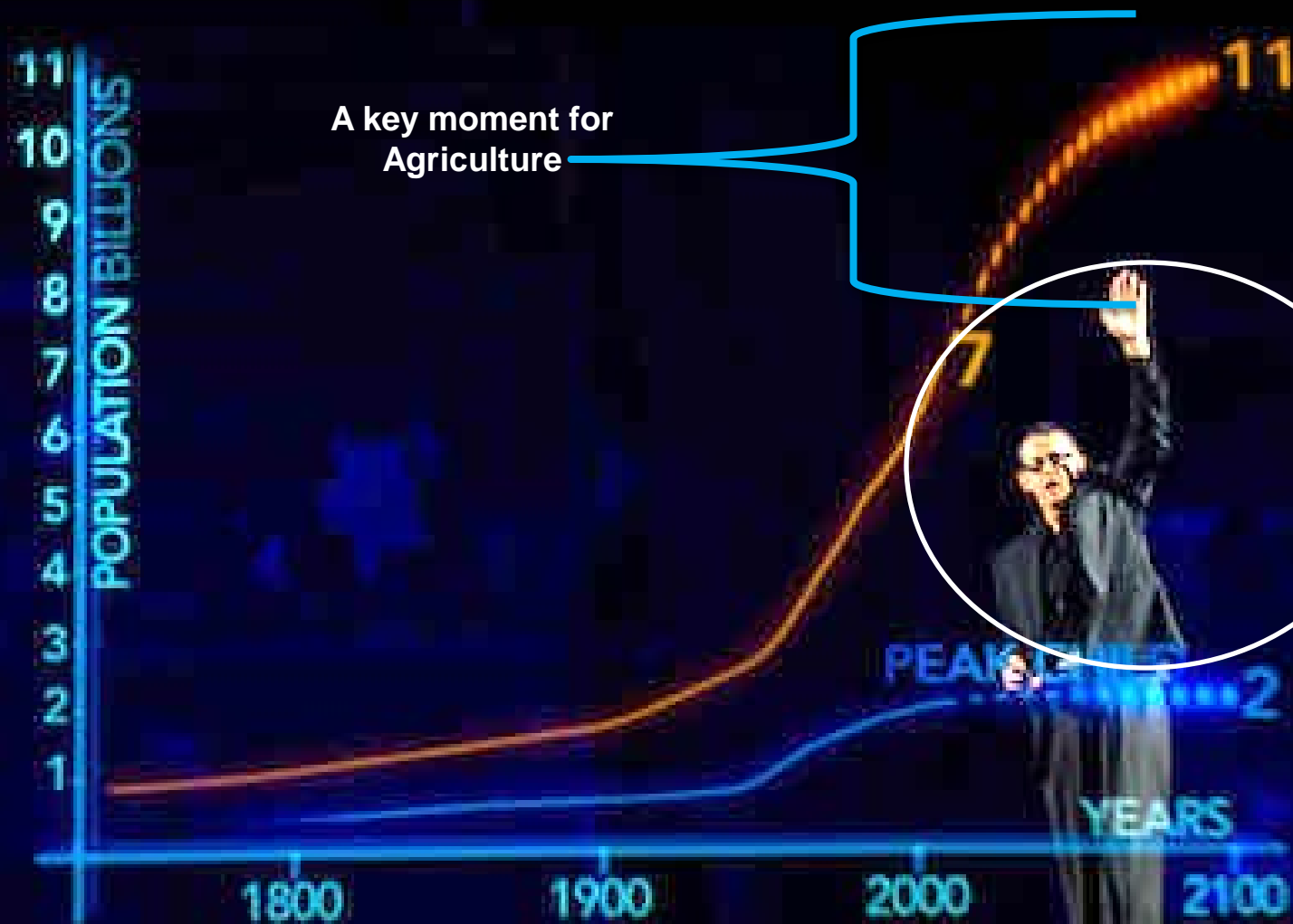
The total fertility rate worldwide.

Peak Child

It is now or never



Making the next 50 years matter



We Need Science

Resources Per Bushel of Corn
1980 – 2011



40% Less Land



60% Less Erosion



50% Less Water



40% Less Energy



35% Less Greenhouse Gases

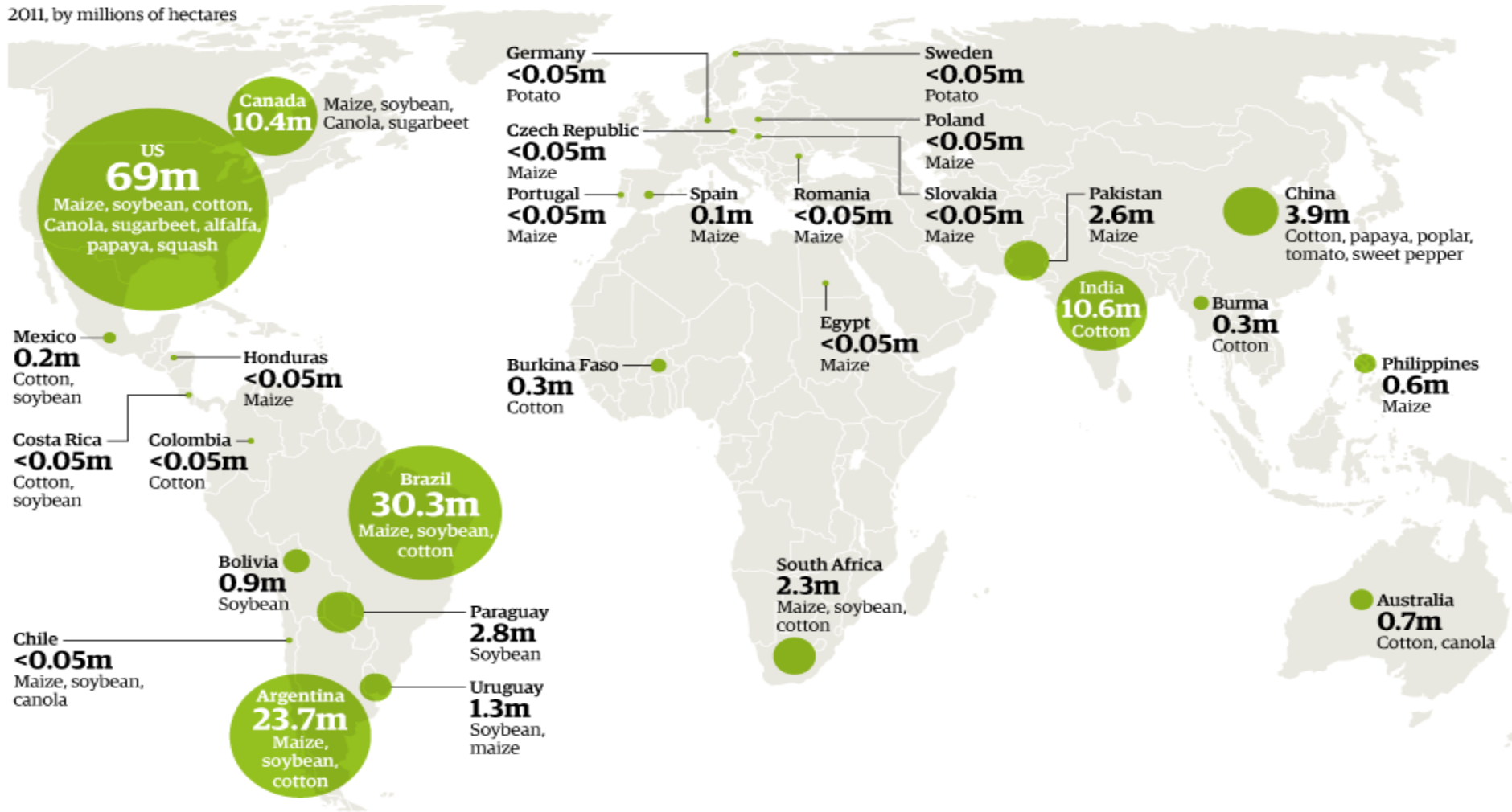
Source: USDA/ERS

Potential in the Spice Industry



Global Status of GE Crops

2011, by millions of hectares



Global Polarization



AN URBAN WORLD



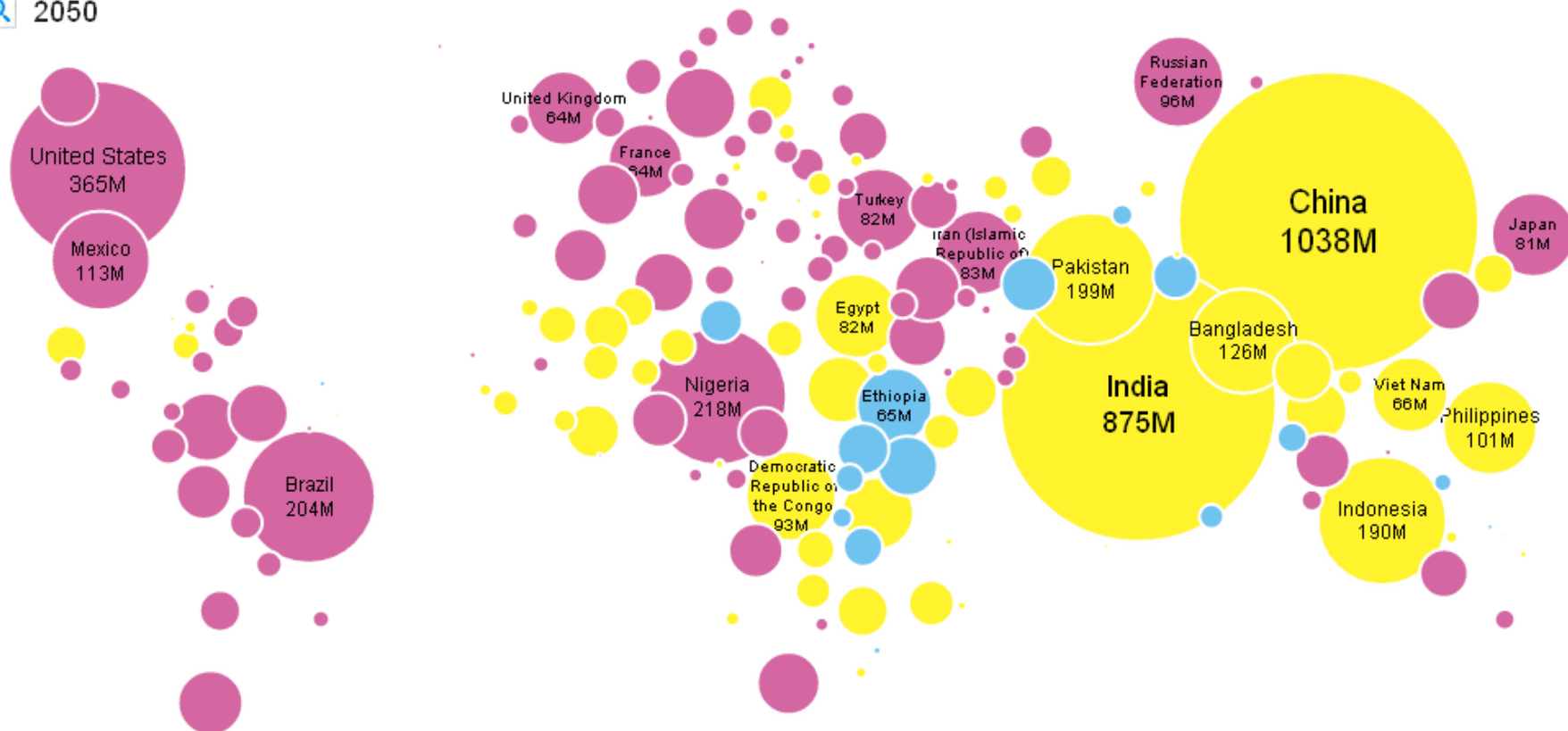
This graphic depicts countries and territories with 2050 urban populations exceeding 100,000. Circles are scaled in proportion to urban population size. Hover over a country to see how urban it is (percentage of people living in cities and towns) and the size of its urban population (in millions).

Urban Population

- Greater than 75%
- 50% - 75%
- 25% - 50%
- Less than 25%



2050



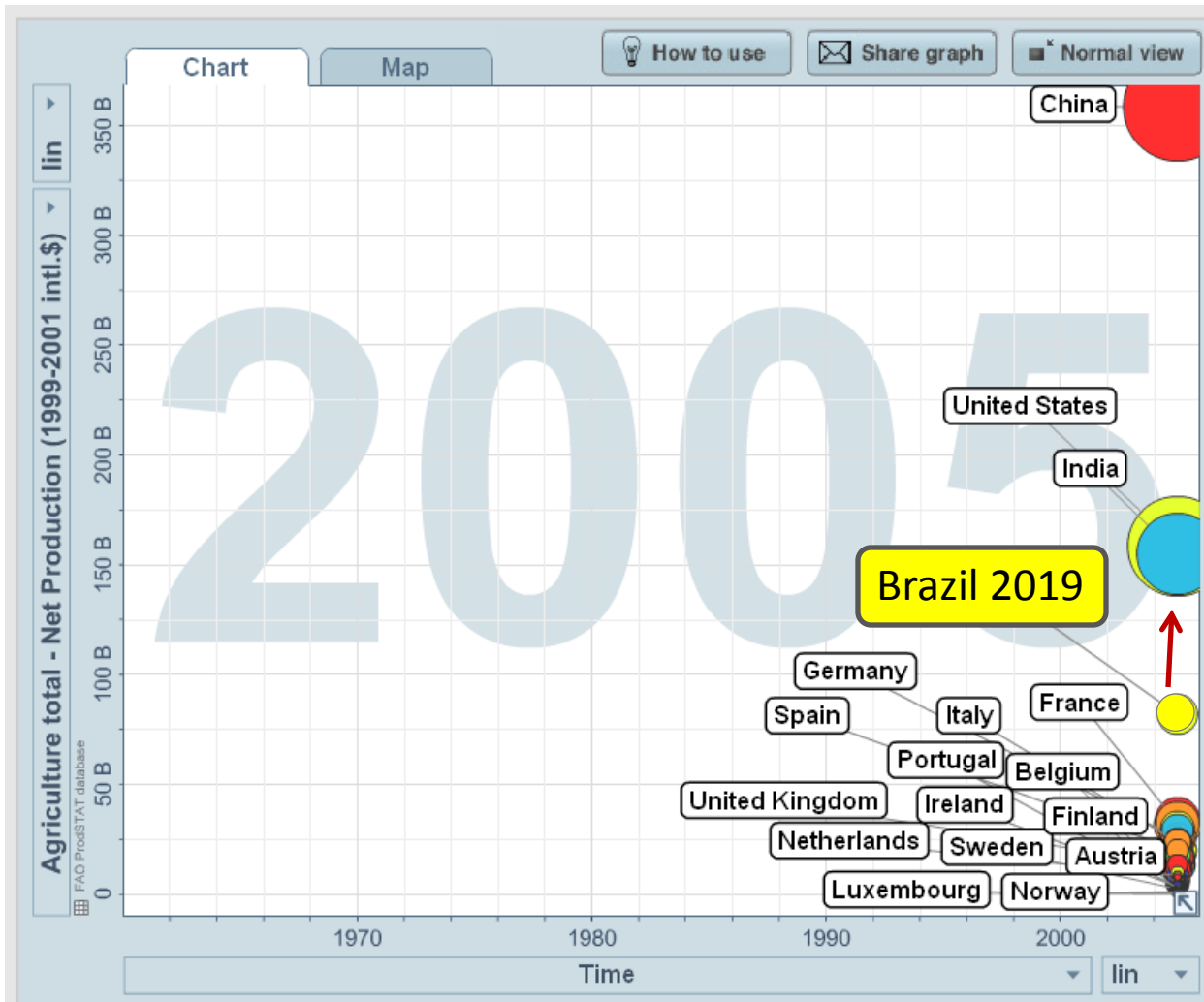
PROJECTED



1950 1960 1970 1980 1990 2000 2010 2020 2030 2040 2050

Notes

Different Choices



The *Tweet-ification*



A detailed microscopic image of a virus particle, likely a herpesvirus, showing a complex, multi-layered structure with a central core and an outer envelope. The virus is surrounded by numerous smaller, green, spherical particles, possibly representing other viral components or host cells. The background is dark, highlighting the intricate details of the virus.

Old School Risk

Hazard x Exposure = Risk

JEFF JOHNSON

BIOLOGICAL & MEDICAL VISUALS

Disruptive Technologies

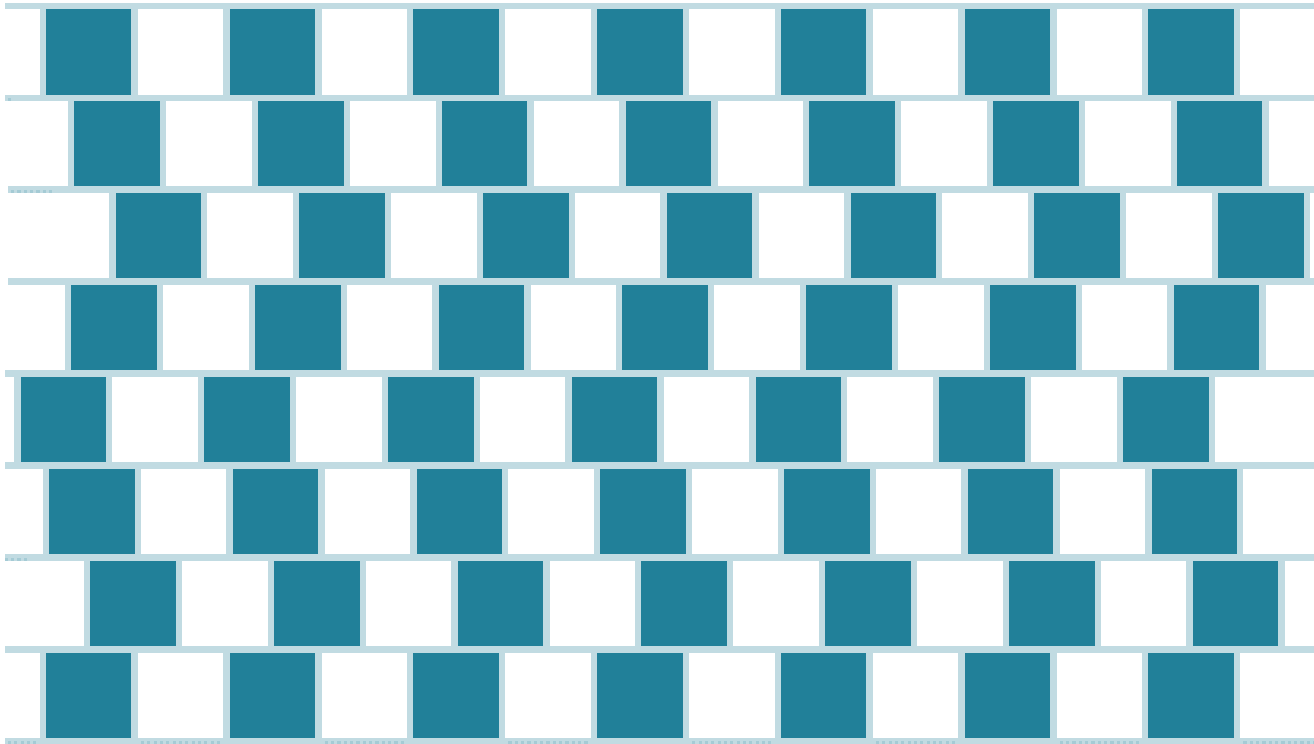


New School Risk



Hazard x Media Exposure = Perception of Risk

What is this?



Shifting Preferences

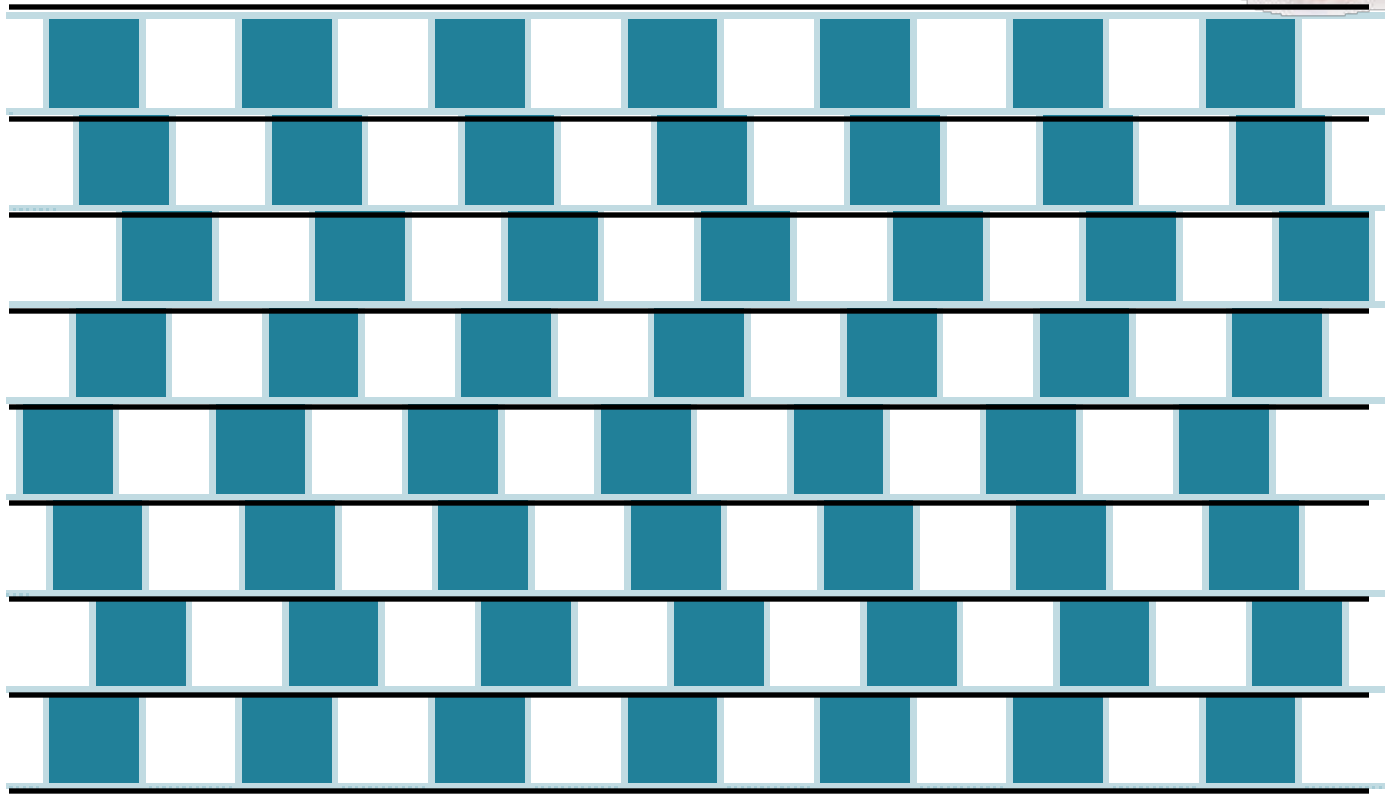
Marketing versus reality



By the way, this is dog food

“The eye sees only what the mind is prepared to comprehend.”

—*Robertson Davies*



Consumer Attitudes

**38% trust the
government**



**49% say
agriculture is on
the wrong track**



**33% say the
media gets the
facts right**



U.S. Farmers and Ranchers Alliance

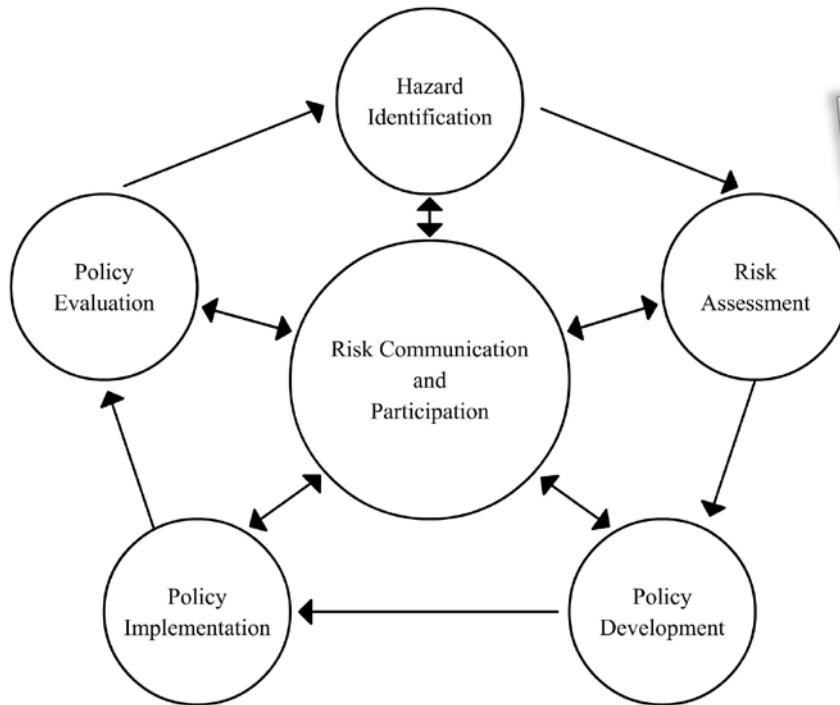
Health Scares

Versus

Scary but Healthy



How to communicate?



WHO Theory



Media Reality

When to communicate?

Risk High



Media Attention Low

Risk Low

**GMO
OMG**

Media Attention High

What to communicate?

Language that turns people off:

Amount is miniscule

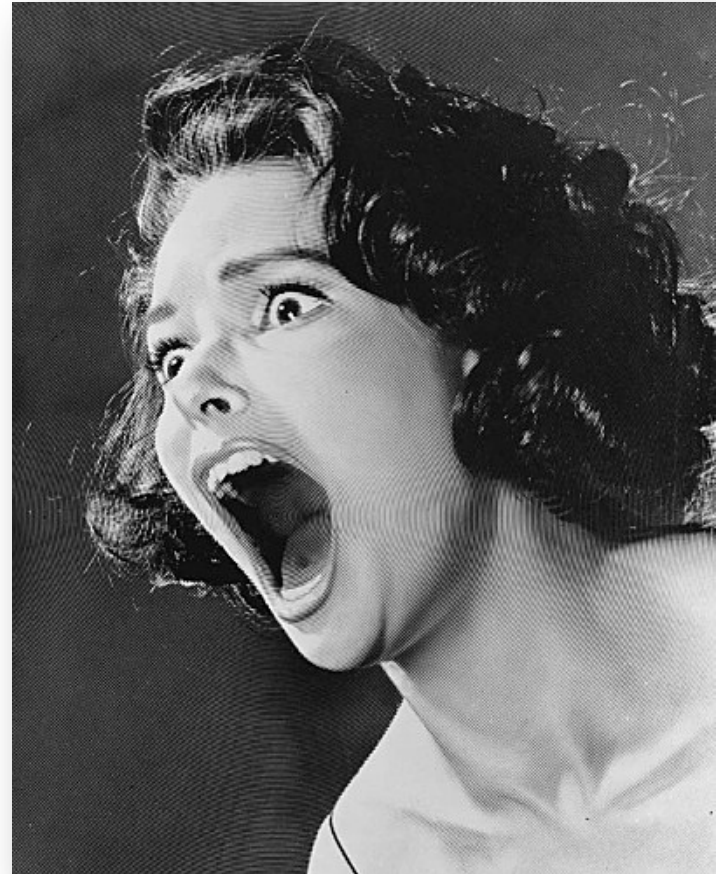
Research shows it's safe

Let us feed the world

Keeps prices low

Better for the environment

Lesson: If you lead with the science, you may lose with the science



Consumer Concerns

Cancer
Obesity
Diabetes
Heart health



Food doesn't have to be scary

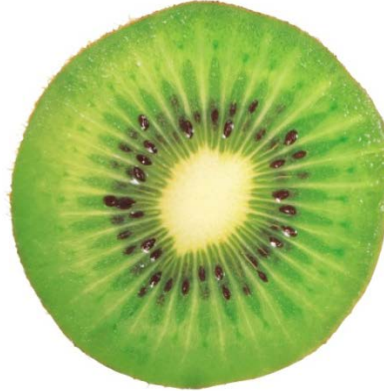


What's in a name?

Has anybody eaten Chinese gooseberries?



AN ALL-NATURAL KIWI



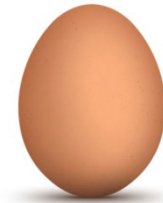
AN ALL-NATURAL BANANA



INGREDIENTS: WATER (75%), **SUGARS** (12%) (GLUCOSE (48%), FRUCTOSE (40%), SUCROSE (2%), MALTOSE (<1%), STARCH (5%), FIBRE E460 (3%), **AMINO ACIDS** (<1%) (GLUTAMIC ACID (19%), ASPARTIC ACID (16%), HISTIDINE (11%), LEUCINE (7%), LYSINE (5%), PHENYLALANINE (4%), ARGININE (4%), VALINE (4%), ALANINE (4%), SERINE (4%), GLYCINE (3%), THREONINE (3%), ISOLEUCINE (3%), PROLINE (3%), TRYPTOPHAN (1%), CYSTINE (1%), TYROSINE (1%), METHIONINE (1%)), **FATTY ACIDS** (1%) (PALMITIC ACID (30%), OMEGA-6 FATTY ACID: LINOLEIC ACID (14%), OMEGA-3 FATTY ACID: LINOLENIC ACID (8%), OLEIC ACID (7%), PALMITOLEIC ACID (3%), STEARIC ACID (2%), LAURIC ACID (1%), MYRISTIC ACID (1%), CAPRIC ACID (<1%), ASH (<1%), PHYTOSTEROLS, E515, OXALIC ACID, E300, E306 (TOCOPHEROL), PHYLLQUINONE, THIAMIN, **COLOURS** (YELLOW-ORANGE E101 (RIBOFLAVIN), YELLOW-BROWN E160a), **FLAVOURS** (3-METHYLBUT-1-YL ETHANOATE, 2-METHYLBUTYL ETHANOATE, 2-METHYLPROPAN-1-OL, 3-METHYLBUTYL-1-OL, 2-HYDROXY-3-METHYLETHYL BUTANOATE, 3-METHYLBUTANAL, ETHYL HEXANOATE, ETHYL BUTANOATE, PENTYL ACETATE), 1510, NATURAL RIPENING AGENT (ETHENE GAS).

INGREDIENTS: AQUA (83.1%), **SUGARS** (9.0%) (FRUCTOSE (48%), GLUCOSE (46%), MALTOSE (2%), GALACTOSE (2%), SUCROSE (2%)), FIBRE E460 (3.0%), ASH, **AMINO ACIDS** (1.1%) (GLUTAMIC ACID (17%), ASPARTIC ACID (12%), ARGININE (8%), LYSINE (6%), GLYCINE (6%), LEUCINE (6%), VALINE (5%), ISOLEUCINE (5%), ALANINE (5%), SERINE (5%), PHENYLALANINE (4%), PROLINE (4%), THREONINE (4%), HISTIDINE (3%), CYSTINE (3%), TYROSINE (3%), METHIONINE (3%), TRYPTOPHAN (1%)), **PRESERVATIVES** (E236, E296) **FATTY ACIDS** (<1%) (OMEGA-6 FATTY ACID: OCTADECADIENOIC ACID (68%), OCTADECANOIC ACID (13%), OMEGA-3 FATTY ACID: OCTADECATRIENOIC ACID (12%), HEXADECANOIC ACID (4%), OCTADECANOIC ACID (3%)), **COLOURS** (E160a, E161b, E161c, E140, E161d, E161e, E161g, E161h) E300, E307, FOLATE, CHOLINE, BETAINE, PHYTOSTEROLS, **FLAVOURS** (2,5-DIMETHYL-4-HYDROXY-3(2H)-FURANONE, 3-HYDROXY-BETA-DAMASCONE, 4-VINYLGUAIACOL, (Z)-3-HEXEN-1-OL, UNRIPE FLAVOUR: (E)-2-HEXENAL, RIPE FLAVOUR: ETHYL BUTANOATE, METHYL ETHANOATE, METHYL BUTANOATE, ETHYL BUTANOATE, METHYL HEXANOATE), E210.

INGREDIENTS OF AN ALL-NATURAL EGG



INGREDIENTS: AQUA (75.8%), **AMINO ACIDS** (12.6%) (GLUTAMIC ACID (14%), ASPARTIC ACID (11%), VALINE (9%), ARGININE (8%), LEUCINE (8%), LYSINE (7%), SERINE (7%), PHENYLALANINE (6%), ALANINE (5%), ISOLEUCINE (5%), PROLINE (4%), TYROSINE (3%), THREONINE (3%), GLYCINE (3%), HISTIDINE (2%), METHIONINE (3%), CYSTINE (2%), TRYPTOPHAN (1%)), **FATTY ACIDS** (9.8%) (OCTADECANOIC ACID (45%), HEXADECANOIC ACID (32%), OCTADECANOIC ACID (12%), EICOSATETRAENOIC ACID (3%), EICOSANOIC ACID (2%), DOCOSANOIC ACID (1%), TETRACOSANOIC ACID (1%), OCTANOIC ACID (<1%), DECANOIC ACID (<1%), DODECANOIC ACID (<1%), TETRADECANOIC ACID (<1%), PENTADECANOIC ACID (<1%), HEPTADECANOIC ACID (<1%), EICOSENOIC ACID (<1%), DOCOSENOIC ACID (<1%), OMEGA-6 FATTY ACID: OCTADECADIENOIC ACID (12%), OMEGA-3 FATTY ACID: OCTADECATRIENOIC ACID (<1%), EICOSAPENTAENOIC ACID (EPA) (<1%), OMEGA-3 FATTY ACID: DOCOSAHEXAENOIC ACID (DHA) (<1%)), **SUGARS** (0.8%) (GLUCOSE (30%), SUCROSE (15%), FRUCTOSE (15%), LACTOSE (15%), MALTOSE (15%), GALACTOSE (15%)), **COLOUR** (E160c, E160a), E306, E101; **FLAVOURS** (PHENYLACETALDEHYDE, DODECA-2-ENAL, HEPTA-2-ENAL, HEXADECANAL, OCTADECANAL, PENTAN-2-ONE, BUTAN-2-ONE, ACETALDEHYDE, FORMALDEHYDE, ACETONE); SHELL (E170), ALSO CONTAINS BENZENE & BENZENE DERIVATIVES, ESTERS, FURANS, SULFUR-CONTAINING COMPOUNDS AND TERPENES.

How do you get a seedless watermelon?



Treat seeds with colchicine
(natural plant extract)

Highly toxic
and mutagenic



Three sets of
chromosomes

Sterile seedless
melon

Mutagenesis

Atomic Energy Can Safely Create New Plants In Your Garden

POPPI
DOUBLE SHIRLEY SWEET BRIAR

ATOMIC-ENERGIZED

These seeds treated with atomic rays to alter heredity.
Normal plant appears as pictured.

Produced by Oak Ridge Atom Industries, Oak Ridge, Tennessee

WHAT ARE ATOMIC ENERGIZED SEEDS?
The seeds in the packet on the front of this card have been carefully treated with gamma rays emitted from cobalt 60. These special kind of rays, as they pass through the sensitive embryo inside each seed, may produce changes that will be evident in the growing or mature plant that results from these seeds. A permanent change is called a "mutation". Mutations occur in nature—but rarely. With the correct use of atomic energy, it is now possible to make them occur much more frequently.

WHAT DOES RADIATION DO?
Gamma rays tend to "shake up" the normal balanced system of the embryo inside the plant. The changes may take more than one year to manifest themselves. Therefore, DO NOT destroy stunted plants. The stunted plants may contain desirable changes when they again regain their hereditary balance in subsequent generations.

WILL EVERYONE FIND CHANGES?
We do not know. We have irradiated these seeds in an ATTEMPT to produce changes, and only by growing these seeds can you determine if you have a change. This is the challenge we offer to you.

WHAT CAN YOU DISCOVER?
No one knows—it may be the most exciting change ever found in this species. There are many useful types of changes that may be found. Remember, you will be taking part in a large and widespread experiment. Many changes will be found by many people. The change you may find could be unique.

CHANGES THAT HAVE BEEN PRODUCED FROM SEED TREATED WITH GAMMA RAYS
All over the world plants grown from irradiated seeds have been studied. Many changes have been found. Some of the desirable changes to look for are: increased

in some species, disease resistance, earlier or later maturity, different growth habits, complete color change, new plant and fruit shape, increased size, increased vigor, etc.

FOR EXAMPLE:
DISEASE RESISTANCE. Lush tomato plant grew in Oak Ridge test plot one mile from where tomatoes were destroyed by blight. 120 tomatoes were harvested from single plant. A true mutation produced by radiation, this plant has bred true for three plant generations.
HIGH PRODUCTION. Eight ears of corn grew on branched stalks from a single root system. This was a first generation change resulting from seed irradiated in Oak Ridge Atom Industries' cobalt 60 irradiation Laboratory.
NEW SHAPE. Goosenecked marigold was grown from seed irradiated at Oak Ridge Atom Industries' laboratories. Changes in marigolds have also included plants that lacked the characteristic unpleasant odor of the marigold.
Irradiated mum cutting had white stripe through golden bloom; another produced double-headed flower. Marigold normally producing bronze and gold flowers, when irradiated produced lemon-yellow flower. Irradiated petunia grew to 7' in height. Irradiated marigold produced vining plant.

HOW TO CONDUCT YOUR EXPERIMENT

1. Plant according to directions on back of seed packet.
2. Do NOT harvest the changed plants until the seed is mature. Dry seed and store in a suitable place for the second year planting.
3. Plant second generation. You may find even more changes. Harvest and store as stated above.
4. If plants breed true for three generations, you have a permanent change—a mutation.
5. For advice and assistance in developing your mutations, write to: Oak Ridge Atom Industries, Inc., P.O. Box 229, Oak Ridge, Tenn.

Seeds that have been exposed to Gamma Rays do not become radioactive. These seeds are completely safe to handle.

***Treated with gamma rays from Cobalt 60**

\$1.00

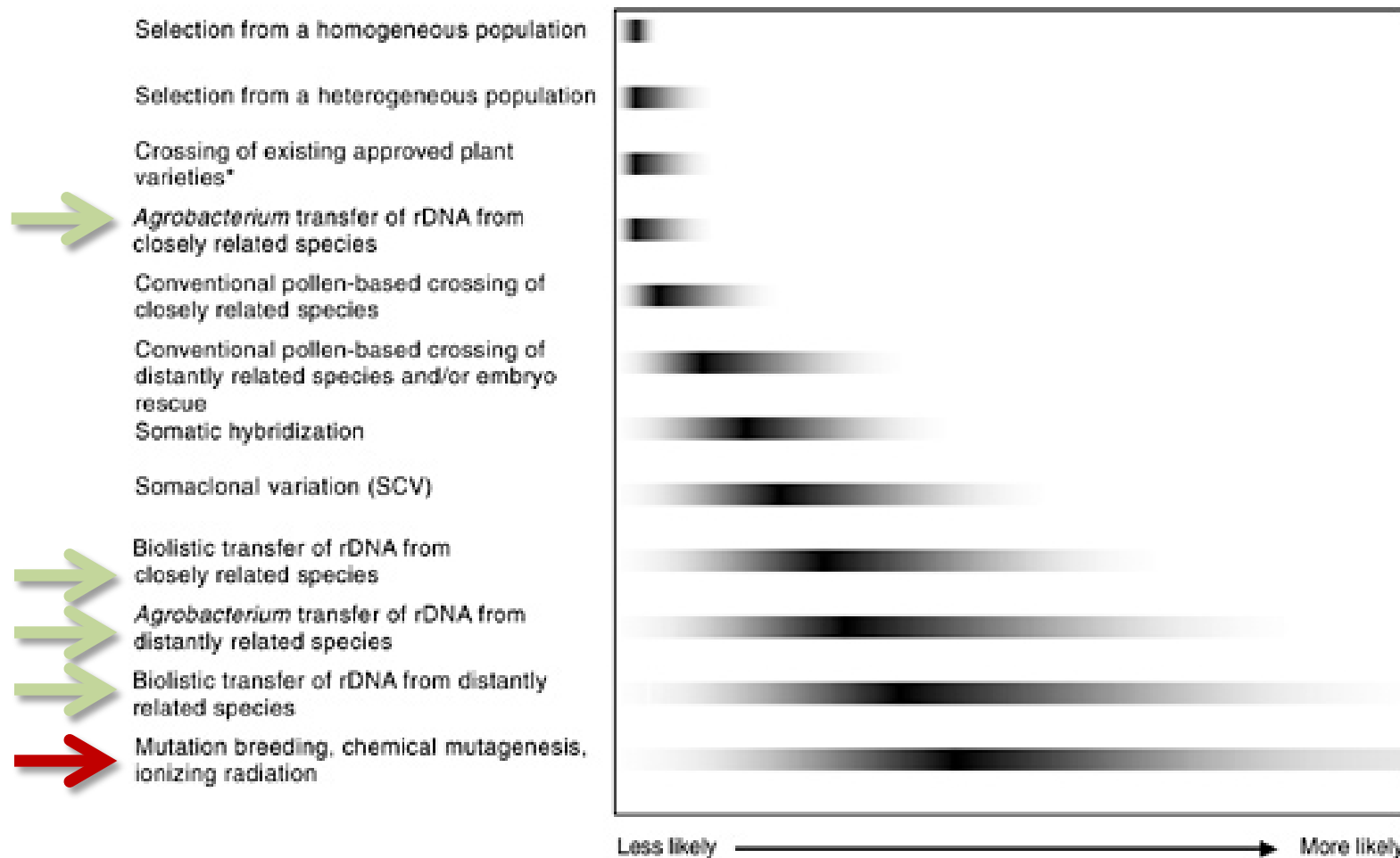
THE PEOPLE'S STORE
OCT 5 1955

WHAT ARE ATOMIC ENERGIZED SEEDS?
WHAT CHANGES MIGHT YOU FIND?
HOW CAN I BEST CONDUCT THIS EXPERIMENT?

SEE ANSWERS ON BACK OF CARD

According to the FAO/IAEA Mutant Variety Database, there are 3218 varieties released officially or commercially around the world.

Risk Spectrum



*includes all methods of breeding

Source: National Academy of Sciences

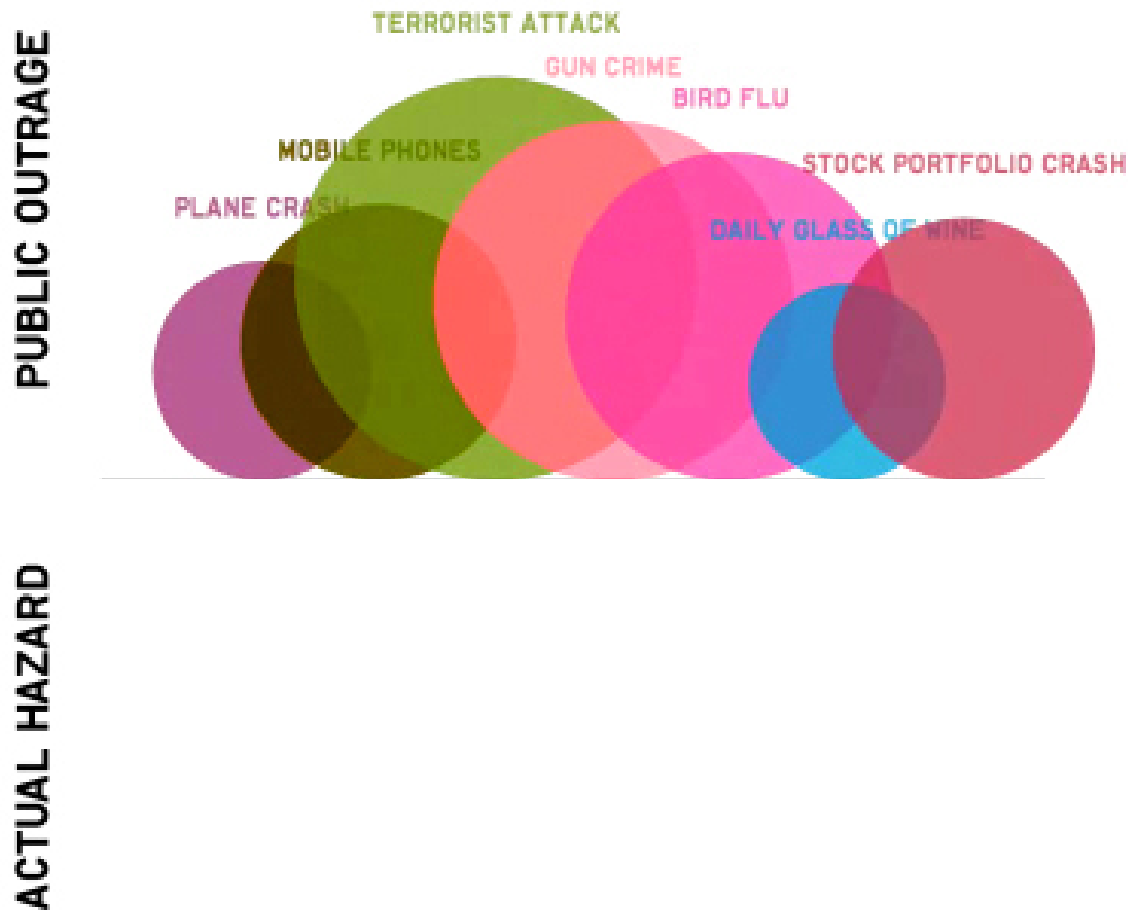
What do they have in common?



None of these products would
be approved today if held to
the same standard as
biotechnology



Risk in Context





Facilitating Connections



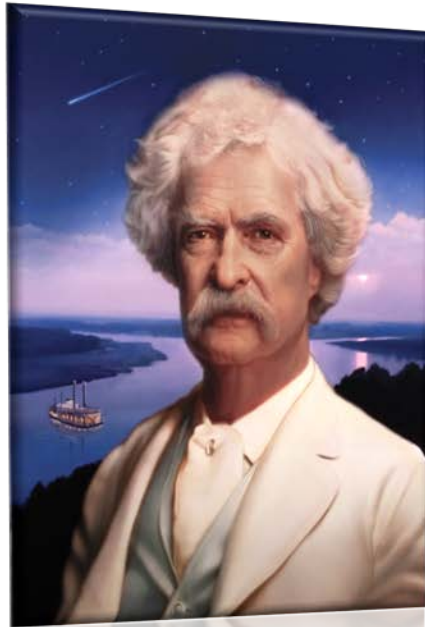
Being a Storyteller

Personalize
Acknowledge
Connect
Build Trust

Only then can we talk about the science



Making it rain



Mark Twain

“Twenty years from now you will be more disappointed by the things you didn’t do than by the ones you did. So throw, off the bowlines. Sail away from the safe harbor. Catch the trade winds in your sail. Explore. Dream. Discover.”

Marcella Szymanski, Ph.D.

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