Name_____Period_____Assignment #_____

_____Teacher initials practice data collection_____Teacher initials procedures

_____Teacher initials experimental data collection

What diet is best for weight loss and a healthy cardiovascular system?

Review Lecture Question #'s 6, 7, 51, and 70

Pre-lab: Annotate up to the hyperlink to the Phet lab

Annotating Text
☐ **UNDERLINE** concepts you think might be useful for understanding or solving the problem
☐ **Box** information you think might be helpful for designing your investigation
☐ ← Write **notes** in the left margin
☐ → Write **questions and answers** in the right margin
Each paragraph (including each step of the procedures) must have something underlined or boxed, **AND** have something written in the margins (a question and/or note).

Journalist Gary Taubes created a stir in 2007 with his impressive but daunting 640-page tome *Good Calories, Bad Calories*. Now he has written a shorter, more accessible book *Why We Get Fat: And What to Do About It* to take his message to a wider audience. His basic thesis is that:

- The calories-in/calories-out model is wrong.
- Carbohydrates are *the* cause of obesity and are also important causes of heart disease, type 2 diabetes, cancer, Alzheimer's, and most of the so-called diseases of civilization.
- A low-fat diet is not healthy.
- A low-carb diet is essential both for weight loss and for health.
- Dieters can satisfy their hunger pangs and eat as much as they want and still lose weight as long as they restrict carbohydrates.

He supports his thesis with data from the scientific literature and with persuasive theoretical arguments about insulin, blood sugar levels, glycemic index, insulin resistance, fat storage, inflammation, the metabolic syndrome, and other details of metabolism. Many readers will come away convinced that all we need to do to eliminate obesity, heart disease and many other diseases is to get people to limit carbohydrates in their diet. I'm not convinced, because I can see some flaws in his reasoning.

He says that [restricting carbohydrates]…leads to weight loss and particularly fat loss, independent of the calories we consume from dietary fat and protein. We know that the laws of physics have nothing to do with it.

This is simply not true. The laws of physics are unavoidable. His demonization of the calories-in/calories-out principle strikes me as a bit of a straw man argument. He says

exercising and reducing total calorie intake don't work; moreover, he says they can't work. Most of us would argue that they can and do; the problem is not with the principle, but with its implementation. Simple physics requires that to lose weight, we must burn more calories than we ingest: that is indisputable. The devil is in the details. It takes a lot of exercise to burn off a few calories, so exercise is not a practical solution; and it has proved very difficult in practice to get people to reduce their calorie intake significantly over long periods of time. Weight loss is *simple*, but it is not *easy*; and those of us who rely on the calories- in/calories-out principle have never suggested that it was. We don't just berate obese people for lack of will power. We try to understand why most people find it so difficult to lose weight. Perhaps the more intriguing question is why some people maintain a low weight throughout a long lifetime of varying food intake, including people who eat a lot of carbohydrates.

There are social and cultural influences and practical considerations; but the basic problem is that because of their genetic makeup, some people's bodies are more efficient at storing calories. In a famine situation, they would be the survivors; in a world where abundant food is available, they are the obese. Taubes is correct when he says, "Those who get fat do so because of the way their fat is regulated." But they still couldn't get fat without eating too many calories for their particular metabolism, and if a way can be found to decrease their calorie intake to a level appropriate for their metabolism, they *will* lose weight.

Diets are just tricks to get people to reduce total calorie intake, and low-carb diets are no exception. A 2003 systematic review in JAMA showed that weight loss on low-carb diets was principally associated with decreased caloric intake and increased diet duration but not with reduced carbohydrate content.

Taubes says "In a world without carbohydrate-rich diets, obesity would be a rare condition." That's undoubtedly true. But is it the carbs or the calories? The two are confusingly intertwined. Carbohydrate-rich diets are high calorie diets. Cutting calories usually involves cutting carbohydrates, and cutting carbs usually results in cutting calories. On any weight loss diet, dieters avoid "empty calories" and try to pick foods that will satisfy their hunger better and for longer.

The diet he recommends allows unlimited amounts of meat, fish, poultry, green vegetables and eggs; limited amounts of cheese, cream, mayonnaise, olives, avocado, lemon, soy sauce and pickles; and no carbohydrates except for a few nutritionally dense, fiber-rich vegetables. A sample menu:

- Breakfast: bacon and eggs
- Lunch: grilled chicken and green salad
- Snack: pepperoni slices and a cheese stick
- Burger or steak, green salad, green vegetables

He admits that the diet can cause side effects, which he attributes to (1) eating too much protein and too little fat, (2) attempting strenuous exercise without taking the time to adapt to the diet, and (3) most importantly, to the body's failure to compensate for the lower insulin levels. He admits that it is a real challenge to overcome carbohydrate cravings, which amount to an addiction. He admits that high protein diets can be toxic. He also admits that people who restrict carbohydrates tend to eat less, and he says their energy expenditure increases. Wait! This sounds like support for very calories-in/out principle that he rejects.

Taubes says the high fat/cardiovascular disease hypothesis led the American public to replace fat calories with carbohydrate calories, thus causing the obesity epidemic. In *The China Study* T. Colin Campbell argues that all animal products should be eliminated from our diet because it is animal products (not carbohydrates) that cause heart disease, cancer, and a host of other diseases. If he and Taubes staged a formal debate or both served on a committee to develop diet recommendations, there might be some spectacular fireworks.

Taubes thinks that low-carb diets reduce cardiovascular risk and that low-fat diets don't. He says a 2001 Cochrane review concluded that there is still only limited and inconclusive evidence of the effects of modifying total, saturated, monounsaturated, or polyunsaturated fats on cardiovascular morbidity and mortality. This is selective quoting. The conclusion stated in the abstract of that review was:

The findings are suggestive of a small but potentially important reduction in cardiovascular risk in trials longer than two years. Lifestyle advice to all those at high risk of cardiovascular disease (especially where statins are unavailable or rationed), and to lower risk population groups, should continue to include permanent reduction of dietary saturated fat and partial replacement by unsaturated fats.

He admits that studies show that low-carb diets tend to raise the level of "bad" LDL cholesterol, but he thinks that this is more than compensated for by rises in "good" HDL cholesterol and by lower levels of triglycerides. Published evidence suggests that he may be wrong. In a 2010 study, adherence to a Mediterranean-like dietary pattern reduced mortality but a carbohydrate-restricted diet appeared to *increase* mortality in elderly Swedish men. Another 2010 study showed that low-carb diets based on animal sources were associated with higher all-cause mortality in both men and women, whereas a vegetable-based low-carbohydrate diet was associated with lower all-cause and cardiovascular disease mortality rates.

How can he be so certain we should go beyond the evidence this time? Has Taubes destroyed the old low-fat myth only to create his own new low-carb myth? Rather than jumping on the low-carb bandwagon before his ideas are properly tested, the precautionary principle suggests that it might be more reasonable to follow a moderate diet like the Mediterranean diet (or to follow Michael Pollan's stunningly simple advice to "Eat food. Not too much. Mostly plants."), to limit "empty calories" from simple carbohydrates like sugar, to eat a variety of vegetables and fruits, to choose low calorie density foods that are more filling, to limit meat intake, to limit salt, and to keep looking for behavioral and environmental ways to change our calories-in/calories-out balance.

Important modeling notes / simplifications:

• The BMI tables and healthy body fat levels were specifically identified as being for full grown adults. Students will have to change height manually which makes sense because kids don't grow at a steady predictable rate, rather in spurts.

• General guidelines for Sedentary to Very Sedentary: When selected the person burns less calories based on the typical resting BMI of a Sedentary person with the given body fat. This is because a sedentary person exercises less. Choosing Very active assumes a lot of physical activity throughout the day so the person burns more calories. You can then change exercise for the person to add in specific physical activities.

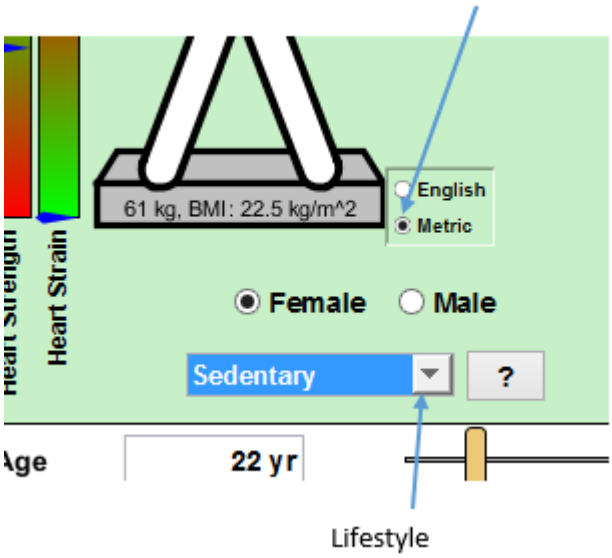
• General guidelines Heart Strength: Depends on how much exercise the person gets and is independent of body fat.

• General guidelines Heart Strain: The heart strain depends on body fat. Both extremely low and extremely high body fat strain the heart. Does not depend on exercise.

• Male and female have different rules because they typically change different levels of body fat when they take in fewer calories than they use. Typical situations are used for defaults.

Go to https://phet.colorado.edu/en/simulation/eating-and-exercise

Set simulation to metric



Select Metric

1) Set the following parameters to your choosing:

Lifestyle:

Age:

Height:

Weight:

Body Fat:

Energy intake:

Metabolic rate:

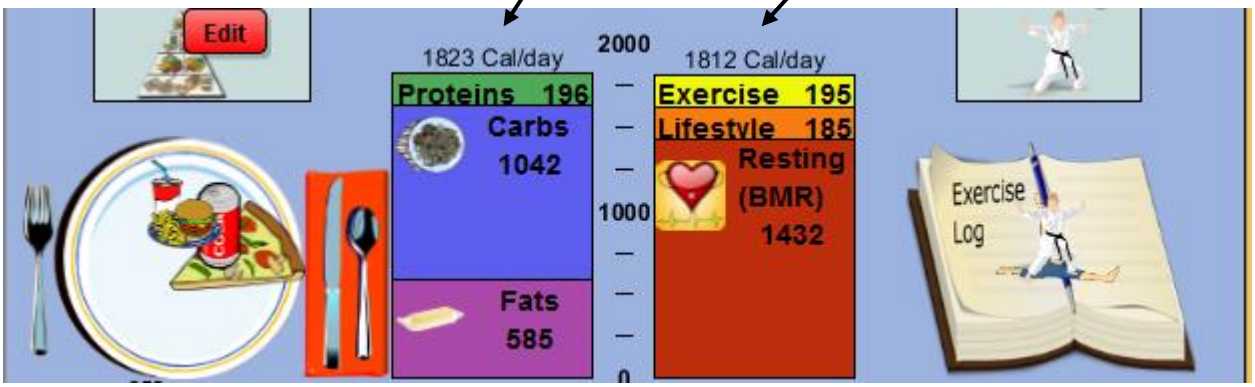
Calories from proteins:

Calories from fats:

Calories from carbohydrates:

Energy intake = Calories/Day:

Total Metabolic rate = Calories/Day used:



Predictions: (What will happen to weight over 12 months, what will happen to calories burned due to exercise, lifestyle, and BMR (basal metabolic rate)?)

Run Simulation for 12 months

Sketch graphs

Describe what happened to weight and calories burned due to exercise, lifestyle, and BMR

Explain why weight and calories burned due to exercise, lifestyle, and BMR changed or why they did not change

2) Run simulation again using different parameters:

Lifestyle:	Energy intake:
Age:	Metabolic rate:
Height:	Calories from proteins:
Weight:	Calories from fats:
Body Fat:	Calories from carbohydrates:

Predictions: (What will happen to weight over 12 months, what will happen to calories burned due to exercise, lifestyle, and BMR (basal metabolic rate)?)

Run Simulation for 12 months

Sketch graphs

Describe what happened to weight and calories burned due to exercise, lifestyle, and BMR

Explain why weight and calories burned due to exercise, lifestyle, and BMR changed or why they did not change

Your Task: Design a controlled experiment to answer the guiding question: What diet is best for weight loss and a healthy cardiovascular system?

1) What are your independent variables?

2) What are your dependent variables?

3) What data will you need to collect?

4) What will be your control condition?

5) What treatments will you set up and how will you do it?

6) How will you determine if there is a difference between the treatment and control conditions?

7) What type of calculations will you need to make?

Connections to cross-cutting concepts

While you design and conduct your experiment, consider the following:

Patterns:

- Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.
- Empirical evidence is needed to identify patterns.

Cause and Effect: Mechanism and Prediction:

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
- Changes in systems may have various causes that may not have equal effects.

Systems and System Models:

- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.

•Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models.

Energy and Matter: Flows, Cycles, and Conservation:

•Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.

•Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems.

Stability and Change:

•Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.

•Systems can be designed for greater or lesser stability.

ADI Investigation Proposal TGB Version

Guiding Question:

Claim:

Alternative claims:

Method:	What data will you collect? How will this data help you answer the guiding question?

Data table(s) and chart(s)

Guiding Question:

Our Claim:

Our Evidence:

Analysis: break it down (Illustrate and describe your data)

Interpretation: What does the analysis mean?

Our Justification of the Evidence:

Use your scientific knowledge and analysis to support your interpretation