



IRON

Iron is of special importance to athletes because of its key role in exercise metabolism.

WHAT DOES IRON DO FOR THE BODY?

Iron is responsible for carrying oxygen throughout the body (as part of hemoglobin in the blood and myoglobin in the muscles). While iron can be stored in all types of cells, the liver contains the largest reserve. Poor iron status can cause fatigue, shortness of breath, and impaired muscular function, affecting overall performance and ability to make positive training adaptations.

HOW MUCH DO YOU NEED?

The Recommended Dietary Allowance for iron is **18mg/day** for women of childbearing age, and **8mg/day** for men and post-menopausal women. This difference is due to the monthly loss of iron in the blood of a female's menstrual cycle.

WHO IS AT RISK FOR IRON DEFICIENCY?

Athletes are at an especially high risk for low iron levels and it is estimated that 22-25% of female athletes are iron deficient.

* **Female athletes:** Blood loss during menstruation increases the iron needs of females. If you experience particularly heavy menstrual bleeding, your needs may be even higher.

* **Dieting athletes:** Restricting caloric intake or certain food groups can result in inadequate iron intake.

* **Vegetarian athletes:** Limiting or eliminating meat excludes some of the best, most biologically available sources of iron. Iron from fruit, vegetable, and cereal sources is not as well absorbed as that from animal sources. Vegetarians may need up to 1.8 X RDA due to the lowered absorption. See tips below to increase your intake.

* **Endurance athletes:** Iron losses by way of intestinal bleeding, sweat, urine, and feces have been observed in endurance athletes. Marathon runners can break tiny blood vessels in the soles of their feet from repetitive pounding and they will need additional dietary iron. Serum ferritin may be elevated in endurance athletes.

* **Growing athletes:** During periods of growth, blood volume increases rapidly. Because of this, the body requires more iron for the synthesis of hemoglobin.

WHAT ARE SIGNS OF IRON DEFICIENCY?

- * Fatigue and exhaustion
- * Pale skin around eyes
- * Tongue inflammation
- * Light headedness
- * Shortness of breath
- * Weak immune system
- * Brittle nails and hair
- * Rapid heartbeat
- * Decrease in appetite

WHAT IS IRON DEFICIENCY?

1. Iron depletion: stores of iron in the liver, bone marrow, and muscle become depleted due to one or more of the following factors: inadequate iron intake, poor iron absorption, loss of iron through sweat, inflammation due to heavy training, destruction of red blood cells or gastrointestinal blood loss, all of which are common in athletes. By mobilizing the iron in storage, your body tries to maintain serum blood iron and actually increases iron absorption.

a. Clinical sign: low serum ferritin

2. Iron-deficiency non-anemia: iron stores are now exhausted, serum iron decreases, and overall supply to red blood cells is reduced. **Many female athletes fall into this category and suffer from a decreased work capacity due to lack of iron.**

a. Clinical signs: low serum ferritin and transferrin saturation

3. Iron-deficiency anemia: small (microcytic), pale (hypochromatic) red blood cells are produced due to the lack of iron needed to make hemoglobin. Diagnosis by blood test is needed to confirm. This condition should be monitored regularly by a health professional. It is not recommended to supplement without medical supervision.

a. Clinical signs: low serum ferritin, hemoglobin, hematocrit, and decreased mean corpuscular volume (of red blood cells)

If you fall into one of the following categories, you should be particularly careful about getting adequate iron in your diet.

CAN YOU HAVE TOO MUCH?

Since the body tightly regulates iron absorption, an overload from dietary intake is uncommon. Supplement over-consumption can cause iron overload, so it is recommended that you consult a medical professional to determine if supplementation is right for you. Symptoms of iron overload include gastrointestinal distress, vomiting, diarrhea, nausea, and dark stools.

DIETARY SOURCES OF IRON

There are two types of dietary iron (See *What's My Iron Intake?* Handout for iron content of foods):

- * **Heme Iron** is found only in animal sources (meat, poultry, fish) and is easily absorbed by the body during digestion.
- * **Non-Heme Iron** is found in plant based foods and fortified products (beans, whole grains, dark leafy greens, fortified cereals). It is not as easily absorbed as heme iron sources and therefore larger quantities are required to meet the body's needs.

TIPS TO MEET IRON NEEDS:

- * Choose lean cuts of red meats and dark poultry meat 3-4 times per week.
- * Eat enriched or fortified breads, cereals, and pastas regularly.
- * Pair vitamin C containing foods with an iron-rich meal to enhance iron's absorption. See *Vitamin C* Handout for food sources. This is especially important with non-heme sources in which the phytates found in whole grains, legumes, and soy products can block absorption. Examples include:

- * **Orange juice (vitamin C) with a fortified cereal product (iron)**
- * **Tomatoes (vitamin C) with bean chili (iron)**
- * **Omelet with red bell peppers (vitamin C) and spinach (iron)**
- * **Salad with brussels sprouts (vitamin C) and lentils (iron)**
- * **Snack on strawberries (vitamin C) dipped in 45% or higher dark chocolate (iron)**

- * Substances such as tannins in tea and polyphenols in coffee inhibit iron absorption. Drink tea or coffee between meals (2-3 hours before) and avoid over-consumption.
- * Cook in cast iron skillet or pots to significantly increase the iron content of your meal. Acidic foods (such as those rich in Vitamin C - i.e. tomatoes, peppers) will pull iron from the cookware and help to increase absorption.

* If you think your dietary intake of iron is inadequate or are considering iron supplementation, first check with your physician or other licensed health professional.

* If prescribed, iron supplements should be taken independently from a calcium supplement (about 4 hours apart). Calcium can interfere with iron absorption and make your supplement less effective.

ORAL IRON SUPPLEMENTS:

Iron supplements come in many different forms; you can recognize iron by the name “ferrous” or “ferric,” followed by another word such as sulfate, fumarate, citrate, or gluconate.

These indicate different compounds the salt form of iron is bound to. Ferrous supplements are more bioavailable than ferric supplements. Iron supplements can be hard on your stomach, so you may want to supplement on alternate days if you experience gastric distress.

Brand	Type of Iron	Dosage	Serving
NOW Iron	Ferrous Bisglycinate	18 mg	1 capsule
GNC Gentlesorb Iron	Hydrolyzed Protein Chelate	18 mg	1 capsule
Nature Made Iron	Ferrous Sulfate	65 mg ³	1 tablet
Vitamin Friends Vegan Iron Gummies	Ferrous Fumarate	30 mg	2 gummies
SLOW Fe Iron	Ferrous Sulfate	45 mg	1 tablet

Some iron supplements will have dosages much higher than the stores. Talk to your doctor about choosing a supplement that will best meet your needs.

It is common for athletes to be iron-deficient without anemia. Check your iron intake on the *What's Your Iron Intake? Handout* to ensure you are getting enough in your diet!





REAL TIME FUELING

WHY ARE CARBOHYDRATES IMPORTANT DURING A WORKOUT/COMPETITION?

Consuming carbohydrates (and fluid) while conditioning, practicing or competing can help prolong your energy, delay fatigue and help you maintain your skill, timing and concentration. For long endurance training events or stop-and-go sports (including soccer, basketball or tennis) which last over one hour it is recommended to take in fuel to keep you going. In fact, the metabolic demands of stop and go and change direction are much greater than previously calculated. Think back to the fuel-tank analogy – during a long road trip, you will have to refuel at a rest stop at some point along the way—your body is the same! When your muscle glycogen runs low, you can feel fatigued and performance will suffer. Additionally, your mental acuity, such as your ability to execute plays or think quickly, can be compromised. How well your muscles were stocked starting out, the intensity of play, and how long you are active for will all determine how quickly to start fueling and how much you need. Typically, by 45 minutes to one hour in it is helpful to fuel. If not possible, use half time to get in 15-25 grams of carbohydrate.

WHAT TYPES OF CARBOHYDRATES SHOULD I CONSUME?

It is important to consume a carbohydrate source that is rapidly digested and does not place stress on the gut. Think simple sugars (low fiber) which can easily digest and raise blood sugar for your muscles to utilize quickly. The best intra-workout sources combine different types of simple sugars, such as glucose and fructose, to increase absorption rates from the GI tract (called “multiple transport”) and to increase oxidation (use) by the muscles. There are actually multiple types of transporters within your small intestines which help move different types of sugar to get energy into your system!

For activity lasting 1-2.5 hours you can consume **30-60g/hr**, and for activity lasting >2.5 hours, you can consume up to **90g/hr**. It is also important to balance carbohydrate intake with adequate fluid; this is especially important when consuming sports gels or chews. Water helps absorption and without fluid, the sugars will pull fluid into your stomach, potentially causing gastric discomfort and even cramping. Sports drinks, which hydrate, also provide carbohydrate, so be careful if you are also consuming gels, goos, or bars, and recognize how much carbohydrate you are consuming at a time.

TRAIN YOUR GUT

You can actually train your gut to tolerate and absorb more carbohydrate while in motion. **It just takes practice.** Try it out for yourself, and see which foods/drinks work best for you. Sometimes, because of decreased blood flow to the gut (as it is all going toward your working muscles) individuals can experience gastrointestinal distress consuming food during a workout. Motility (the joggling of your stomach while running), types of food, and nerves, can all contribute to what is now termed “*Exercise Induced Gastrointestinal Syndrome*” (formally known as Runner’s Trots). For some, it may also be a FODMAPs (certain types of carbohydrates) sensitivity that is exacerbated with activity, causing distress.

It is best to try out different options while training so you can feel confident and comfortable while competing. Work with your sports dietitian-nutritionist on types and timing. You want to start before you “need” the fuel. Depending on intensity, distance and what you ate before you began, you may start fueling anywhere from 45 - 75 minutes into your training/competition or earlier if you missed your pre-snack and it has ben over several hours since you have eaten.

Look to the list below to explore some easy to digest carbohydrate sources to consume during your training. Many of these products also come in versions with caffeine as well, but remember – it is *carbohydrate* that your body needs to fuel working muscle.

Food	Serving Size	Carbohydrate Amount
Honey	1 tbsp	17
Haribo Gummy Bears	13 pieces	23
Pretzels, snaps	24 snaps (30g)	25
Potatoes (baked)	1 medium, white	36
Dry Cereal (e.g. Honey Nut Chex)	¾ cup	28
Raisins	1.5 oz	34
Applesauce, unsweetened	1 cup (244g)	27
Banana	1 medium	27
SPORTS PRODUCTS		
Gatorade Prime Energy Chew	1 pack (6 chews)	24
Gatorade Endurance Energy Gel	1 pouch (37g)	20
Gatorade Endurance Formula Thirst Quencher Powder	½ pack (12 fl oz)	45
Gatorade Endurance Carb Energy Chews	1 pack (4 chews)	31
Jelly Belly Sport Beans	1 package	25
Gu Sports Nutrition Energy Gel	1 packet (32g)	23
Gu Roctane Energy Gel	1 packet (32g)	21
Honey Stinger Energy Chews	1 packet (50g)	39
Honey Stinger Energy Gel	1 packet (34g)	26
Gatorade Original Thirst Quencher	20 fl oz	36
Gatorade Organic Thirst Quencher	16.9 fl oz	30
Gatorade Thirst Quencher Powder	1 2/3 tbsp (23g) – makes 12 fl oz	22
Bobo's Oat Bites	1 packet	24
Stinger Snack Bar	1 bar (42g)	23
Gu Energy Stroopwafel	1 packet (30g)	21



*Nutrition facts retrieved from brand's respective websites January 2020.

If you are buying anything considered a supplement make sure it has the NSF seal to know it has been tested and is safe for sport.



STRESS FRACTURES

ACK! WHAT IS A STRESS FRACTURE?

A **stress fracture** usually starts as a crack or a partial or total break in the bone due to repeated force on the bone (instead of a single incident causing the break). They most commonly occur in the bones of the lower leg and foot due to the repetitive stress placed on the legs during activity. Stress fractures can occur in the pelvis and vertebrae of the back as well. A healthy bone would find the 'stress' of exercise a stimulant to build stronger bones but, if you are in a state of low energy availability, exercise becomes a negative stressor instead of a positive stimulant.

WHAT CAN CAUSE A STRESS FRACTURE?

A stress fracture is a type of an overuse injury. Stress fractures can occur for reasons other than low energy availability including ramping up activity too quickly, poor footwear, poor mechanics or technique, or changes in surfaces without adaptation, but are often due to an underlying energy or nutrient deficit which weakens bones and makes them more susceptible to mechanical stress. Inadequate calories, protein, calcium, or vitamin D intake impair bone strength and the ability to withstand the demands of athletic activity.

RISK FACTORS FOR STRESS FRACTURES INCLUDE:

- * Female athletes
- * Under-fueling (inadequate calorie intake)
- * Low intake of calcium, vitamin D, or protein
- * Drive for thinness
- * Endurance (cross-country running, cycling) and aesthetic-concerned sports (gymnastics, dance, diving, skating)
- * Weight loss, especially when rapid
- * Amenorrhea (not getting your period)
- * Avoidance or elimination of food groups
- * Imbalance of training demands with food intake

A stress fracture is a common manifestation of the Triad, resulting from the interplay between poor bone health, low energy availability and hormonal imbalances.

WHAT DOES A STRESS FRACTURE LOOK LIKE? A CLOSER LOOK INTO BONE REMODELING:

A stress fracture starts with a crack, which signals the bone to "clean up" around it. This hole then signals osteoclasts (cells responsible for bone resorption and breakdown) to come in. The process of rebuilding and remineralization to create strengthened bone can take 6-8 weeks.

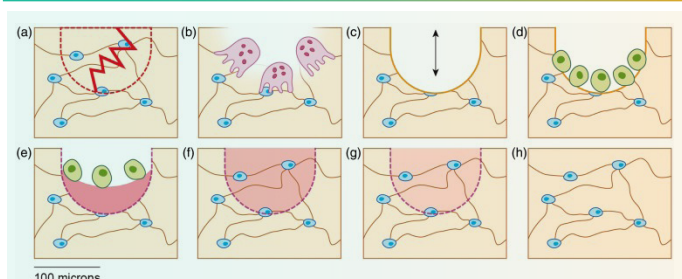


Figure 1 Schematic of bone remodeling following fatigue damage in trabecular bone. (a) Linear microcrack disrupting the osteocyte lacunocanalicular system, leading to osteocyte apoptosis in the affected area (dotted region). (b) Osteoclastic resorption of microdamaged bone. (c) Temporary negative bone space due to osteoclastic resorption. (d) Osteoblast recruitment to the remodeling space. (e) Osteoblastic deposition of unmineralized bone matrix (osteoid). (f) Primary mineralization of newly deposited matrix. (g) Secondary mineralization of bone matrix. (h) Completed remodeling cycle. (A color version of this figure is available in the online journal.)

Attributed to Hughes et al (2017)

HOW DO STRESS FRACTURES HEAL?

Stress fractures need time to heal. If under-fueling is at the root of the cause, healing will be hindered until caloric intake is corrected for. Athletes may fear eating more due to their inactivity, yet when the body is repairing bone, calories are necessary! A varied diet with adequate fats, proteins, and carbohydrates, including all the food groups to ensure calcium, magnesium, vitamin D and a host of other nutrients are provided, is necessary for proper healing.








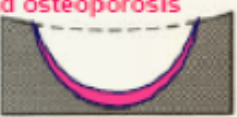







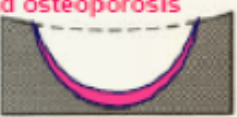







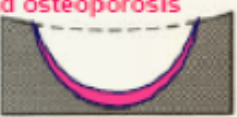
Breakdown of bone and rebuilding of bone is an ongoing process. When there is a lessened hormonal status, which naturally occurs post-menopause, bone rebuilding is hindered. Poor energy intake hurts bone building even more than reduced hormones. When poor estrogen status (suppressed hormones) is coupled with poor energy status, as in the Triad, bone remodeling is compromised the most.

HOW ARE UNDER-FUELING AND POOR ESTROGEN STATUS RELATED TO BONE HEALTH?

Without adequate energy, exercise, the most immediate demand, is fueled. This leaves a deficit for other body systems to do their job appropriately and fully. The body

shunts energy away from some functions, such as those involved in reproduction and growth. In both females and males, the sex hormones estrogen and testosterone, respectively, are suppressed. In females, hormone levels can be decreased without loss of monthly periods (amenorrhea). It is important for female athletes to pay attention to changes in their cycle that may be indicative of low estrogen and progesterone levels, such as longer duration between periods, or shorter duration/lightening of period. Your physician might test your hormones to get better insight. Losing your menstrual cycle is a definitive sign something is amiss. Yet recognize that even if you have your period every month, you may still be in an energy deficit that can hurt your bone health. Read more about the menstrual cycle and the hormones affecting it in the handout Reproductive Hormones.

In addition, other hormonal systems are affected, such as suppressed thyroid hormones (T3) or growth hormones (IGF-1) and elevated cortisol, all of which work to suppress bone formation and increase bone resorption. Only with sufficient energy can the body “spend” calories on these systems that help to improve bone strength. It only takes 5 days at a low energy availability to affect your hormones!

<p><u>Normal Bone Remodeling</u> Formation=Resorption</p> <p><u>Poor Estrogen Status</u> Increased bone breakdown (resorption)</p> <p><u>Poor Energy Status</u> Decreased IGF-1 and Decreased bone formation</p> <p><u>Poor Estrogen and Energy Status</u> Increased bone breakdown (resorption) Decreased bone formation</p>	<table border="0"> <tr> <td style="text-align: center;">Resorption</td> <td style="text-align: center;">Formation</td> </tr> <tr> <td></td> <td></td> </tr> <tr> <td colspan="2" style="text-align: center;">Postmenopausal osteoporosis</td> </tr> <tr> <td></td> <td></td> </tr> <tr> <td></td> <td></td> </tr> <tr> <td colspan="2" style="text-align: center;">Female Athlete Triad osteoporosis</td> </tr> <tr> <td></td> <td></td> </tr> </table>	Resorption	Formation			Postmenopausal osteoporosis						Female Athlete Triad osteoporosis			
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Adapted from Parfitt, 1988 and Sanborn, 2005
Attributed to Dr. DeSouza (FNCE 2019)

BOTTOM LINE:

Athletes must eat adequate calories to regain their menstrual cycle and allow for a stress fracture to heal!



INTERNAL DIALOGUE

BREAK THE CYCLE: REDIRECTING YOUR INTERNAL DIALOGUE

It is easy to get caught up in thinking patterns that can sabotage our well-being. Some people are not even aware of their internal dialogue! What we say to ourselves matters. How we identify and respond to emotions and our own actions can cause a chain reaction that can take us closer to where we want to be or further away.

If we look back on behaviors to restrict food intake, often a common cycle emerges – trying to control our food intake both in choice and amount, then feeling badly (shame, guilt, remorse, regret) about failing to do so, and starting the pattern over again. It’s important to learn ways to interrupt that inner voice that may keep us stuck in this cycle. How can you break out?

Our internal dialogue usually starts with an emotion.... Which leads to a thoughtWhich leads to an action ... Which leads to a reaction/emotion ...Which leads to another action, etc...

While we are not going to try and change the emotion (that can be explored in therapy), it is helpful to explore the reaction to an emotion as it relates to food.

Look at the “chain reaction” to the right.



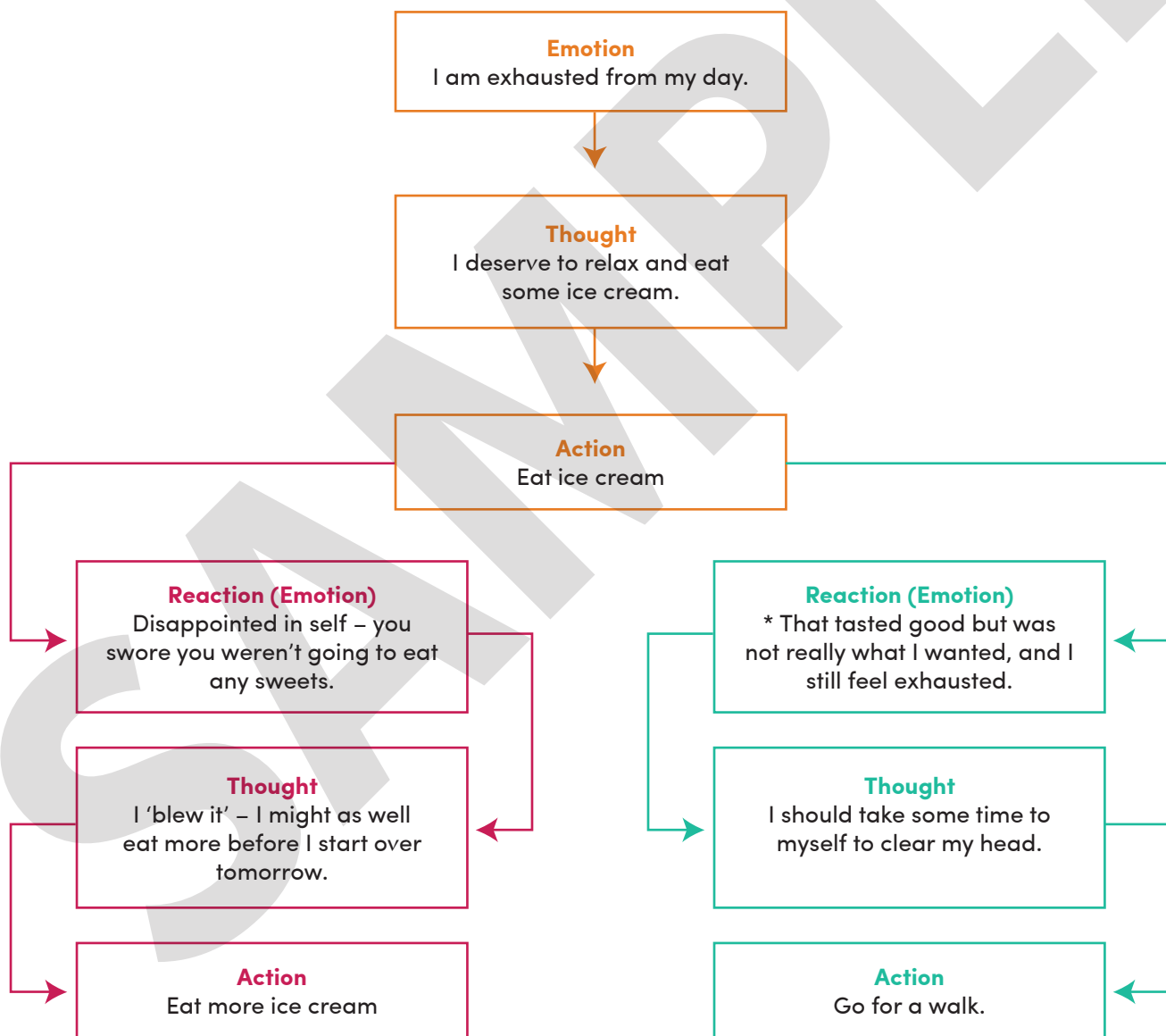
There are several things to unpack in this example. Without changing the emotion, what can you do that would be a healthier response to the emotion of tired (or angry, disappointed, etc) that would encompass better self-care?

“I am tired, I am going to relax, put my feet up on the couch, read a magazine, call a friend, pet my dog, etc.”

Check ‘in’ to see if you are hungry (see *Mindful Eating and Hunger Scale*) or eating in response to an uncomfortable emotion. If you are hungry, then eat a meal or snack that is satisfying and fulfilling. If you want ice cream, have some ice cream, but do not eat the ice cream as a way to relieve the feeling of being tired/angry/disappointed/bored.

In fact, by eating instead of recognizing and sitting with the feeling, you replace the original uncomfortable feeling with self-loathing (more familiar for many) instead of dealing with the actual issue (in this example, your day, your relationship, etc).

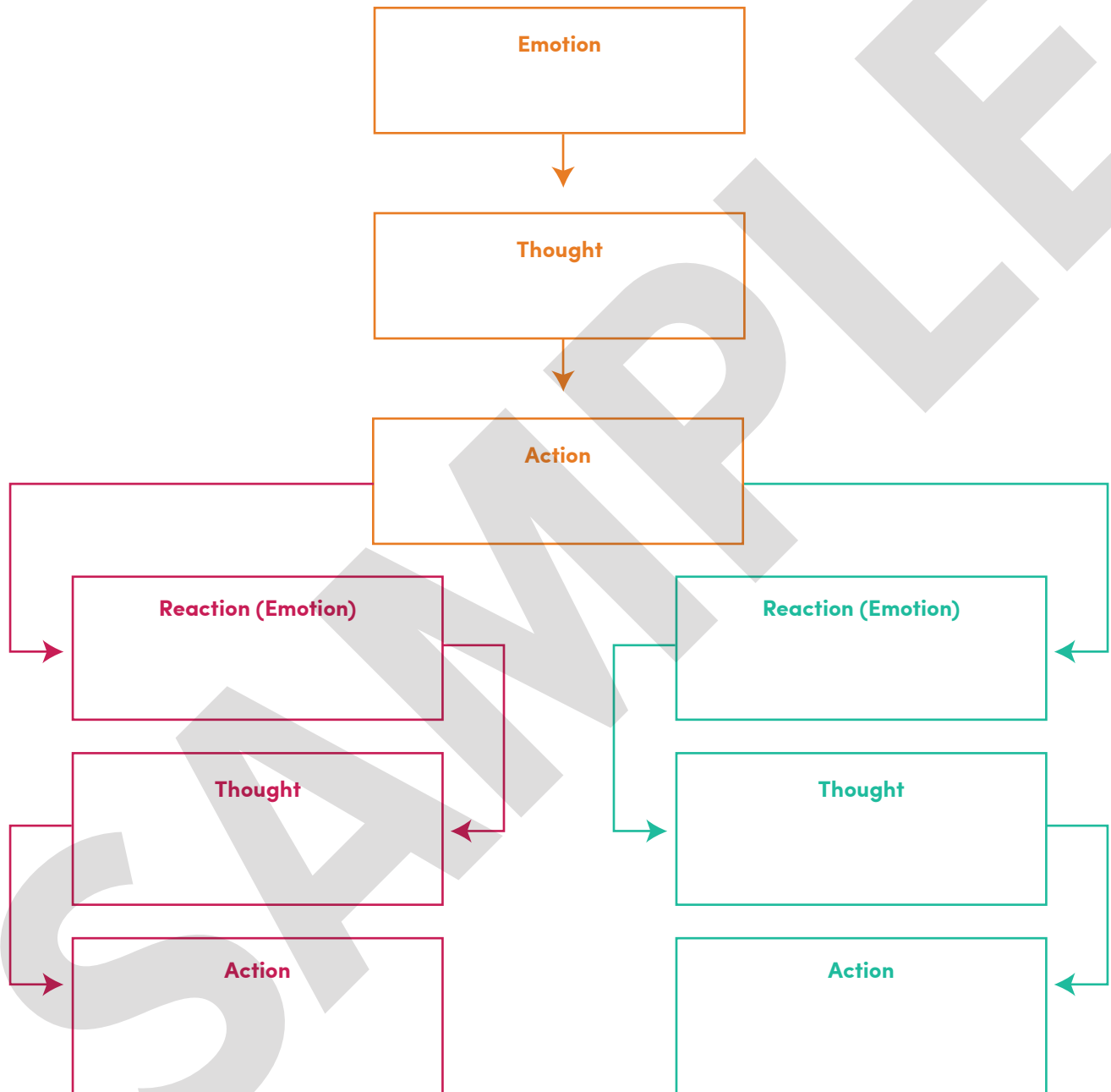
What might also be very helpful is to realize that at any step along the cycle, you can redirect your internal dialogue to a different thought/action. Let’s say you eat the ice cream at step one. Instead of beating yourself up, acknowledge what just happened “wow, I was so tired/angry/disappointed I just reacted by turning to food. Now that I can think more clearly, I will journal my feelings (or walk the dog, call a friend).” You do not have to stay in the cycle.



* Often when we “react” eat, it is not about the food, so it is difficult to really enjoy and savor it (see *Mindful Eating Handout*) as opposed to when you really want to eat a specific food to enjoy the taste!

ACTION STEPS

This week, see if you can “catch your internal dialogue” a few times, even if you do not alter any actions. Bring your observation back to our next session so we can see how what you think and say to yourself might affect what and how much you eat. It is also a good idea to bring these observations to talk over with your therapist.



“You can be fat, skinny, tall, short, twisted every which way, but we’re interested in what your body can do.”

*Elizabeth Streb,
Choreographer of Contemporary Dance
Episode 26; Hear Her Sports*

**SECTION 02:
NUTRIENTS**