

# MARS 2040: EATING IN SPACE

USING RESEARCH FROM NASA'S  
NUTRITIONAL BIOCHEMISTRY  
LAB, DESIGN A MENU THAT  
WILL KEEP AN ASTRONAUT  
HEALTHY ON A TRIP TO MARS

# MISSION TO MARS

# CONTENT

**KEY CONCEPTS**

**SPACE TRAVEL**

**PHYSICAL HEALTH**

**CALCULATING DAILY NEEDS**

**SPACE MENU ACTIVITY**

**NEXT GENERATION SCIENCE STANDARDS**

## **SPACE TRAVEL**

**Traveling to Mars:** A trip to Mars will take six to nine months. On average, Mars is 140 million miles from Earth. This changes as Mars and Earth orbit around the sun at different speeds, like two cars on a racetrack.

**Limitations of Space Travel:** While traveling between planets, astronauts experience microgravity. This is when the pull of gravity is so small that astronauts appear to be weightless, floating around their living space. The experience of weightlessness in space is super cool, but it has the negative effect of weakening our bones, a condition called osteoporosis.

## PHYSICAL HEALTH

**Importance:** Space travel has numerous effects on the human body, most of which we can adapt to over time. But the biggest and most challenging effect is on our bones. Here on Earth, gravity helps keep our bones strong. Weight-bearing activities like standing, running and dancing help bones stay dense and strong enough to support us. In the micro-gravity of space, the pace of weakening increases dramatically, putting astronauts at risk for breaks and fractures once they return to a stronger gravitational field.

## NUTRITION

**Design a Menu:** Astronauts need to exercise like athletes and carefully maintain their nutrition to protect their bones while in space. You will design a menu for an astronaut that considers an exercise regimen and nutrients that support bone health.

## **NUTRITION IN SPACE**

Astronauts are basically scientist-athletes in the way they need to care for their minds and bodies in space. But they don't do it alone. Researchers in the **Nutritional Biochemistry Laboratory** (NBL) at NASA's Johnson Space Center help keep astronauts healthy during space flight.

**Biochemistry** is the study of how living organisms work. The job of the NBL is to figure out how much of each nutrient (**calories, protein, vitamins, calcium and other minerals**) the human body needs during space flight. Combined with proper exercise, the inclusion of these nutrients will combat the effects of osteoporosis that occur in micro-gravity environments.

## NUTRITION IN SPACE

All vitamins and minerals are important for our health. But Vitamin D, Vitamin K and Calcium are crucial in keeping our astronauts' bones healthy in space.

**Vitamin D:** Found in fish, fortified milks, cereals and orange juices. Vitamin D helps our body absorb Calcium.

**Vitamin K:** Dark green and leafy vegetables like spinach and kale are high in Vitamin K. It helps our bones make proteins that keep Calcium in place.

**Calcium:** Dairy products and vegetables like broccoli. Calcium is essential for healthy bones.

It's also important for astronauts to balance their diet:

**50-60% Carbohydrates:** rice, bread and pasta

**30% Fats:** whole milk, meat and nuts

**10-20% Proteins:** whole grains, dairy, meat and beans

**CALCULATING DAILY CALORIE NEEDS FOR ASTRONAUT ALI**



Plan a day of meals for Astronaut Ali. She will be a scientist gardener on this mission and will create of a greenhouse once the team has landed on Mars.

We have her Basal Metabolic Rate (BMR), which is the daily amount of calories her body needs to function. This number is different for everyone, and varies depending on age, height and weight.

Ali's calorie needs in space will be different, as she will need to increase her exercise regime to keep her bones healthy. Using her BMR and the equation provided, calculate the number of calories Ali needs each day she travels in space.

**ASTRONAUT ALI**

**Age:** 34    **Height:** 157 cm    **Mass:** 55 kilograms

**Basal Metabolic Rate (BMR):** 1631 calories

<b>DAILY CALORIE NEEDS IN SPACE</b>			
_____	x	1.9	= _____
BMR		Exercise Factor	Daily Calories

# INTERNATIONAL SPACE STATION STANDARD MENU NUTRITIONAL DATA

Now that you know how many calories Astronaut Ali needs to eat in a day, use the menu on the following pages to plan a daily diet that meets her nutritional needs (and hopefully tastes good too!).

Use the chart on the later pages to log your choices and add up your calorie amounts. Don't forget to include foods that will keep her bones healthy. For more information on eating in space: [https://www.nasa.gov/audience/foreducators/stem-on-station/ditl\\_eating](https://www.nasa.gov/audience/foreducators/stem-on-station/ditl_eating)



**BREAKFAST**

FOOD ITEM	CALORIES
Blueberry Raspberry Yogurt	120
Bran Chex	135
Breakfast Sausage Links	155
Cheese Grits	121
Chocolate Breakfast Drink	120
Citrus Fruit Salad	70
Cornflakes	147.6
Fruit Cocktail	81
Granola	313
Granola with Blueberries	230
Granola with Raisins	315
Grape Jelly	75
Grits with Butter	117
Homestyle Potatoes	160
Maple Muffin Top	250
Mexican Scrambled Eggs	202
Oatmeal with Brown Sugar	170
Oatmeal with Raisins and Spice	162
Sausage Patty	127
Scrambled Eggs	183
Seasoned Scrambled Eggs	187
Tropical Fruit Salad	81
Vanilla Breakfast Drink	136
Vegetable Quiche	271
Waffles	208

**LUNCH/DINNER**

FOOD ITEM	CALORIES	FOOD ITEM	CALORIES
Barbecued Beef Brisket	231	Noodles and Chicken	105
Beef Fajitas	187	Pasta with Pesto Sauce	124
Beef Pattie	89.4	Pasta with Shrimp	135.6
Beef Steak	208	Peanut Butter	205
Beef Stew	150.5	Potato Soup	124
Beef Tips with Mushrooms	182.2	Rice and Chicken	154
Cheese Tortellini	216	Salmon	85
Chicken Fajitas	169.9	Seafood Gumbo	129
Chicken in Pouches	90	Shrimp Cocktail	117.95
Chicken Noodle Soup	134	Shrimp Fried Rice	114.56
Chicken Teriyaki	150	Smoked Turkey	108
Chicken with Corn and Black Beans	127.5	Split Pea Soup	180
Chicken with Peanut Sauce	214	Sweet and Sour Chicken	144
Chicken Pineapple Salad	128.1	Sweet and Sour Pork	178
Crawfish Etouffee	113	Teriyaki Beef Steak	234
Cream of Mushroom Soup	141	Teriyaki Chicken	142
Curry Sauce with Vegetables	107	Tofu with Hoisin Sauce	125
Fiesta Chicken	220	Tofu with hot Mustard Sauce	111
Grape Jelly	75	Tomato Basil Soup	54.4
Grilled Pork Chop	261	Tortillas	189
Hot and Sour Soup	54.4	Tuna	79
Lasagna with Meat	202	Tuna Salad Spread	100
Macaroni and Cheese	194	Turkey Tetrazzini	117
Meatloaf	177.3	Vegetarian Vegetable Soup	95
Minestrone Soup	84	Wheat Flat Bread	194

## SIDES

FOOD ITEM	CALORIES
Apples with Spice	137.28
Applesauce	132
Asparagus	22
Baked Beans	158
Berry Medley	105
Black Beans	114
Broccoli au Gratin	124
Brown Rice	161
Candied Yams	129
Carrot Coins	42.5
Cauliflower with Cheese	55
Corn	137
Cornbread Dressing (Stuffing)	195
Creamed Spinach	65
Green Beans with Mushrooms	22
Italian Vegetables	92
Mashed Potatoes	71
Mixed Vegetables	57
Peaches	75
Pears	61
Potato Medley	139
Potatoes au Gratin	141
Red Beans and Rice	159
Rice Pilaf	103
Rice with Butter	168
Southwestern Corn	124.1

FOOD ITEM	CALORIES
Strawberries	89
Teriyaki Vegetables	47
Tomatoes and Artichokes	44.7
Tomatoes and Eggplant	65

## SNACKS

FOOD ITEM	CALORIES
Almonds	243
Cashews	268
Cheddar Cheese Spread	178
Chicken Consommé	14
Chipotle Snack Bread	191.5
Crackers	82
Dried Apricots	156
Dried Peaches	131
Dried Pears	138
Granola Bar	120
Macadamia Nuts	308
Nut and Fruit Granola Bar	135
Peanut Butter	205
Peanuts	274
Trail Mix	215
Tuna Salad Spread	100
Wheat Flat Bread	194
Yogurt Covered Granola Bar	159

## DESSERT

FOOD ITEM	CALORIES
Apricot Cobbler	330
Banana Pudding	124
Bread Pudding	219
Brownie	268
Butter Cookies	150
Butterscotch Pudding	123
Candy Coated Almonds	230
Candy Coated Chocolates	141
Candy Coated Peanuts	228
Cherry Blueberry Cobbler	306
Chocolate Pudding	124
Chocolate Pudding Cake	319
Cranapple Dessert	144
Lemon Curd Cake	460
Lemon Meringue Pudding	140
Rhubarb Applesauce	56.8
Rice Pudding	142
Shortbread Cookies	139
Vanilla Pudding	128

**BEVERAGES**

FOOD ITEM	CALORIES
Apple Cider	112.5
Cherry Drink with Artificial Sweetener	3.94
Cocoa	165.6
Cranberry Peach Drink with Artificial Sweetener	4
Decaf Coffee, Black	8
Decaf Coffee with Cream and Artificial Sweetener	11
Decaf Coffee with Cream and Sugar	72
Decaf Coffee with Cream	28
Decaf Coffee with Sugar	53
Grape Drink	66.3
Grape Drink with Artificial Sweetener	4
Grapefruit Drink	119.7
Green Tea	0
Green Tea with Sugar	71
Kona Coffee, Black	4.3
Kona Coffee with Artificial Sweetener	6
Kona Coffee with Cream and Artificial Sweetener	18
Kona Coffee with Cream and Sugar	68
Kona Coffee with Cream	16
Kona Coffee with Sugar	49
Lemonade	81
Lemonade with Artificial Sweetener	7

FOOD ITEM	CALORIES
Lemon-Lime Drink	62
Mango Peach Smoothie	200
Milk	0
Orange Drink	43
Orange Drink with Artificial Sweetener	7
Orange Juice	123.6
Orange-Grapefruit Drink	30
Orange-Mango Drink	32
Orange-Pineapple Drink	30
Peach-Apricot Drink	104
Pineapple Drink	17
Strawberry Drink	19
Tea	2.57
Tea with Cream and Sugar	41
Tea with Lemon and Artificial Sweetener	7
Tea with Lemon and Sugar	84
Tea with Sugar	53
Tea with Artificial Sweetener	5
Tea with Cream	22
Tea with Lemon	5
Tropical Punch	97
Tropical Punch with Artificial Sweetener	5



## **NEXT GENERATION SCIENCE STANDARDS**

Our lesson has connections to the following standards:

**MS.PS2.B:** Types of Interactions: Forces that act at a distance can be explained by fields that extend through space.

**MS-LS1-7:** Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy.

MISSION TO  
**MARS**

Share your experiments with us:

**@MSICHICAGO**



Or email us:

[learning.lab@msichicago.org](mailto:learning.lab@msichicago.org)



museum of  
**science+industry**  
chicago