



Somna (Sleep overseer)

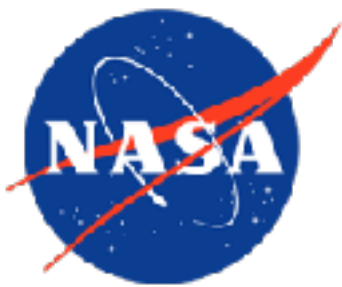
Abstract

Since inception mankind has always been limited by sleep. Much more contemporarily, owing to a drastic change from our tree-swinging ancestors in environmental and psychological conditions. This massive void cannot be bridged by evolutionary conditioning of natural selection.

Advanced studies on sleep disorders and on the biological clock has shown humans show distinctive differences from others in quality, quantity and cycles of sleep. These differences manifest in inability to generalize sleep and hence necessitates custom-tailored sleep programs that can be availed to the general populace at a flick of a thumb.

'Somna' uses various telltale parameters to empirically evaluate a subject and actively profile them. Over days the profile is subsequently used to figure the ideal sleep/work data that is then recommended to the subject for a longer period of time. Succeeding the period re-profiling is done to adjust for gradual deviation over time.

The widget is expected to be imperative to people with non-circadian cases of astronauts and near-pole dwellers among others. Patients of sleep disorder stand to gain from regularized custom sleep, easy diagnosis from medical practitioners from sleep data. Use among general populace to optimize work cycles boosts overall productivity and quality of work, thereby revolutionizing quality of life, work/life balance and perspective on sleep.



Goal:

- Optimal Sleep
- Healthy meal
- Good Exercise Plan
- Better Workflow
- Keeping the rhythm Alive

Hardware:

- Actigraph
- Polysomnograph

Parameters:

1. Blue Light
 2. social interactions
 3. Chronobiological medication
 4. Hypnotic and alertness medication
 5. Atmospheric conditions
 6. Exercise
 7. Eating/drinking patterns
 8. Metabolic Rate
 9. Food Intake
 10. Nutrients
 11. Calories Burn
 12. Biomarkers
 13. Workload
 14. Muscle strain
 15. Physique
-



BASAL METABOLIC RATE (BMR)

- BMR is the rate at which energy expenditure takes place per unit time in endothermic animals at rest i.e. it is the amount of calories burned by an endothermic animal per unit time.
- BMR for a male is calculated using the formula
$$66.47 + (13.75 \times \text{Weight in KG}) + (5.003 \times \text{Height in CM}) - (6.755 \times \text{Age in YEARS})$$
- BMR for a female is calculated using the formula
$$655.1 + (9.563 \times \text{Weight in KG}) + (1.85 \times \text{Height in CM}) - (4.676 \times \text{Age in YEARS})$$

Parameters: Height, Weight, Age, Gender



Visualisation

Candidate Criteria(max):

Weight: 80Kg

Age: 46

Height: 177cm

- Data Acquired : Height, Weight, Age, Gender, Calories required for different genders,
- We have cleaned the data in the reference with nasa astronaut criteria and manipulated the data to get the required data.
- Formula used, method pursued are as mentioned in the Nasa resources



NUTRITION

- The every day nutrition plan of an astronaut is measured in “CALORIES”. The original definition of a calories is that it is the amount of energy required to raise the temperature of 1 KG of water from 0 C to 1 C.
- The composition of an astronaut’s nutrition plan in calories is 55-60% from carbohydrates, 30% from fat and 10-15% from proteins.
- 1 gram of carbohydrates has 4 calories, 1 gram of protein is 4 calories and 1 gram of fat has 9 calories approximately.
- If an astronaut needs 2000 calories every day to sustain the he should be consuming 275 - 300 grams of carbohydrates, 66 - 67 grams of fat and 50 - 75 grams of protein every day.

Parameters: Calories, Cholesterol, Proteins, Fiber

Source: https://www.nasa.gov/centers/johnson/pdf/669816main_Space%20Nutrition.pdf



NUTRITIONAL INTAKE

- Nutritional intake is calculated using the Total Daily Energy Expenditure or TDEE.
 - $TDEE = BMR + \text{Calories released due to activity}$
 - There can be anomalies here and their and thus the TDEE of a person may start to vary a bit thus leading to a gain or loss in weight. These anomalies can be overcome by continuously monitoring the test subjects and adjusting their nutrition and exercise routine in such a way that they are in peak physical condition.
-



Parameters: Vitamin D, Vitamin K, Vitamin C, Vitamin A, Vitamin B,
Protein, Calcium, Iron, Caffeine

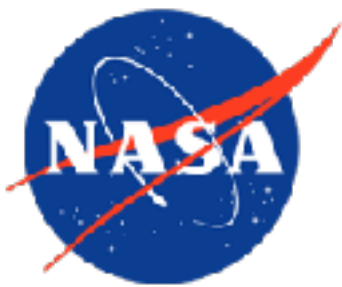
Primary	Secondary
Vitamin D	Vitamin C
Vitamin K	Vitamin A
Calcium	Iron
Protein	Caffeine
Vitamin B	

Source2: https://www.nasa.gov/sites/default/files/space_nutrition_book.pdf



Algorithm Plot:

1. The candidate will taste different foods during 5 months training period and after the training they will try out the selected foods(packed) in the Model Station which is located in the planet earth and they will list out the final choice.
 2. After the selection, the desired food will be loaded up and they will consume the selected foods in the space.
 3. After short intervals, Blood test and urine test will be taken and the acquired data will be compared with the data which is obtained in the 5 months training period.If there is any deficiency/lack of nutrients, the deficient parameters/nutrients will be noted and uploaded in the application.
-



4. Here we have two options, either the medic can upload the data or the candidate can directly choose the deficiency after going through the report.

5. After selecting deficient parameter/nutrients, the user needs to decide the courses

Example: Take the deficient parameters as Vitamin A, Vitamin K, Calcium and Protein. Now the candidate can choose a main course which is rich Vitamin A or Vitamin K or Protein or calcium, that's upto them. Similar method applies for the side dish, extras and drinks. One thing to keep in mind is, If the candidate selects main dish which is in rich in Vitamin A, he/she cannot select the sides or other courses which has similar richness, even the application will extrude the vitamin c food from all other courses. Meanwhile the application will analyse the deficiency and will show up with a suitable meal plan. Candidate can customise there own menu or they can just go with the suggested meal plan posted by the application.



6. After meal selection, the total amount of the Tertiary parameter will be calculated by the application.

Tertiary Parameter: Mass, Kcals, Proteins ,Cholesterol ,Fat.

7. The reason to calculate such data is, there are some restriction which is to be followed strictly in order to stay healthy.

Mass	*Based on the candidate requirement*
Kcals	*Based on the candidate requirement*
Proteins	270-275 gm
Cholesterol	60 - 75 gm
Fat	66 gm



-
8. The over-consumption of fat and alcohol that may contribute to the development of obesity and alcoholism. Linked to fat and alcohol, are galanin (GAL), the opioid peptides enkephalin (ENK) and dynorphin (DYN), and the orexins (ORX).
 9. Since there is no weather up there, we cant keep a track of cycle's calorie requirement.If you eat too much, or exercise too little, you gain weight. If you gain too much weight, you may put yourself at risk for diabetes or a host of other health problems.
 10. Nasa claims that overdose of proteins we cause a adverse health effect and affects the food rhythm.
 11. Most foods that are rich in cholesterol are also high in saturated fatty acids and thus may increase the risk of CVD due to the saturated fatty acid content

Source 1: <https://www.nasa.gov/sites/default/files/human-adaptation-to-spaceflight-the-role-of-nutrition.pdf>

Source 2: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2077813/>



-
11. After comparing the Tertiary parameters with the threshold, if any one value is higher than the threshold, the candidate need to refresh the meal plan and once again the application will come up with a good suggestion.
 12. After picking up the meal plan, the time in which the meal is consumed will be recorded and the clock will start ticking to intimate the next meal hour.
 13. The meal choose by the candidate will be recorded and then will be evaluated for the future process.
 14. If any particular food starts to disturb the candidate, that particular food will be removed from the future meal plans and a replacement of the food will be provided.
-



EXERCISE

- Energy expenditure due to exercise depends on the amount of work done per unit time. If the amount of work done produces enough heat to raise 1KG of water from 0C - 1C then 1 calorie of energy is released.
 - The amount of energy released depends on the intensity of the exercise.
 - Low intensity walking or cycling => 4 calories/minute
 - Brisk walk or brisk cycling => 5 calories/minute
 - Jogging => 7-8 calories/minute
-



Equipments Used:

1. VELO Ergomoeter Bike (VB-3)
2. Combined Operational Load Bearing External Resistance Treadmill
3. Cycle Ergometer with Vibration Isolation System (CEVIS)
4. Advanced Resistive Exercise Device (ARED)

Source1: <https://technology.nasa.gov/patent/MS-C-TOPS-59>

Source2: <https://nasa.tumblr.com/post/136706596374/exercising-in-space>

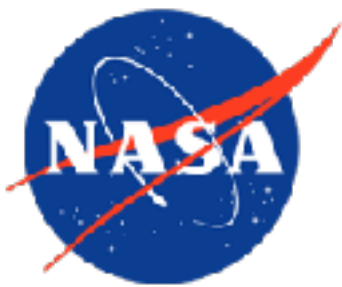


Algorithm Plot:

1. Based on the Work Load, type of Work and food consumption the exercise will be scheduled.

2. Different schedules causes strains in the different part of the muscle. Even though the NASA restricted the repair/investigating work beyond the shuttle, there are sum cases where the Astronauts has to got the outer to part. For example, If there is blockage in the A/C vent either then need to reboot the system or they to clear the vent manually. If the rebooting isn't successful the astronauts has to move out of the shuttle to repair the A/C vent. In those cases, Muscle strain will be more, In that particular day we need to reduce the exercise in order to maintain the muscle strain.

3. We have collected the working egg & heart rate to predict working hours and we have allotted exercise and its timing based on both food consumption and work load.



4. There are some restriction in the timing.

Average workout time(in hrs)	2
Maximum Workout time(in hrs)	2.5

5. So we have taken the reference timing from nasa and we have manipulated time within the stipulated period.

6. We have predicted the time period and the type of exercise from the previous nasa experiments.

7. We will construct a personalised plane for each and every candidate based on the pre-flight performance.

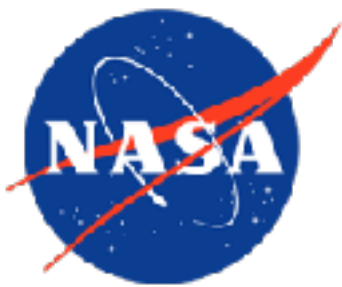


SLEEP

- Sleep is one of the most important parameters that determines the daily well being of a person. Sleep depends on the aforementioned factors namely nutrition and exercise.
- The main parameters in sleep are Deep sleep, Shallow sleep and REM (Rapid Eye Movement) Sleep. To be in peak shape the astronaut needs to get a good amount of deep sleep.
- The quality of sleep is assessed using a wearable tracking device that monitors sleep and stores the data.

Parameters:

1. Blue Light
 2. social interactions
 3. Chronobiological medication
 4. Hypnotic and alertness medication
 5. Atmospheric conditions
 6. Biomarkers
 7. Workload
-



Algorithm Plot:

1. According to the candidates suitable light exposure they can alter the blue light spectrum in cabin. For an instance, the suitable light exposure will be set, if they need increase/decrease the light exposure they can do it with the application.
 2. The emotions have a direct impact in the sleep. they tend to control the parameters like sleep latency, REM sleep, Sleep duration and even there are chances for the candidate to fall in deep sleep (rather than a shallow sleep) who just had a happy conversation. So we have imparted a special tab to monitor the emotions of the candidates, through which we will provide tasks. For example, one must go and ask a particular candidate about the prettiest incident that happened in their life, so that both will have a positive emotion flow, with which we can improve the sleep latency and sleep duration of both the candidate. Depending upon the task performed, corresponding points will be allotted.
-



3. We tried to reduce the effect of circadian rhythm, by altering the blue light with respect to each individual, by rescheduling the work plan, imparting the work to another member when the corresponding member's rhythm is affected and by providing adequate amount of medication.

4. When the sleep latency of a person is prolonged for a period of time, we recommend them to listen to their favourite bed time songs and by adding melatonin (a biomarker) boosting food elements in their meal plan.

5. Based on the working hours and preferred sleeping hours, the sleep scheduling will be carried out. Basically, in the pre-flight most the data we will acquire, So we just need to apply the data and monitor the sleep. In most of the times, when we compare pre-flight sleep and Dive sleep, there are differences in the sleeping hours and the difference is small though.

