

# GPS WATCHES FOR MEASURING ENERGY EXPENDITURE DURING PHYSICAL ACTIVITY

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## What is GPS?

The *Global Positioning System* (GPS) is a space-based navigational and positioning system. A network of between 24 and 32 satellites transmit continuous microwave signals to the Earth. These signals can be picked up by a GPS *receiver* anywhere on the Earth to calculate three-dimensional position, velocity, and time in order to determine present location.



GPS receiver –Garmin  
GPSMap 60®

## What is Energy Expenditure?

Total energy expenditure is the amount of energy used to perform an activity. Energy expenditure, measured in calories, is the energy needed to maintain constant conditions in the body (i.e. resting energy expenditure, diet-induced thermogenesis, and the energy cost of physical activity). Your daily energy expenditure, or basal energy expenditure is the minimum amount of calories needed to survive, or the minimum number of calories one should eat each day to maintain weight.

## How GPS Measures Energy Expenditure of an Individual?

For a given body weight, energy expenditure during physical activity (e.g. walking) can be determined by tracking speed, slope, and duration of physical activity. GPS technology offers benefits for assessing physical activity by tracking the exact location of individual through time. This permits the calculation of an individual's pace (time spent in increments of physical activity) as they move both horizontally across the landscape, as well as their altitude variation (slope). These measurements can then be transformed into an estimate of energy expenditure.

GPS and fitness technology have been integrated into single device, commonly called a GPS fitness unit or a GPS watch, which not only records location, but also computes energy expenditure (kcal/min). These GPS fitness units can track fitness progress and history and can be used during a variety of outdoor activities including: walking, hiking, running, and cycling. Here is the list of popular GPS watches available (not an exclusive list) on the market.

## GPS Fitness Units/GPS Watches on the Market:

Company Product	Price <sup>†</sup>	SiRFstarIII chip*	WAAS*	Accessories	Advantage
Garmin 305	\$300	Yes	Yes	HR monitor, foot pod	Customizable screens, compete with past workouts
Garmin 405	\$300	Yes	Yes	HR monitor, foot pod	Sleek look, share workouts with other users
Polar RS800G3	\$470	Yes	Yes	HR Monitor, GPS, USB adapter, ProTrainer 5 software included	Geared towards fitness
ADEO fitness trainer motionlingo	\$150			Works with MP3/iPod	Designed to enhance a physically active lifestyle, compatible with Google Earth
Suunto Multi-Sport Pack, t3	\$320			Includes HR belt, GPS Pod	Useful for a variety of outdoor activities

HR = heart rate

\*Note: The SiRFstarIII chip and WAAS (Wide Area Augmentation System) have increased a GPS receiver's ability to communicate with the orbiting satellites that provide a user with their location. The advantages of this latest technology are 1) faster location identification and 2) higher sensitivity for locking onto satellite signals in areas under dense foliage or in urban canyons or near sky scrapers.

†Prices are subject to change.

## Pros & Cons of GPS Fitness Units/GPS Watches

Building from evidence that GPS technology has potential to enhance accuracy of measurement of outdoor physical activity, four GPS fitness units/watches were tested at three different speeds (3, 5, & 7 km/hr). Three GPS watches were worn on the wrists, while the ADEO was placed on the

arm. These were compared against an RT 3 accelerometer (a validation tool for the assessment of physical activity) and pedometer worn on the waist. All units were worn simultaneously during trials on an outdoor 400 meter track. The pros and cons observed for each unit compared are noted below:

Company Product	Pros	Cons	Manufacturer's website
Garmin 305	User friendly, audible alerts	Bulky frame	www.garmin.com
Polar RS800G3	Good EE measurement	Downloading procedure not user friendly	www.polarusa.com
ADEO fitness trainer motionlingo	Frequent audio updates, customizable workouts, ipod connection	Less accurate EE measurement	www.motionlingo.com
Suunto Multi-Sport Pack, t3	Download/workout view on computer	Not user friendly, poor user manual	www.suunto.com

EE = energy expenditure

## Our Best Pick for the GPS watch

**Garmin Forerunner 305** – Good energy expenditure, audible alerts for speed, time, and distance, visual interface, usability, heart rate monitor available, easy data transfer.



At each speed (3, 5, and 7 km/hr) Garmin Forerunner 305 consistently underestimates by 50% of mean differences compared to the RT3 accelerometer (a validation tool for the assessment of physical activity). Polar and Suunto tend to underestimate by 35-50% and differences vary in each subject. ADEO overestimates EE by 30-100% but underestimates some by 25%.

The Garmin Forerunner 405, a design based on the 305, was introduced at the time of publication and thus was not tested.

### Fun with a GPS Fitness Units

#### Geocaching:

Make your workout twice the fun with an activity, **geocaching!** This activity combines the use of GPS technology with the outdoor adventure of a treasure hunt. The participants use a GPS receiver (including GPS watches) or other navigational tools to hide and seek containers (called “geocaches” or “caches”) anywhere in the world. Geocache waypoints (or favorite locations) can be found at various websites where the geographic coordinates can be downloaded onto a GPS receiver or watch. Anyone with a GPS unit can then try to locate the geocache. See more information at [www.geocaching.com](http://www.geocaching.com) or [www.garmin.com/outdoor/geocaching](http://www.garmin.com/outdoor/geocaching).

#### Map@Syst Geocoin:

One of the fun things about geocaching is discovering what is hidden in the cache! Cooperative Extension is participating through the eXtension Map@Syst Community of Practice, who has developed a special “Geocoin” – an identifiable token (in the shape of a large coin). We have registered hundreds of these coins and are tracking their progress across the U.S. and even to other countries! To learn more about these and how you might integrate them into your GPS physical activity adventures, see [http://www.extension.org/pages/Map@Syst\\_Geocoin\\_Adventure](http://www.extension.org/pages/Map@Syst_Geocoin_Adventure)

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