The Field Guide to Hacking

A collaborative effort by hackers and makers

Edited by Michelle Poon

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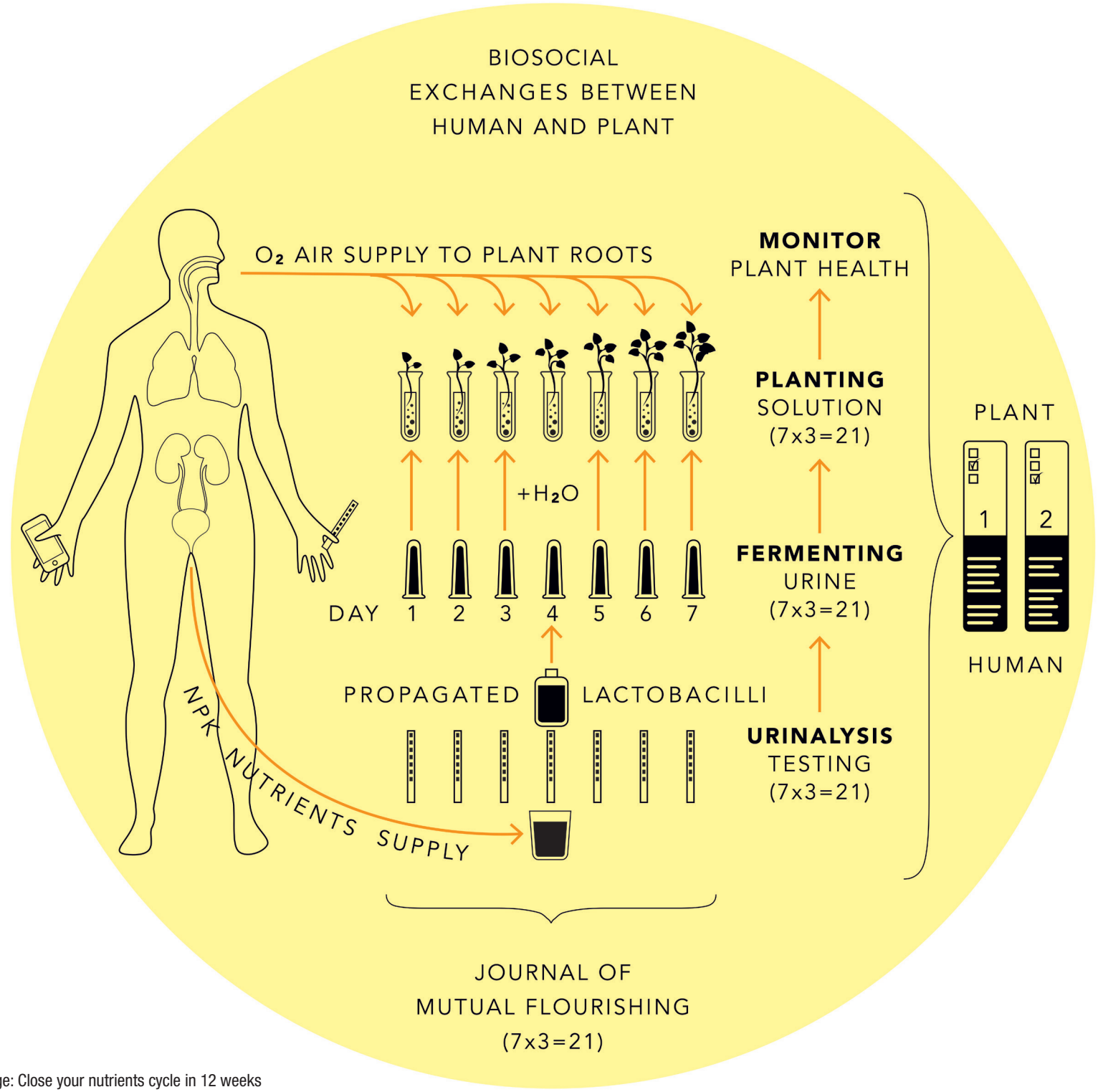

Image: Close your nutrients cycle in 12 weeks

Markus Wernli • Sarah Daher

ANTHROPONIX

At Dim Sum Labs we are not confined to a specific maker space. Sometimes we deliberately go out into the field. By exposing ourselves to the reality of the 'urban wild' and the everyday, we can also explore how to engage with technologies in more convivial, playful and possibly more life-affirming ways.

In spring 2017 we branched into the field of domestic horticulture in close collaboration with microbiologists, agro-ecological tinkerers and 22 indoor planting enthusiasts to enter a three-month long experimentation of co-biohacking and co-learning. The basic goal was to enable our participants so that they could biophysically reconnect with the food loop, in a way that would be simple and suitable for their busy lives in hyper-urbanity. The following 'urine-to-hydroponics' instructable is the result of an immense group effort. Through this collective trial and error, stumbling forward, respectful failing and perseverance we reached a form or accelerated group learning that brought forth this agro-ecological approach.

WHEN CITIZEN SCIENCE MEETS HACKING

Exploring Agro-Ecological + Fermentive Co-Learning

Before creating this instructable we tried to learn about domestic horticultural practices in Hong Kong as much as possible. We realised how some people are keeping with good traditions. How they like to bring plants into their homes and raise them, preferably for decoration, or, even better, for contributing in little parts to fresh food and supplement what's usually comes from afar and unknown origins. Many Hong Kongers live in tiny and dark flats, so recently these water-based hydroponics plant incubators (equipped with LEDs and air pumps) have become all the rage. No soil and no sunlight is needed anymore, just the petrochemical growing solution will make the veggie sprout.

Another good Hong Kong tradition is to be industrious with available resources (at least on the home making front). We noticed how some frugal indoor growers are adding a splash of their fresh urine to the water or soil of their plants with very best intentions since human nutrients have been a priced asset in Chinese agriculture for ages. We also observed that such improvised practices of life-hack fertilisation did rather produce results contrary to such good intentions: Plants would falter and odours would emit because the bounty of human nutrients would literally go up into the air (ammonification) instead of becoming palatable for plants.

From recent sanitation research ('Terra Preta' [1]) we knew that lactic acid fermentation (akin to bacterial cultivation of yoghurt) is applied to stabilise urine and make it smell-free for indoor use. Combining this sensitive bioprocessing upcycling with hydroponics and medical urine monitoring, we wanted to test out with our 22 home-gardeners if eating habits and lifestyles had an influence on the self-fertilized plants.

ANTHROPONIX
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SOME FOOD FOR THOUGHT AND TRUST

Why Preferring Industrial to Homemade Options?

The following setup will enable people to circumvent petrochemical A/B or A/B/C solutions and grow basil, waterspinach, tomatoes, radishes and lettuce using simply water and overabundant urine. The growing takes longer than with the petrochemical option but the taste of ANTROPONIX veggies is easily beating the conventional option. And if we are worried about harmful substances in our own urine, we also need to contemplate if we really can trust the substances applied in industrial agriculture production.

Figure 1. Five week old water spinach, pure-bred from seed in fermented urine solution.

[1] N Andreev, M Ronteltap, B Boincean, M Wernli, E Zubcov, N Bagrin, and PNL Lens. 2017. "Lactic Acid Fermentation of Human Urine to Improve Its Fertilizing Value and Reduce Odour Emissions." Journal of Environmental Management, no. 198: 63-69.

NUTRIENTS CYCLING IN TWELVE (12) WEEKS

OVERVIEW

In ANTROPONIX we combine small-scale waste upcycling with plant growing that is sensitively adapted for urban and indoor use. Our bioremediation process includes three basic phases of (A) cultivating lactic acid bacteria and propagating them, (B) collecting, inoculating and stabilising the urine, and (C) diluting the urine in water and exposing it to coco-fibre that helps mineralise the human nutrients so it becomes the growing medium growing your plants. The coco-fibre provides good aeration that stimulates essential bacterial activity permitting 'passive' water-based growing without external air pumping. Cultivating lactic acid bacteria takes four weeks (A), fermenting the urine takes three weeks (B) and raising plants from seeds takes another five weeks (C), totalling twelve (12). ANTROPONIX uses fermentation to stabilise nutrients and eliminate odour because it but doesn't require any electricity input and keeps greenhouse gases emissions at a minimum (compared to other processes like pasteurisation).

QUALITY CONTROL OF URINE

We are aware that many environmental toxins and polluters (like micro-particle plastics epidemic in our tap water) are entering our penetrable bodies are out of control and will end up in your urine. Yet, over the intake and use of foods, drugs and body care products we do have certain control. Pharmaceuticals linger for about two weeks in our organisms and antibiotics which sabotage our fermentation process for up to six weeks [2]. It is advised to abstain from such substances ahead of the urine collection period. ANTHROPONIX users who want to learn more about the substances in their urine we recommend to keep a food and lifestyle journal and do an Urinalysis test before each collection.

LIST OF INGREDIENTS

- Fresh cabbage
- Kosher sea salt
- Molasses or brown sugar
- Still (chloride-free) water
- Morning urine (at least 20 ml)
- Coco-peat substrate (coir, coconut fibre)
- *Optional* – Soluble seaweed extract
- *Optional* – Pure wood ash
- *Optional* – Biochar or perlite
- Plant seeds (basil, lettuce, waterspinach or radish)
- *Optional* – Plant cuttings (spinach or tomato)

REQUIRED EQUIPMENT

- Kitchen knife
- Cutting board
- Potato musher (or small glass jar)
- Plastic or wooden cooking bowl (non-metal!)
- Mason jar or large recycled glass jar with lid
- Zip-lock bags (small)
- PET drink bottle small with lid (0.5L for fermenting)
- PET drink bottle large (2.0L ml for planting)
- Cheese cloth or triangular bandage
- *Optional* – Urinalysis test strips
- *Optional* – pH test strips or pH dye indicator
- *Optional* – food and lifestyle journal
- Pipette or measuring cup (50ml)
- Cutter, scissor and awl (pricker)
- Drill and large 30 mm drill bits
- Water-resistent marker
- Airline tubing (7 mm wide), 150 cm long
- Aluminium foil or white and black acrylic paint
- Small water can

[2] R Mullen, D Aga, A Noe-Hays, K Nace, R Lahr, H Goetsch. 2015. "Analysis of Pharmaceuticals in Food Crops Grown in Urine and Related Products Fertilized Soil". Rich Earth Institute, University at Buffalo, State University at New York in Buffalo.

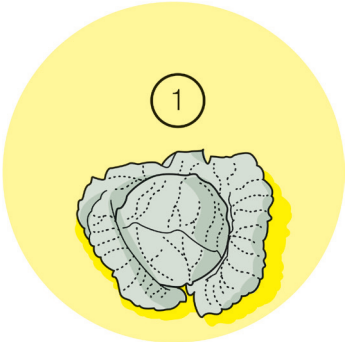
CULTIVATE + PROPAGATE LACTIC ACID BACTERIA

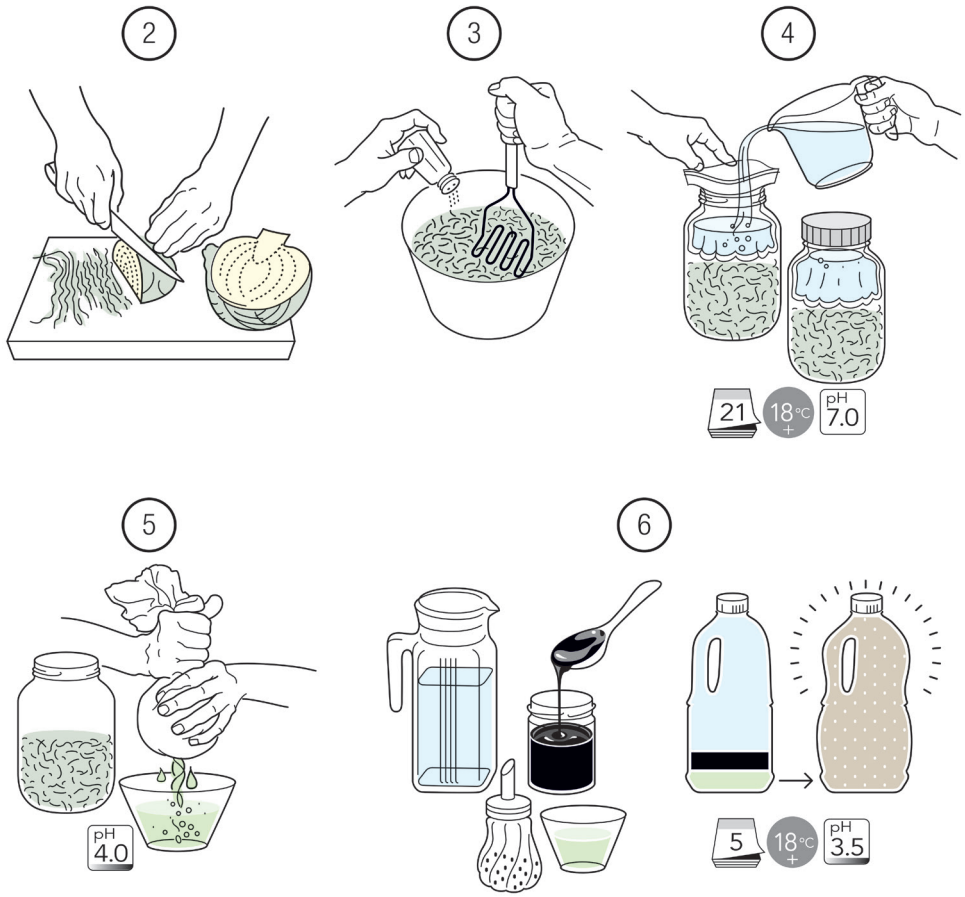
(A) CONCEPTS

There are many different ways of cultivating lactic acid bacteria (from rice-wash residue to bio-enzyme from citrus peels). Here we opt for sauerkraut from fermented cabbage because it is the most effective and ecologically very sensitive option. Amazing about cabbage is that its leaves already contain both the lactic acid bacteria and the sugars essential for fermentation. Because these DIY lacto acid bacteria are awakened and raised in your neck of the woods (hence 'indigenous') they are much better adjusted to your specific ecosystem than industrially isolated bacterial strains from the lab [3].

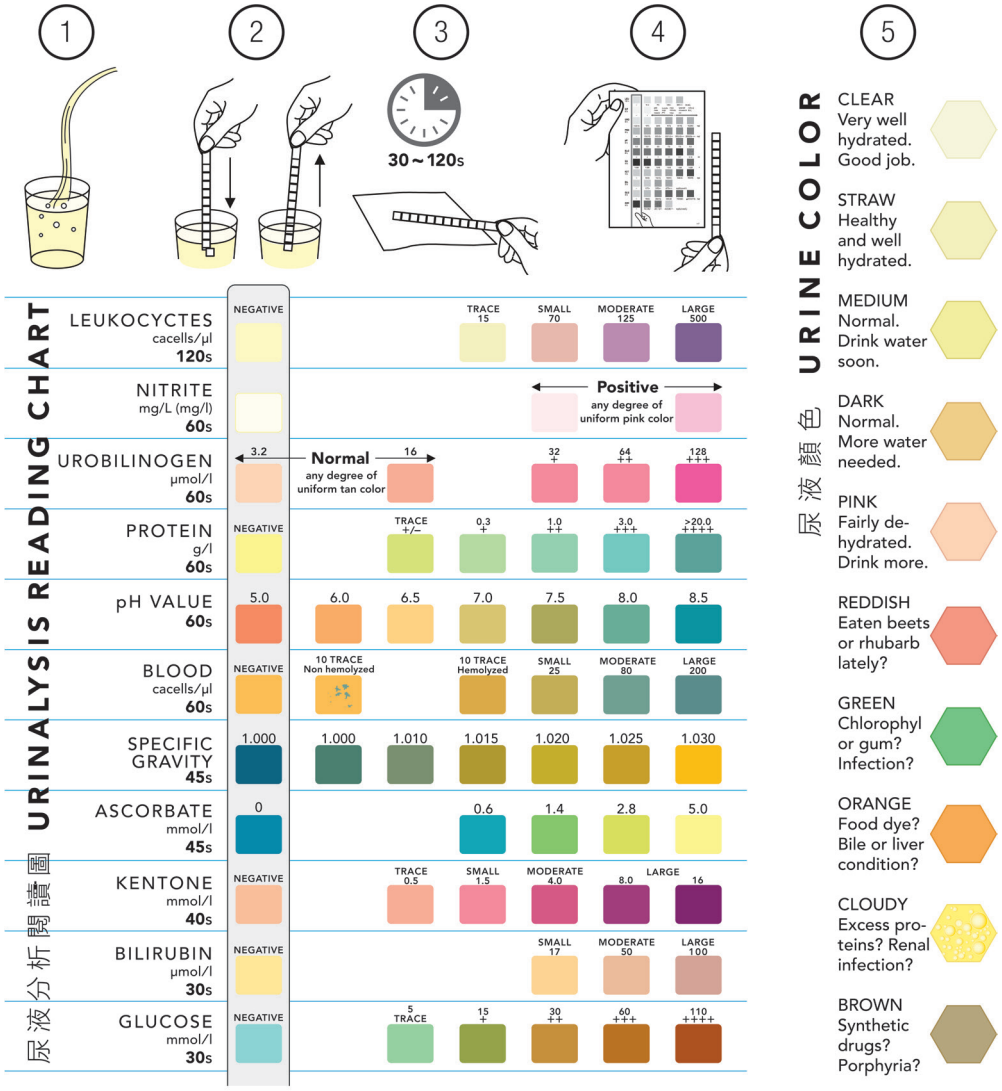
(A) DIRECTIONS

1. Get fresh cabbage. The best season for making sauerkraut is autumn and winter because lower temperatures slow down the fermentation process improving the taste.
2. Remove outer leaves. Shred the cabbage very finely.
3. Mush shreds one layer at time (with a pinch of salt) until saturated with liquid. The salt ensures the sauerkraut gets a crunchy bite (consistency).
4. Stuff cabbage into jar, press down with water-filled Ziplock bag that serves as weight. Close lid tightly. Make sure the cabbage remains soaked in its own juice which keeps the air and mold out. Place jar inside a bucket and store for three weeks in dark, cool space (shield from sunlight). In the fermentation process, excess liquid and carbon dioxide is released over night.
5. After three weeks, sauerkraut is magically to be found in the jar! Squeeze out the juice with (rich in lactic acid bacteria) with cheese cloth that is used as whey for urine stabilisation. Store in fridge in airtight bottle. Eat the remaining solids as a probiotic salad or steamed veggie.
6. Before the sauerkraut juice (whey) can be used to stabilize the urine, it needs to be propagated: provide the lactic acid bacteria with plenty of sugars so they can get to work (since there is no sugars to feed on in the urine). For one part (10%) sauerkraut juice, we add one part (10%) molasses or liquefied, brown sugar and fill it up with eight parts (80%) of tap water that has been aired for 24 hours to be free of chlorine and iodine. Store in airtight PET bottle for one week. Now the lactic acid bacilli should be well fed and releasing carbon dioxide that is bulking up the bottle. This propagated whey is ready to use.





[3] R Nout, P Sarkar, and L Beuchat. 2007. "Indigenous Fermented Foods." Food Microbiology: Fundamentals and Frontiers 3 (July): 505–59.



COLLECT, INNOCULATE + STABILIZE YOUR URINE

(B) CONCEPTS

Urine concentrates about 85% of the nutrients released by the human body. If sensibly collected and applied as fertilizer, the urine of one person per annum would be enough to grow up to 250 kg of wheat or rice [4]. When urine is reeking like ammonia it is this volatile bounty of nutrients that is chemically reacting with the oxygen in the air. Through fermenting we can acidifying the urine (lowering its pH to 5 or below) therefore curbing ammonification and odour release, and in effect stabilizing the nutrients. Also, in this sour environment bacteria and viruses other than lactic acid bacilli can't survive [5]. Separated (diverted) collection of urine is therefore the foundation for optimal nutrients recovery.

(B) DIRECTIONS

1. Collect the midstream of your first, morning urine in a drinking cup. Fresh morning urine is sterile and most nutrients-dense. Midstream ensure it is of purest quality.
2. Dip Urinalysis strip into urine and remove it quickly.
3. Observe the reading time required (30 to 120 seconds) for colours to indicate.
4. Check colour codes of Reading Chart and note respective values.
5. Check appearance colour to monitor your body hydration and detox status.
6. Add three parts (30%) of propagated sauerkraut juice (whey, see A6) to urine collection bottle and fill up with seven parts (70%) of urine.
7. Store fermenting in urine for three weeks.
8. Test fermented urine with pH test strip (pH dye indicator) or your nose: it should smell pleasantly like vinegar or wine and pH needs to be below 5.0.

[4] Wolgast, Mats. 1993. "Rena Vatten: Om Tankar I Kretslopp [Clean Water: About Tanks in Circulations]." Creanom HB, Uppsala (in Swedish), 186–89.
[5] Krause and S Jacobsen. 2011. "Aspekte der Hygienisierung im Kontext der Entwicklung eines neuen Sanitär-Ansatzes." [Aspect of hygienization in context of developing a new sanitation approach] Berlin Technical University.

SETTING UP URINE-POWERED WINDOW GARDEN

(C) CONCEPTS

After anaerobic (airless) fermentation in sauerkraut and urine stabilisation (A and B) we need aerobic bacterial activity in the last phase so that the organic nutrients turn into mineralised form for plant roots to absorb. Keeping our window garden off the electric grid, we use a passive, hydroponic system where the porous and bacteria-friendly coco-fibre provides the growing medium (with welcome'nitrogen fixing' and 'phosphate solubizing') for bringing human nutrients and plant seeds to fullest fruition. This top-to-down, self-dripping vertical garden shown here is just one, very space-efficient option. Other planting setups are viable as well.

(C) DIRECTIONS

1. Drill hole into planter bottle base to fit another bottle.
2. Draw and cut two side openings in each planter bottle.
3. Drill hole into cap for plastic tube of drip water.
4. Cover bottom third of bottle with alu foil or paint (black primer, white finish) as light blocker to avert algae.
5. Hang watering bottles, planters and recollectors into rows: insert bottle neck in base hole, tighten with lid.
6. Start sprouting plant seeds on moist napkin in Tupperware: observe seasonality and varietal needs!
7. Fill lower third of planter bottles loosely with dissolved coco-fibre. If available, mix in biochar dust or perlite for better porosity and cationic exchange.
8. Dilute urine (0.5%) with water (99.5%) at 1:200 ratio. Fill nutrients solution in watering containers, impregnate coco-fibre with urine solution.
9. After 2 weeks, double intensity of nutriemts solution to ratio 1:100.
10. Check for nutrients deficiencies; add pinch of wood ash or seaweed extract if needed.

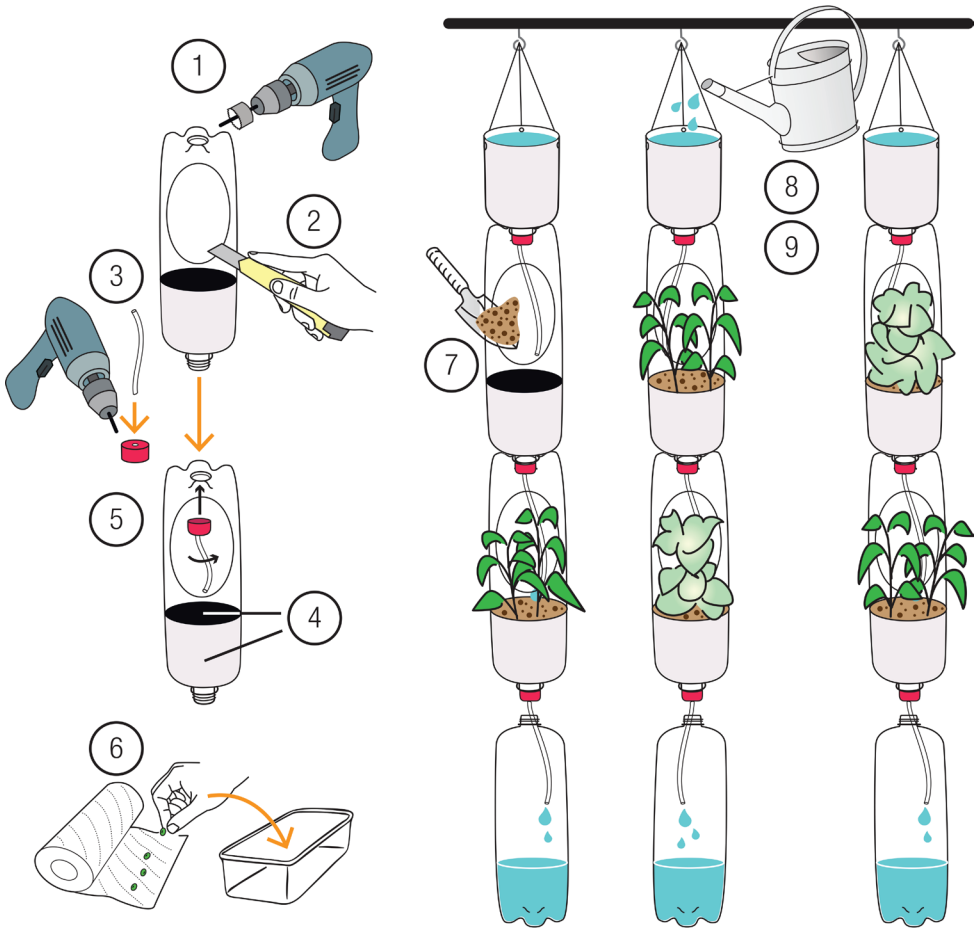


Image: Self-documentation from ANTHROPONIX participants in spring 2017.

In spring 2017, 22 planting enthusiasts engaged helped us explore the possibility of closing the food loop over two months. Each participant received a 'Grow With Your Own Nutrients' kit that allowed them to collect, medically test and ferment a small, daily urine sample over three weeks at home. In each of those 21 urine specimen – after undergoing lactobacilli fermentation – a lettuce or watercress seed was grown. For comparing how one's eating habits and emotional fluctuations would be reflected in the urine-bred plants, an elaborate journal was provided, for keeping track on daily behaviour, fermentation process and plant development. This home-based urine/plant cultivation routine was guided by five bi-weekly workshops where participants received instalments of supplies, skilling and experience sharing. In wake of the initial technical shortcomings, the intentional biophysical link between person and plant was intensified. The shared, more-than-human precariousness provided a springboard for participants' creativity, sociability and imagination.

In our time of insatiable energy demand, increasingly organic waste, including human waste, ends up powering bioreactors, engines and batteries. In the age of environmental depletion and nature-human dichotomy, more mutually replenishing, more concrete and direct ways of nurturing our living foundation is required. Here human waste approached not just as energy supply but as life force lets us test out sociable technologies and living feedback protocols in a given context.

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