



**SEXUAL ASSAULTS and
FORENSIC BIOLOGY**



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Sexual Assaults and Forensic Biology November 2015



**CFS Services for
Sexual Assault Cases**

BIOLOGY SECTION

- Body Fluid Identification - blood, semen, saliva
- DNA (STR) Analysis
- Criminal Paternity/Familial DNA Analysis
- Male-specific Y-STR DNA Analysis


CHEMISTRY SECTION

- Lubricant Identification/Analysis
- Hair & Fibre Analysis
- Damage Assessment: Fabric/Clothing

TOXICOLOGY SECTION

- Analysis of blood, urine or suspicious substances for drugs/alcohol


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Agenda

- **The Sexual Assault Examination Kit (SAEK)**
- Hypothesis-Based Testing
- Body Fluid Testing
- Chemistry Section Analyses
- DNA Analysis
- National DNA Databank
- Case Examples


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SAEK DESIGN

- Facilitated storage
 - SAEK can be stored dry or frozen (except blood/urine) prior to police involvement
 - Blood/urine must be stored in refrigerator
 - Some items must be frozen:
 - Condoms
 - Sanitary pads
 - Tampons
 - Diapers

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Police Instructions

Yellow envelope - outside bottom of Core Kit Box:

- Submitter information
 - URL for CFS website to obtain submission forms, contact info, section guidelines, etc.
- Submission guidelines chart
- French versions of these documents are also available if required

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Physician/SANE Instructions

- Instructions and forms - envelope inside Core Kit Box
 - Hospital instructions booklet
 - Step-by-step instructions including when and how to collect samples
 - Consent forms (SAEK collection & release of kit to police)
 - Forensic evidence forms
 - Physical examination forms
 - Guidelines for medical/health care

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2015 SAEK Design

- The current STANDARD SAEK kit is now divided into two components:

CORE Kit:

- Small, streamlined collection kit that will be used for every examination.
- Contains only items that are frequently used for collection.

AUXILIARY Pack:

- Contains items that are used less frequently.
- Contents based on actual usage as determined from a review of case information
- One AUXILIARY Pack will be provided with every 10 CORE Kits.

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The Process

- For each examination, the nurse will have a CORE Kit and AUXILIARY Pack on hand.
- The Hospital Instructions have been changed to indicate at each STEP if the collection items are in the CORE Kit or the AUXILIARY Pack.
- All items collected during the examination are then placed in the CORE Kit and sealed.
- Once items for the collection of a particular STEP in the AUXILIARY Pack run out, another AUXILIARY Pack can be opened and remaining items from the first Pack can be transferred to the newly opened one and used.

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Core Kit Contents

- The box is approximately half the size of the previous kit box
- Contains all kit documents, stickers and seals

ENVELOPE #	CONTENTS	FOR COLLECTION OF:
Step 1	2 drop sheets, 1 paper bag (loose in box),	Underwear
Step 2,4,7,8 & 9	10 swabs and 10 swab boxes	Internal and skin samples
Step 5	Blood tube and foam, blood bag, fridge transport	Blood
Step 10	FTA card, applicator, plastic bag and desiccant	Reference
Step 11	Jar with preservative, urine bag	Urine


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Auxiliary Pack Contents

- The box is larger than the CORE Kit
- Contains items that are not routinely collected
- One Auxiliary Pack contains sufficient additional items to supplement 10 CORE Kits


STEP #	CONTENTS PER ENVELOPE:	FOR COLLECTION OF:
STEP 1 (NO ENVELOPE)	5 evidence drying pouches, 10 small paper bags and 10 large paper bags	Other clothing
STEP 3 – (5 ENVELOPES)	2 tapered swabs, 2 collection sheets and 2 self-sealing envelopes	Fingernail samples
STEP 5 – (1 ENVELOPE)	Spare blood collection	Blood (spare)
STEP 6-1 (2 ENVELOPES)	1 collection sheet and 1 envelope	Deposits in pubic hair
STEP 6-2 (3 ENVELOPES)	1 collection sheet, 1 comb and 1 envelope	Combing of pubic hair
STEP 6-3 (2 ENVELOPES)	1 collection sheet and 1 envelope	Foreign material
STEP 6-4 (2 ENVELOPES)	1 jar and 1 freezer transport bag	Foreign material (freeze)
STEP 6-5 (2 ENVELOPES)	1 white bag	Tampon/sanitary napkin/diaper
Other	10 swabs and 10 swab boxes	Spare swabs



SAEK Collection

- Collect within 12 days of alleged assault
 - Clothing and related items may still be accepted for forensic analysis after 12 days
- Collect within 72 hours for pre-pubertal children


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SAEK Collection

- Use SAEK Forensic Evidence Forms to guide your collection
 - Collect relevant samples only
 - Forms help us to guide our examinations**
- Do not include medical records as part of forensic kit

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Persistence of Semen

After ejaculation, we are able to detect sperm in these cavities up to the following **maximum** times:

ORAL – up to 1 DAY
RECTAL – up to 3 DAYS
VAGINAL – up to 12 DAYS


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Persistence of Semen

- Majority of semen is lost from the vagina within **2 to 3 DAYS**
- Examine the complainant ASAP
- Collect the underwear worn after the assault
- Attempt to obtain information about last previous consensual sexual acts.
 - Record on Forensic Evidence Form

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Forensic Evidence Form

FORENSIC EVIDENCE FORM
(To be completed by examining physician/nurse examiner)
USE BALLPOINT PEN, PRINT LEGIBLY AND PRESS HARD

Page 1 of 5

KIR No. _____		Patient's Surname _____		Given Name _____		Birth Date (YYYYMMDD) _____		Age _____		Sex <input type="checkbox"/> M <input type="checkbox"/> F	
Date (YYYYMMDD) _____		Admission 1) ER _____		2) SACC _____		3) Physician/Nurse Examiner _____		Arrested _____			
Did police accompany patient to hospital? <input type="checkbox"/> Yes <input type="checkbox"/> No		Police Service & Division/Department _____		Officer's Name _____		Badge No. _____		Telephone No. _____			
Date (YYYYMMDD) and time of assault: _____		Location (e.g. patient's home, assailant's home, outdoors, etc.) _____									
Did the following sexual contact occur, either before or after the assault?											
Cunnilingus or fellatio performed on patient (since the last shower/bath)				Yes <input type="checkbox"/>		No <input type="checkbox"/>		Was a condom used?		Yes <input type="checkbox"/>	
Cunnilingus or fellatio performed by patient				<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	
Anal (if within last 72 hours)				<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	
Vaginal (if within last 12 days)				<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	
Between the assault and the evidence collection, did the patient:											
Shower / bathe?				<input type="checkbox"/>		<input type="checkbox"/>		U/K <input type="checkbox"/>		N/A <input type="checkbox"/>	
Dress?				<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	
Void?				<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	
Defecate?				<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	

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Step 1: Clothing & Drop Sheet

- Collect relevant clothing
 - *****UNDERWEAR*****
- One item per bag
- Drop sheet used to prevent loss of trace material (ex. hairs &/or fibres)
- Drying pouch for damp/wet items
 - May be used for larger clothing items

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Forensic Evidence Form – Step 1

STEP 1 – CLOTHING AND DROPSHEET				EVIDENCE (Items)	
Describe the body site(s) of any bleeding injuries: _____					
Are these the clothes worn during the assault?	Yes <input type="checkbox"/>	No <input type="checkbox"/>		1-1	_____
If clothes were changed, are they available?	<input type="checkbox"/>	<input type="checkbox"/>		1-2	_____
Have the clothes worn during the assault been washed?	<input type="checkbox"/>	<input type="checkbox"/>		1-3	_____
Have the clothes worn during the assault been damaged?	<input type="checkbox"/>	<input type="checkbox"/>		1-4	_____
Underwear: Check ALL that apply to when each pair was worn relative to the occurrence of the assault.				1-5	_____
Bag 1- _____	Before <input type="checkbox"/>	During <input type="checkbox"/>	Immediately after <input type="checkbox"/>	1-6	_____
Bag 1- _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1-7	_____
Bag 1- _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1-8	_____
Did the assailant potentially transfer bodily fluids to the patient's clothing (e.g. external ejaculation, saliva, blood)? If yes, specify if possible: _____				1-9	DROP SHEET

CFS BAEK 2015
Hospital – White Copy
CFS – Blue Copy
Police – Yellow Copy

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Step 2: Oral Swabs

- Collect within 24 hrs only
- Use 2 swabs simultaneously
 - rub along gums & teeth
- Place one swab into each box to dry

FORENSIC EVIDENCE FORM
(To be completed by examining physician/nurse examiner)
USE BALLPOINT PEN, PRINT LEGIBLY AND PRESS HARD

KIT No. _____ Page 2 of 5

STEP 2 – ORAL SAMPLES			EVIDENCE	
Was there penetration or attempted penetration of the patient's mouth by the assailant's penis (Vaginal)?	Yes <input type="checkbox"/>	No <input type="checkbox"/>		
Was there ejaculation?	<input type="checkbox"/>	<input type="checkbox"/>		
If yes, specify: Internal <input type="checkbox"/> External <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	2-1 Oral swab	Done <input type="checkbox"/> Not Done <input type="checkbox"/>
If external, explain _____	<input type="checkbox"/>	<input type="checkbox"/>	2-2 Oral swab	Done <input type="checkbox"/> Not Done <input type="checkbox"/>
Was a condom used?	<input type="checkbox"/>	<input type="checkbox"/>		
If yes, did it remain intact?	<input type="checkbox"/>	<input type="checkbox"/>		
Was an object used?	<input type="checkbox"/>	<input type="checkbox"/>		
If yes, specify _____	<input type="checkbox"/>	<input type="checkbox"/>	Time: _____	
Was a lubricant used?	<input type="checkbox"/>	<input type="checkbox"/>		

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Step 3: Fingernail Samples



- Collect scrapings or clippings up to 72 hours if:
 - Struggle/scratching alleged
 - Complainant did not shower/bathe
- Collect regardless of co-habitation
- Sample each hand separately – over folded paper (included)
- Clippings – use sterile instrument
- Scrapings – tapered mini-swab


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Step 4: Skin Swabs

- Collect within 72 hours only if complainant has not showered/bathed
- Include location of swab on forms, and rationale (kiss/lick/external ejaculation)
- One swab only
 - Two for large areas, but used simultaneously
- Moisten with sterile water
- Place swabs into boxes to dry
 - Separate boxes for different areas swabbed


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Step 4: Skin Swabs

- Why only one swab?
 - For internal orifice swabs, lab routinely tests one swab only, and 2nd swab is preserved
 - For skin swabs, want to concentrate any potential foreign DNA as much as possible to maximize possibility of developing foreign DNA profile


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 Forensic Evidence Form – Fingernails & Skin Swabs			
STEP 3 – FINGERNAIL SAMPLES			
Did the patient scratch the assailant?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	UK <input type="checkbox"/>
		EVIDENCE 3-1 Fingernail samples - left hand <input type="checkbox"/> Done <input type="checkbox"/> Not Done 3-2 Fingernail samples - right hand <input type="checkbox"/> Done <input type="checkbox"/> Not Done	
STEP 4 – SKIN SAMPLES			
Did the assailant potentially transfer bodily fluids to a non-genital area on the patient's skin (e.g. external ejaculation, kissing / licking / biting)? If yes, specify:	Yes <input type="checkbox"/>	No <input type="checkbox"/>	UK <input type="checkbox"/>
If patient does not recall events, collect swab of each breast		EVIDENCE Swabs of deposits on skin Reason collected? 4-1 Site _____ 4-2 Site _____ 4-3 Site _____ 4-4 Site _____	


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 Step 4: Breast Swabs
<ul style="list-style-type: none"> ▪ Collect “blind” swab of each breast when history is unknown and complainant has not showered prior to SAEK <ul style="list-style-type: none"> ▪ In case review, the collection of “blind” breast swabs of each breast when history is unknown and complainant has not showered has occasionally been missed ▪ Rationale <ul style="list-style-type: none"> ▪ Complainant may be unaware of licking/kissing of breasts ▪ No alternate light source (ex. Woods Lamp) examination necessary

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 Step 5: Blood Sample
<ul style="list-style-type: none"> ▪ Collect in all cases, if within 3 days ▪ Examined by Toxicology Section <ul style="list-style-type: none"> ▪ Drugs ▪ Alcohol ▪ Tubes can be used past expiry date. This expiry date is the manufacturer's guarantee on the time period that the blood tube will retain an optimal vacuum

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Step 6: Pubic Hair & Foreign Material


Up to 72 hours...

- Cut out deposits (6-1) found in pubic hair
- Foreign material (6-3/6-4)
 - Package any additional materials found in vaginal/rectal area into envelope provided
 - Condoms (store frozen in leak proof container)

Up to 10 days...

- Collect & freeze tampons, sanitary napkins, diapers (6-5)

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Step 6: Pubic Hair & Foreign Material

Pubic hair combings (6-2)

- Collect up to 12 days (regardless of shower)
- Possible transfer of pubic hair
 - From complainant to scene or suspect
 - From suspect to complainant
- Comb pubic hair for loose hairs/fibres
 - Package comb & hairs/fibres into envelope

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Forensic Evidence Form – STEP 6

STEP 6 – PUBIC HAIR AND FOREIGN MATERIAL		EVIDENCE		
		Done	Not Done	None Found
6-1 Deposits in pubic hair		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6-2 Combing of pubic hair	Collect always – if possible	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6-3 Foreign material - Location & Description		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6-4 Foreign material requiring freezing - Location & Description		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6-5 Tampon <input type="checkbox"/>	Sanitary napkin <input type="checkbox"/> Diaper <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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STEP 7 – EXTERNAL GENITALIA SAMPLES			EVIDENCE	
	Yes	No	U/K	
Did the assailant attempt or perform cunnilingus/fellatio or vaginal/rectal penetration on the patient?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<div>7-1 External genitalia swab</div> <div>7-2 External genitalia swab</div>
				<div>Done</div> <div><input type="checkbox"/></div>
				<div>Not Done</div> <div><input type="checkbox"/></div>




Step 8: Vaginal Swabs

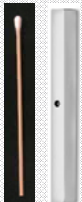


- Collect within 12 days for penile penetration (regardless of shower/condom use)
- Collect within 7 days for digital penetration (regardless of shower)
- Use speculum
 - Make note on exam form if not used
 - Do not use lubricant
- Two swabs collected simultaneously
- Place one swab into each box to dry

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Step 9: Rectal Swabs



- Collect within 3 days only
 - Penile or digital penetration
 - Regardless of shower/condom use
- Two swabs collected simultaneously
- Place one swab into each box to dry

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Forensic Evidence Form – Vaginal & Rectal Swabs


STEP 8 – VAGINAL SAMPLES				EVIDENCE	
	Yes	No	N/A	Done	Not Done
At the time of the assault, was the patient menstruating or bleeding?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
At the time of the examination, was the patient menstruating or bleeding?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	8-1 Vaginal swab <input type="checkbox"/>	<input type="checkbox"/>
Was there penetration or attempted penetration of the patient's vagina by the assailant's penis?	Yes	No	UNK	8-2 Vaginal swab <input type="checkbox"/>	<input type="checkbox"/>
Was there ejaculation by the assailant?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Time: _____	
If yes, specify: Internal <input type="checkbox"/> External <input type="checkbox"/> If external specify location: _____					
Was a condom used?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
If yes, did it remain intact?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
the assailant's mouth/tongue (sunningsus)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
the assailant's finger(s)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
an object? Specify: _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Was a lubricant used?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		

STEP 9 – RECTAL SAMPLES				EVIDENCE	
	Yes	No	UNK	Done	Not Done
Was there penetration or attempted penetration of the patient's anus by the assailant's penis?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	9-1 Rectal swab <input type="checkbox"/>	<input type="checkbox"/>
Was there ejaculation by the assailant?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	9-2 Rectal swab <input type="checkbox"/>	<input type="checkbox"/>
If yes, specify: Internal <input type="checkbox"/> External <input type="checkbox"/> If external specify location: _____				Time: _____	
Was a condom used?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
If yes, did it remain intact?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
the assailant's mouth/tongue?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
the assailant's finger(s)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
an object? Specify: _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Was a lubricant used?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		

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Step 10: Buccal Swab on FTA Paper



- **ALWAYS COLLECT**
- Rinse mouth first with sterile water
- Swab inside of cheeks, tongue & gums with applicator
- Press foam applicator onto collection card (FTA paper)
- Package collection card and desiccant into bag provided
 - Discard foam applicator


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Step 11: Urine Sample

- Collect in all cases, if within 7 days
- Examined by Toxicology Section
 - Drugs
 - Alcohol


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Sample Preservation

- Secure the swab boxes using tape or stickers provided in SAEK
 - Secure open edges so that nothing escapes and nothing enters
- Use leak-proof containers as necessary
- Place kit labels on items
 - Complete relevant information on labels


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 Forensic Evidence Form – use of Auxiliary Pack			
FORENSIC EVIDENCE FORM (To be completed by examining physician/nurse examiner) USE BALLPOINT PEN, PRINT LEGIBLY AND PRESS HARD			
Kit No. _____		Page 5 of 8	
Medical Staff			
Hospital name _____		Hospital address _____	
Hospital telephone number _____			
Physician/Nurse Examiner (Print name) _____		Signature _____	Date _____
Assistant Nurse (Print name) _____		Signature _____	Date _____
Auxiliary Pack Seal Broken (if relevant): _____		Auxiliary Pack Seal Applied (if relevant): _____	Date _____


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 SUMMARY – Internal swabs	
Kits can be collected up to 12 days after the alleged incident, depending on the allegations	
Oral swab Collect within 24 hours	Vaginal swab Penile penetration, regardless of shower/condom use - collection has been increased to 12 days Digital penetration, regardless of shower - collect up to 7 days
	Rectal swab Penile penetration or digital penetration, regardless of shower or condom use - collect up to 3 days

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 SUMMARY – External genitalia swabs	
Kits can be collected up to 12 days after the alleged incident, depending on the allegations	
External genitalia swab	
Penile penetration of vagina, regardless of shower/condom use - collection has been increased to 12 days	Penile penetration of rectum only, regardless of shower/condom use - collection has been increased to 3 days
Cunnilingus or fellatio, only if patient has not showered - collect up to 3 days	Digital penetration of the vagina or rectum, regardless of shower - collect up to 3 days


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TIPS

- ✓ Always collect underwear
- Internal swabs and external genitalia swabs:
 - ✓ Use the two swabs simultaneously (only one if penile)
 - ✓ Indicate clearly why taken
 - ✗ No wet/dry swabs
 - Fingernail samples:
 - ✓ Each hand separately – over folded paper (included)
 - ✓ Clippings – use sterile instrument

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TIPS

- Skin Swabs
 - ✓ One swab only
 - ✓ Indicate clearly why taken
 - ✗ No wet/dry swabs
- 
 - Alternate Light Sources (ALS)
 - Not a reliable method of identifying semen or saliva
 - ✓ Collect if case history warrants
 - ✓ Indicate if collected based on ALS


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TIPS

- 
 - Buccal Sample
 - ✓ Always collect
 - ✓ Include desiccant with card
 - Discard Lollipop; Keep Card
 - 
 - Contamination
 - ✓ Be vigilant & aware
 - ✓ Wear PPE
 - ✓ Change gloves between collection steps

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Sample Preservation

The two worst enemies of biological samples are:

MOISTURE & HEAT

- Ensure all items are labelled, packaged and stored properly
- **AIR DRY** all swabs and case items as soon as possible after collection
- **FREEZE** any sample that cannot be air-dried immediately due to time or item constraints

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Contamination Dangers


YOU ↔ **ITEM**

<ul style="list-style-type: none"> ▪ Protect <u>yourself</u> ▪ Blood & body fluids may contain diseases or viruses (ex. HIV, hepatitis) 	<ul style="list-style-type: none"> ▪ Protect the <u>item</u> ▪ Your DNA (from skin or body fluids), fibres or hairs can contaminate the item
---------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------

COMPLAINANT ↔ **SCENE** ↔ **SUSPECT**

Protect evidence items from other evidence items
(especially items from different sources)


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Contamination Dangers

- May generate a DNA profile that is not the true target profile
 - Lab has internal database to detect internal lab contamination
 - External contamination ... no way for lab to determine this
 - Can lead to a false exclusion of suspect


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Contamination Dangers

- Suspect profile may be transferred to item via cross-contamination vs. a true association
 - Example: semen from external skin swab transferred to vaginal swab
- Chemical or environmental contamination may prevent generation of DNA profile

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Precautions



- Wear disposable mask and gloves
 - Change gloves between each step
 - Change gloves when accessing the Auxiliary Pack
- Wear protective clothing
- Collect one step at a time, and repackage prior to next step
- Avoid talking, coughing or sneezing in the vicinity of items being collected
- Use disposable utensils where possible
 - Wipe with bleach between samples if not available


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Hypothesis-Based Testing




*DNA is a powerful tool...
but only when
appropriately used
and its significance
properly conveyed.*

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Hypothesis-Based Testing



- What questions need to be answered?
- What testing will assist in answering the questions at hand?

A Forensic Scientist can only determine this from the information provided regarding the case.

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Hypothesis-Based Testing

- Our purpose:
Can an individual can be excluded as the source of a body fluid stain or other bodily substance?
- Continue to test items until this question is answered

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Hypothesis-Based Testing

- What items of evidence are available to test?
 - Which ones are most relevant?
 - Which ones are most likely to generate a result?
- What examinations are to be conducted?
- Do the results obtained assist in answering the questions at hand?

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Context

- All decisions are framed around the context of the case
- Proceed with examinations only where “reliable inferences” can be drawn

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Scientific Context

- Scientific context will never change – it is an observation seen in the lab

“Semen was detected on the bed sheet.
John SMITH cannot be excluded as the donor of the semen.”

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Factual Context


- Factual context can change
- This may change the significance of the scientific observation

John SMITH lives in the house.

vs.

John SMITH is a stranger and has never been to the house prior to the alleged event.


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Case History Information

- The SAEK Forensic Evidence Forms provide valuable case history information
- SAEK forms and case history provided by police are used to frame hypothesis for case examination at the CFS

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Direct-to-DNA Approach

Cases submitted after September 10, 2012...

- No up-front semen identification on internal SAEK swabs (vaginal, oral and rectal) and external genitalia swabs
 - Semen ID can be performed later if required
- One swab from each type of sample (if warranted by case history) will be subjected automatically to DNA analysis to determine if male DNA present


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Direct-to-DNA Approach

- Simplified report
 - Chart format
 - Specifically addresses whether male DNA profile suitable for upload was generated
- Potential for expedited reporting of results from internal swabs and external genitalia swabs


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Examination for Blood

STEPS:

- Visual examination
- Chemical test using "Kastle-Meyer test"
- Human origin using "ABAcord® HemaTrace®"



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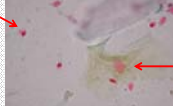


Examination for Semen

STEPS:


- Visual examination
- Chemical test for *acid phosphatase*
- Chemical test for *p30*
- Examine under microscope for *spermatozoa*

High amounts in semen



Epithelial Cell


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Examination for Amylase

STEPS:

- Visual examination
- Chemical test for *amylase* using Phadebas™ test
- Amylase present in saliva in high amounts
- Amylase present in other body fluids in much lower amounts




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Agenda

- The Sexual Assault Examination Kit (SAEK)
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- Case Examples

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Hair & Fibre Examination

Items for hairs and/or fibres should be preserved and may be submitted in sexual assault cases

- Hairs may be examined in cases when no DNA is available
- Fibres may be examined in stranger-to-stranger cases when no DNA is available
- Hairs and damage assessment may be examined in cases where force is an issue (consent or denial of occurrence)

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Hair & Fibre Examination

- Approximately 80% of hairs and fibres are lost in the first 4 hours from contact/transfer
- Clothing should be handled minimally to preserve hair and fibre trace evidence and damage

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Hair Examination

- Source (Scalp/Body/Pubic)
- Fallen / Pulled
- Human / Animal


TESTS

- Macroscopic comparisons
- DNA profiling of single hairs (provided root sheath present)



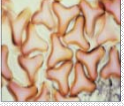
SIGNIFICANCE is CASE DEPENDENT

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Fibre Examination


- Identification of natural and man-made fibres
- Comparison with possible originating fabric
- Important to locate the clothing that was worn during the time of the assault
- Although garments are mass produced, there is a high variability of fibre types and dyes



SIGNIFICANCE is
CASE DEPENDENT



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Damage Examination

- Damage assessment of textile items
- Used to determine if force was involved


DETERMINATIONS

- Type of damage
- Possible implement used
- Whether damage is recent or not



SIGNIFICANCE is CASE DEPENDENT


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Lubricant Examination

- Lubricant trace evidence may be important
 - ex. Condom is used and is unavailable for DNA testing
- Items to potentially examine:
 - Clothing (ex. underwear)
 - Swabs taken from victims and suspects (ex. penile swab)
 - Offence-related lubricants
 - Control samples (personal use lubricants)
 - Other objects


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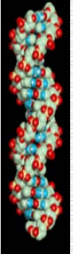
Agenda

- The Sexual Assault Examination Kit (SAEK)
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DNA

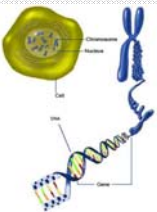


- Deoxyribonucleic Acid (DNA)
- "Genetic blueprint of life"
- Inherited from your biological parents
- No 2 individuals (except identical twins) have exactly the same DNA
 - >99% of our DNA is identical
 - <1% is different
- Your DNA is identical in every cell

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DNA



- DNA is packaged within each cell into chromosomes
- Humans have 23 pairs of chromosomes
 - one from each pair originating from the mother, one from the father
- Gender determining chromosomes are X and Y
 - females have two X chromosomes
 - males have one X and one Y chromosome

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Sources of DNA


ROUTINELY TESTED

- Semen
 - Internal swabs, unwashed clothing, condoms, etc.
- Blood
 - Variety of surfaces, washed items
- Saliva
 - Underwear, bras, cigarette butts, bite marks, gum, cups, etc.

LESS COMMON


- Skin
 - Fingernail clippings/scrapings
- Hair
- Bone/Teeth
- Tissue

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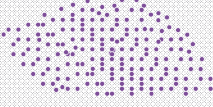


Sensitivity of the System

We work with ~ 1ng of DNA




"Smartie"
~ 1 gram

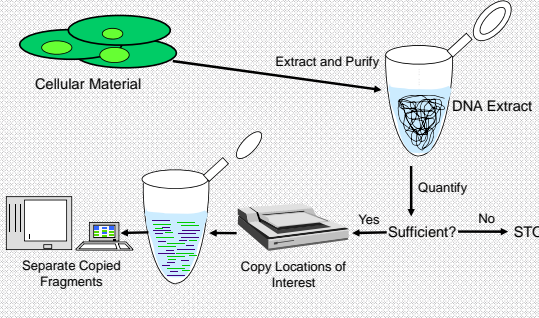


One billion pieces
1 piece = 1 nanogram

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DNA Analysis Process



```

graph TD
    A[Cellular Material] -->|Extract and Purify| B[DNA Extract]
    B -->|Quantify| C{Sufficient?}
    C -- Yes --> D[Copy Locations of Interest]
    C -- No --> E[STOP]
    D --> F[Separate Copied Fragments]
    
```


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DNA Comparisons: Exclusion


OBSERVATION:

- DNA profile from sample A is **different from** DNA profile from sample B



➤ A & B **must** come from 2 different sources

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DNA Comparisons: Exclusion

CONCLUSION:

“Mr. Smith is **excluded** as the source of...”

- When a person is **excluded** as the contributor of a questioned sample, the conclusion is certain


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DNA Comparisons: Not Excluded


OBSERVATION:

- DNA profile from sample A is **the same** the DNA profile from sample B



➤ A & B **may** come from the same source

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DNA Comparisons: Not Excluded

CONCLUSION:
 "Mr. Smith **cannot be excluded** as the source of..."

Two possible explanations for this finding:

- 1) Mr. Smith **is** the source of the DNA from the questioned sample
- 2) Mr. Smith **is not** the source of the DNA from the questioned sample, but coincidentally shares the same DNA profile as the questioned sample


➔ addressed with a statistic (Random Match Probability)



Random Match Probability


"The probability¹ that a randomly selected individual unrelated to Mr. SMITH would coincidentally share the observed DNA profile is estimated to be 1 in 16 trillion."

¹: Based upon data from a sample of the Ontario population (Asians, Blacks, Caucasians, East Indians, and Northern Ontario Natives).



Random Match Probability


- We do not test all of the DNA
 - We routinely test 15 locations on the DNA
 - Locations are not unique, but are highly variable between individuals
- Assume the true perpetrator could be any unrelated individual from the population
- We cannot test everyone in the world
- We use population databases to estimate the frequency of the profile



Y-Chromosome Testing

STRs	Y-STRs
<ul style="list-style-type: none"> Male & female DNA Inherited from mother and father Inherit DNA profile in parts – share <i>portions</i> of profile from each parent 	<ul style="list-style-type: none"> Male DNA only Inherited from father only Inherit DNA profile as a whole – share <i>entire profile</i> of father


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Y-Chromosome Testing

- New kit for Y-STR testing has been in use at CFS since mid-2015
- New kit provides results at 23 Y-STR loci
- Refinement in amount of male DNA required to generate a male-specific DNA profile
 - Can now attempt to generate a Y-STR profile from 100 picograms of male DNA


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National DNA Databank

<http://www.rcmp-grc.gc.ca/nddb-bndg/>



RCMP

Ottawa, ON

Since July 2000

Assists law enforcement agencies in solving crimes by:

- **Linking** crimes together that have no suspects
- **Identifying** suspects
- **Eliminating** suspects, when there is no match
- Determining whether a **serial offender** is involved

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National DNA Databank

Two Indices:

- **Convicted Offender Index**
 - Provides comparison to known offenders
- **Crime Scene Index**
 - Ties casework together across Canada


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Case Example #1

- 22 year old female attends a party at friend's house
- Becomes intoxicated and goes upstairs to a bedroom to lay down at midnight
- Wakes up next morning naked from waist down
- Recalls someone licking her right breast
- Thinks she may have been sexually assaulted

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Case Example #1

Important Information for the CFS:

- Does she have a consensual partner? **Yes**
- If so when was last previous consensual intercourse? **~30 hours prior**
- Was clothing/bedding washed? **No**
- Did she shower prior to SAEK? **No**
- Time between alleged assault and SAEK?
Maximum 10 hours

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Case Example #1

What items should be collected?

- Step 1: underwear, bra/shirt
- Step 2: oral swabs
- Step 4: swab of right breast
- Step 5: blood
- Step 6: pubic hair combing
- Step 7: external genitalia swabs
- Step 8: vaginal swabs
- Step 9: rectal swabs
- Step 10: buccal on FTA paper
- Step 11: urine

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Case Example #1B

Same scenario but different circumstances:

- Does she have a consensual partner? **No**
- If so when was last previous consensual intercourse? **N/A**
- Was clothing/bedding washed? **No**
- Did she shower prior to SAEK? **Yes**
- Time between alleged assault and SAEK? **4 days**

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Case Example #1B

What items should be collected?

- Step 1: underwear, bra/shirt
- Step 5: blood
- Step 6: pubic hair combing
- Step 7: external genitalia swabs
- Step 8: vaginal swabs
- Step 10: buccal on FTA paper
- Step 11: urine


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Case Example #2

- 14 year old female chatting with 18 year old suspect over the internet for 3 months
- Agree to meet at his house to watch a movie
- He makes sexual advances that she refuses
- He digitally penetrates her vagina for several minutes - interrupted when his mother comes home

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Case Example #2

Important Information for the CFS:

- Does she have a consensual partner? **No**
- If so when was last previous consensual intercourse? **N/A**
- Was clothing washed? **No**
- Did she shower prior to SAEK? **No**
- Time between alleged assault and SAEK? **6 hours**

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Case Example #2

What items should be collected?

- Step 1: underwear
- Step 3: fingernail samples (if struggle is indicated)
- Step 5: blood
- Step 6: pubic hair combing
- Step 7: external genitalia swabs
- Step 8: vaginal swabs
- Step 10: buccal on FTA paper
- Step 11: urine


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Case Example #3

- 25 year old female walking home after a night of drinking with friends
- Unknown male attacks her from behind and forces her into alley
- She struggles until he threatens her with a knife
- Forces her to perform fellatio
- Suspect ejaculates in her mouth - she spits onto front of her shirt

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Case Example #3

Important Information for the CFS:

- Does she have a consensual partner? **Yes**
- If so when was last previous consensual intercourse? **2 days prior (vaginal)**
- Was clothing washed? **No**
- Did she shower prior to SAEK? **No**
- Time between alleged assault and SAEK? **2 hours**

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Case Example #3

What items should be collected?

- Step 1: shirt
- Step 2: oral swabs
- Step 3: fingernail samples
- Step 5: blood
- Step 10: buccal on FTA paper
- Step 11: urine


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Case Example #4

- Female exotic dancer attends bachelor party at hotel
- 3 males force complainant into bedroom
- Vaginal, oral and anal penetration (penile)
- Complainant bleeding heavily from her vagina
- She does not know if any ejaculated
- Recalls at least one wearing a condom but none are located at the scene

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Case Example #4

Important Information for the CFS:

- Does she have a consensual partner? **Yes**
- If so when was last previous consensual intercourse? **That night**
- Was clothing/bedding washed? **No**
- Did she shower prior to SAEK? **Yes**
- Time between alleged assault and SAEK? **36 hours**

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Case Example #4

What items should be collected?

- Step 1: underwear
- Step 5: blood
- Step 6: pubic hair combing
- Step 7: external genitalia swabs
- Step 8: vaginal swabs
- Step 9: rectal swabs
- Step 10: buccal on FTA paper
- Step 11: urine


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Case Example #5

- 37 year old female meets male at bar and agrees to go back to his apartment
- Consensual kissing
- He forces her to remove her skirt and underwear and performs cunnilingus
- Attempts to penetrate her vaginally but she believes he was unsuccessful

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Case Example #5

Important Information for the CFS:

- Does she have a consensual partner? **No**
- If so when was last previous consensual intercourse? **N/A**
- Was clothing washed? **No**
- Did she shower prior to SAEK? **Yes**
- Time between alleged assault and SAEK? **~48 hours**

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Case Example #5

What items should be collected?

- Step 1: underwear
- Step 5: blood
- Step 6: pubic hair combing
- Step 7: external genitalia swabs
- Step 8: vaginal swabs
- Step 10: buccal on FTA paper
- Step 11: urine

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Sexual Assault Scientific Advisor

- Dedicated number during business hours for all sexual assault inquiries, including submissions
- Email general inquiries 24/7 to a dedicated inbox

☎ **647.329.1603**

✉ **cfs.biology.sexualassault@ontario.ca**

Contact CFS Chemistry Section at:
647-329-1500
CFSChemistry.ScientificAdvisor@ontario.ca

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DISTRIBUTION

- Distribution of the new CORE Kit and AUXILIARY Pack will begin before the end of 2015.
- Use up any current kits that are on-hand.
- Remaining current kits at CFS may be distributed to remote locations where nurse training may be minimal.
- 1st order of the new kits will automatically get at least 2 AUXILIARY Packs; minimum of one for every 10 CORE Kits plus a spare.
- When re-ordering, also let CFS know if you need more AUXILIARY Packs

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